

Wenjiang Du  
*Editor*

# Informatics and Management Science I

# Lecture Notes in Electrical Engineering

Volume 204

For further volumes:

<http://www.springer.com/series/7818>

Wenjiang Du  
Editor

# Informatics and Management Science I

 Springer

*Editor*  
Wenjiang Du  
College of Elementary Education  
Chongqing Normal University  
Chongqing  
People's Republic of China

ISSN 1876-1100                      ISSN 1876-1119 (electronic)  
ISBN 978-1-4471-4801-2            ISBN 978-1-4471-4802-9 (eBook)  
DOI 10.1007/978-1-4471-4802-9  
Springer London Heidelberg New York Dordrecht

Library of Congress Control Number: 2012952024

© Springer-Verlag London 2013

FLAC3D © 2012 Itasca

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media ([www.springer.com](http://www.springer.com))



# Preface

Welcome to the proceedings of the International Conference on Informatics and Management Science (IMS) 2012, which is to be held in December 21–23, 2012, in Kunming, China.

IMS 2012 will be a venue for leading academic and industrial researchers to exchange their views, ideas, and research results on innovative technologies and sustainable solutions leading to Informatics and Management Science. The conference will feature keynote speakers, a panel discussion, and paper presentations.

The objective of IMS 2012 is to facilitate an exchange of information on best practices for the latest research advances in the area of Informatics and Management Science. IMS 2012 will provide a forum for engineers and scientists in academia, industry, and government to address the most innovative research and development including technical challenges, social, and economic issues, and to present and discuss their ideas, results, work in progress, and experience on all aspects of Informatics and Management Science.

There were a very large number of paper submissions (2351). All submissions were reviewed by at least three Program or Technical Committee members or external reviewers. It was extremely difficult to select the presentations for the conference because there were so many excellent and interesting submissions. In order to allocate as many papers as possible and keep the high quality of the conference, we finally decided to accept 614 papers for presentations, reflecting a 26.1 % acceptance rate. We believe that all of these papers and topics not only provided novel ideas, new results, work in progress, and state-of-the-art techniques in this field, but also stimulated the future research activities in the area of Informatics and Management Science.

The exciting program for this conference was the result of the hard and excellent work of many others, such as Program and Technical Committee members, external reviewers, and Publication Chairs under a very tight schedule. We are also

grateful to the members of the Local Organizing Committee for supporting us in handling so many organizational tasks, and to the keynote speakers for accepting to come to the conference with enthusiasm. Last but not least, we hope you enjoy the conference program, and the beautiful attractions of Kunming, China.

With our warmest regards.

December 2012

Wenjiang Du  
Guomeng Dong  
General and Program Chairs  
IMS 2012

# Organization

IMS 2012 was organized by Electric Power Research Institute, YNPG, Yunnan Normal University, Wuhan Institute of Technology, Guizhou University, Chongqing Normal University, Chongqing University, Yanshan University, Xiangtan University, Hunan Institute of Engineering, Shanghai Jiao Tong University, Nanyang Technological University, and sponsored by National Natural Science Foundation of China (NSFC). It was held in cooperation with *Lecture Notes in Electrical Engineering* (LNEE) of Springer.

# Executive Committee

General Chairs:	Maode Ma, Nanyang Technological University, Singapore Yuhang Yang, Shanghai Jiao Tong University, China
Program Chairs:	Yanchun Zhang, University of Victoria, Australia Rafa Kapelko, Wroclaw University of Technology, Poland Rongbo Zhu, Virginia Tech, USA Ming Fan, University of Washington, USA
Local Arrangement Chairs:	Qing Xiao, Chongqing University, China Wenjiang Du, Chongqing Normal University, China
Steering Committee:	Maode Ma, Nanyang Technological University, Singapore Nadia Nedjah, State University of Rio de Janeiro, Brazil Lorna Uden, Staffordshire University, UK Dechang Chen, Uniformed Services University of the Health Sciences, USA Mei-Ching Chen, Tatung University, Taiwan Rong-Chang Chen, National Taichung Institute of Technology, Taiwan Chi-Cheng Cheng, National Sun Yat-Sen University, Taiwan Naohiko Hanajima, Muroran Institute of Technology, Japan Shumin Fei, Southeast University, China Yingmin Jia, BeiHang University, China Weiguo Liu, Northwestern Polytechnic University, China Yongji Wang, Huazhong University of Science and Technology, China Xiaoping Ma, China University of Mining and Technology, China Jie Wang, Zhengzhou University, China Seong G. Kong, The University of Tennessee, USA

Pan Li, Mississippi State University, USA  
Xuejun Li, Hunan University of Science and  
Technology, China  
Pengjun Mao, Henan University of Science  
and Technology, China  
Guang-Bin Huang, Nanyang Technological  
University, Singapore  
Wenjiang Du, Chongqing Normal University, China  
Qixing Xu, Henan Institute of Engineering, China  
Xiaohong Fan, Henan University of Urban  
Construction, China  
Ragip Kurceren, Nokia Research, USA  
Nils Aschenbruck, University of Bonn, Germany  
Song Ci, University of Nebraska-Lincoln, USA  
Rong-Chang Chen, National Taichung Institute  
of Technology, Taiwan  
Mei-Ching Chen, Tatung University, Taiwan  
Juergen Bruess, AutoTXT, Germany  
Bahram Honary, Lancaster University, UK  
Michael Darnell, Warwick University, UK  
Plamen Angelov, Lancaster University, UK  
Farideh Honary, Lancaster University, UK  
T. R. Melia, Cisco Systems, Switzerland

# Program/Technical Committee

Ragip Kur	Nokia Research, USA
Mina Gui	Texas State University, USA
Yanbin Sun	Beijing University of Posts and Telecommunications, China
Ven Prasad	Delft University of Technology, Netherlands
Yajun Li	Shanghai Jiao Tong University, China
Mengze Liao	Cisco China R&D Center, China
Xiwen Hu	Wuhan University of Technology, China
Yajun Guo	Huazhong Normal University, China
Suresh Subra	George Washington University, USA
Mingyi Gao	National Institute of AIST, Japan
Yanliang Jin	Shanghai University, China
Haibing Yin	Peking University, China
Jianxin Chen	University of Vigo, Spain
Yuan Lin	Norwegian University of Science and Technology, Norwegian
Miche Rossi	University of Padova, Italy
Nils Asc	University of Bonn, Germany
Chunxiao Yu	Yanshan University, China
On Altintas	Toyota InfoTechnology Center, Japan
Guofu Gui	CMC Corporation, China
Dianxuan Gong	Hebei Polytechnic University, China
Haiyong Bao	NTT Co., Ltd., Japan
Shuang Cong	University of Science and technology of China, China
Yangwen Zou	Apple China Co., Ltd., China
ai-hon Kim	Defense Security Command, Korea
Sean McLoo	National University of Ireland, Ireland
Jian-Xin Peng	Queens University of Belfast, UK
Lui Piroddi	Technical University of Milan, Italy
Wi Richert	University of Paderborn, Germany
Meh shafiei	Dalhousie University, Canada
Girij Prasad	University of Ulster, UK

Jams Li	University of Birmingham, UK
Liang Li	University of Sheffield, UK
Hai Qi	University of Tennessee, USA
Yuezhi Zhou	Tsinghua University, China
Duolin Liu	ShenYang Ligong University, China
Zengqiang Chen	Nankai University, China
Dumisa Wellington Ngwenya	Illinois State University, USA
Hu Changhua	Xi'an Research Insti. of Hi-Tech, China
Juntao Fei	Hohai University, China
Zhao-Hui	Jiang Hiroshima Institute of Technology, Japan
Michael Watts	Lincoln University, New Zealand
TChun Lee	Howon University, Korea
Cent Leung	Victoria University of Technology, Australia
Haining Wang	College of William and Marry, USA
Worap Kreesuradej	King Mongkut's Institute of Technology Ladkrabang, Thailand
Muhammad Khan	Southwest Jiaotong University, China
Stefa Lindstaedt	Division Manager Knowledge Management, Austria
Yiming Chen	Yanshan University, China
Tashi Kuremoto	Yamaguchi University, Japan
Zheng Liu	Nagasaki Institute of Applied Science, Japan
Seong Kong	The University of Tennessee, USA
R. McMenemy	Queen's University Belfast, UK
Sunil Maharaj	Sentech University of Pretoria, South Africa
Paolo Li	Polytechnic of Bari, Italy
Cheol Moon	Gwangju University, Korea
Zhanguo Wei	Beijing Forestry University, China
Hao Chen	Hunan University, China
Xiaozhu Liu	Wuhan University, China
Xilong Qu	Hunan Institute of Engineering, China
Lilei Wang	Beijing University of Posts and Telecommunications, China
Liang Zhou	ENSTA-ParisTech, France
Yanbing Sun	Beijing University of Posts and Telecommunications, China
Xiyin Wang	Hebei Polytechnic University, China
Hui Wang	University of Evry in France, France
Uwe Kuger	Queen's University of Belfast, UK
Nin Pang	Auckland University of Technology, New Zealand
Yan Zhang	Simula Research Laboratory and University of Oslo, Norway
Sa Sharma	University of Plymouth, UK
Wang Bin	Chinese Academy of Sciences, China

YongSheng Ding	Donghua University, China
Xiang Mei	The University of Leeds, UK
Yongning Tang	Illinois State University, USA
Wenbin Jiang	Huazhong University of Science and Technology, China
Jun Cai	University of Manitoba, Canada
Xingang Zhang	Nanyang Normal University, China
Veli Mumcu	Technical University of Yildiz, Turkey
Xiao Li	CINVESTAV-IPN, Mexico
Ruichun Tang	Ocean University of China, China
Michiharu Kurume	National College of Technology, Japan
Dong Yue	Huazhong University of Science and Technology, China
Qishi Wu	University of Memphis, USA
Zhichun Li	Northwestern University, China
Lisong Xu	University of Nebraska-Lincoln, USA
Mei Yu	Simula Research Laboratory, Norway
Gui-Rong Xue	Shanghai Jiao Tong University, China
Jalel Ben-Othman	University of Versailles, France



# Contents

## Part I Computer Engineering and Applications I

<b>1</b>	<b>Research on UIG Cooperation Management Mode for Complex Large-scale Innovative Projects</b> .....	<b>3</b>
	X. Guo and Z. Wu	
<b>2</b>	<b>Research of Internal Temperature Distribution for Liver Tissues Under Laser Irradiation</b> .....	<b>11</b>
	Hanzhou Hao, Rugang Zhong, Yongxing Wang, Chenwu Liu and Xuebin Zhong	
<b>3</b>	<b>Battlefield Target Selection Based on RBF Neural Network and Evidence Theory</b> .....	<b>17</b>
	Lixin Wang, Xisheng Jia, Mei Zhao and Wensheng Li	
<b>4</b>	<b>Data Synchronization of Earthquake Precursor System Based on Log Optimization Algorithm</b> .....	<b>25</b>
	Q. Liu, W. Chen and X. Wang	
<b>5</b>	<b>Research on Green Supply Chain Operation</b> .....	<b>35</b>
	Yongming Liang and Yao Xiao	
<b>6</b>	<b>CBI-Based Assisted Internet ESP Teaching Mode</b> .....	<b>41</b>
	Xiaohua Zhu	
<b>7</b>	<b>Strategy of Timing Backup ORACLE Database</b> .....	<b>49</b>
	C. Xue	

<b>8</b>	<b>Study of Relationship Between Inorganic Polymer Concrete Cracks and Strain Based on Fractal Theory. . . . .</b>	<b>55</b>
	Yan Yan, Zhean Lu, Xiaochun Fan, Dingguo Cao, Jianju Li and Yinping Wang	
<b>9</b>	<b>Research on Product Recovery Forecast in Remanufacturing Based on Weighted Markov Chain. . . . .</b>	<b>63</b>
	Zhanfeng Zhou	
<b>10</b>	<b>Relationship Model Between Chlorophyll-<i>a</i> and Sediment Nutrients. . . . .</b>	<b>71</b>
	H.-J. Luo, D.-F. Liu and Y.-P. Huang	
<b>11</b>	<b>Scalable Karatsuba Multiplier Over Finite Field GF (<math>2^m</math>). . . . .</b>	<b>79</b>
	Huafeng Chen, Yanbing Jiang and Buping Jin	
<b>12</b>	<b>3D Parametric Design on Chimney-Tray Gas-Liquid Distributor. . . . .</b>	<b>85</b>
	Pengfei Zhang and Shuyan Wang	
<b>13</b>	<b>Research of Table Tennis Forehand Loop Technology CAI Courseware. . . . .</b>	<b>93</b>
	Baowei Zhang	
<b>14</b>	<b>A Hybrid Genetic Algorithm Based on Harmony Search and its Improving. . . . .</b>	<b>101</b>
	W.-W. Shi, Wei Han and W.-C. Si	
<b>15</b>	<b>Analysis on Construction Project Safety Based on Fuzzy Evaluation Method. . . . .</b>	<b>111</b>
	Minghua Wang and Jing Gao	
<b>16</b>	<b>Analysis Based on Curve Fitting Analysis of Tai Chiquan Treatment of Spinal Diseases Feasibility . . . . .</b>	<b>117</b>
	Wenhong Deng and Nan Jiang	
<b>17</b>	<b>A Device Diagnosis Algorithm Based on Naive Bayesian. . . . .</b>	<b>125</b>
	Xiaoqiang Jia and Nina Li	
<b>18</b>	<b>A NN-Based Control Method of Uncertain System with Large Time Delay . . . . .</b>	<b>133</b>
	L.-X. Wei, Liang Cheng and Ying Li	
<b>19</b>	<b>Sampling System Based on DSP I/O Space and Resolver . . . . .</b>	<b>141</b>
	Lin He, Jie Bai, Hexu Sun and Jie Gao	

**20 Antispam Topic Crawler Algorithm Based on Anti Spoofing** . . . . . 149  
 Xiaoqiang Jia

**21 Solution of Fuzzy Pattern Recognition Inverse Problem** . . . . . 155  
 Cuilan Mi, Xinchun Wang and Jianming Liu

**22 Research on Combination Mode of College Art Education and Computer Art** . . . . . 163  
 W. Shan

**23 A Survey of Software Reliability Qualitative Evaluation**. . . . . 169  
 Q. Li and L. Liu

**24 Identification Method of Streaming Media Based on Queuing Theory** . . . . . 179  
 Shuliang Pan, Ye Liang, Jingzhang Liang and Cui Teng

**Part II Engineering Management and Applications I**

**25 Research of Smoke Denitration Technology in Denitrating Process in Coal-Fired Power Plants** . . . . . 189  
 Yuanshang Zhang, Tianrong Zhang, Xiaoman Zhang, Xiaochun Lin and Xiaoming Weng

**26 Research on SNCR Technology in the Denitration Engineering**. . . . . 197  
 Xiaoman Zhang, Rongtian Zhang and Xiaochun Lin

**27 Analysis on Accumulation Stability at Puji Slag Yard** . . . . . 203  
 Sugang Sui, Shiguang Xun, Zhuguo Fan, Wenlian Liu, Maobin Din and Jianliang Wang

**28 Characteristic and Environmental Risk Assessment of Heavy Metals in Farmland Soil of Based on Speciation Analysis** . . . . . 213  
 X. Wang

**29 Research on Architectural Style and Formative Causes of Traditional Tujia Residence** . . . . . 221  
 Jin Hu

**30 Decorative Beauty of Bionic Ceramic Vessels with Floral Rims** . . . . . 229  
 Yalin Zhang, Miaomiao Wang and Yong Yu

<b>31</b>	<b>Study on Plants Community Succession in Land for Coal Gangue Dump in Fushun Mining Area</b> . . . . .	237
	Chen Wang	
<b>32</b>	<b>Research on Advanced Manufacturing Technology Foresight of Chinese Furniture Industry</b> . . . . .	243
	M. Chen and J. Lv	
<b>33</b>	<b>Analysis on Context of National Games Material for Industrial Development</b> . . . . .	251
	Ya Liu and Fusheng Jang	
<b>34</b>	<b>Research of Shale Gas in China</b> . . . . .	259
	Haifeng Chen, Miao He, Bing Han, Zhonglin Li and Peihai Li	
<b>35</b>	<b>Research on Football Flight Trajectory Based on Aerodynamic</b> . . . . .	265
	Zhaonian Wang and Rui Jiang	
<b>36</b>	<b>Efficient Plastic Mould Design of Condiment Box</b> . . . . .	271
	Guangjuan Chen and Meiling Hao	
<b>37</b>	<b>Petroleum Sulfonates as Oil Displacement Agent and Application</b> . . . . .	277
	Shengchun Xiong, Ying He, Maolei Cui, Weicheng Zhang and Wei Xiong	
<b>38</b>	<b>Research on Anxiety and Influential Factors of Occupational Female</b> . . . . .	285
	Qi Ren, Qian Li and Weijun Guan	
<b>39</b>	<b>Research of Occupational Stress in Mine Emergency Rescuers</b> . . . . .	293
	Xiaoming Li, Sanqiao Yao, Jia Li, Ruzhu Wang, Yuan Liu, Yuping Bai, Yulan Jin, Fuhai Shen, Shoufang Jiang, Qingzhao Li and Qian Wang	
<b>40</b>	<b>Effect of Curcumin on Biological Behavior of T24 Cells of Bladder Cancer and its Mechanism</b> . . . . .	301
	Yu Su, Zhuo Wang, Lei Zhou, Qunxi Li and Yanbo Peng	
<b>41</b>	<b>Effect of Soyasaponin on Expression of Fas/FasL of Pneumonocyte in Silicotic Fibrosis Rats</b> . . . . .	309
	Houjun Xu, Yulan Hao, Yu Su, Q. Li, Jianhui Wu, Hongmin Fan, Manman Wang, Licheng Yan, Haijuan An and Yanshu Zhang	
<b>42</b>	<b>Study of Electre II Multiple Attribute Decision-Making Method in Construction Project Management Mode Selection</b> . . . . .	315
	Jingzhong Ma and Yuxin Liang	

<b>43</b>	<b>Marketing Strategy Analyse Based on 4P Theories</b> . . . . .	321
	X.-C. Song and J.-Z. Cui	
<b>44</b>	<b>Distribution of Mn, Pb and Zn Microelements in Agricultural Soil.</b> . . . . .	333
	M. Hu	
<b>45</b>	<b>Research on Economy Increasing Based on Terraced Fields Development</b> . . . . .	339
	M. Hu	
<b>Part III Financial Management and Applications</b>		
<b>46</b>	<b>Measurement of Liquidity Risk of Listed Commercial Banks</b> . . . .	349
	Fang Hu, Wenyi Xia and Zongfa Wu	
<b>47</b>	<b>Study on Safety Accounting Theoretical System.</b> . . . . .	357
	Xiangjun Zhang	
<b>48</b>	<b>Research on Dependence and Coupling Relationship Between China and America Under Institutional Building.</b> . . . . .	365
	Guohua Jing	
<b>49</b>	<b>Rural Financial System Reform and Practice in Western China</b> . . . . .	371
	Youbi Mao	
<b>50</b>	<b>Research of Bank Internationalization Theory</b> . . . . .	381
	X. Liu	
<b>51</b>	<b>Analysis and Recommendations on Status of Banking Profits</b> . . . . .	389
	Jiyan Xu	
<b>52</b>	<b>Study on RMB Exchange Rate Transmission Mechanism Based on VAR Model</b> . . . . .	395
	Y. Wang	
<b>53</b>	<b>Study on Listed Company Accounting Policy Selection.</b> . . . . .	403
	Zhensheng Zhuang	
<b>54</b>	<b>Research on Effect of Banks Risk Weighted Assets</b> . . . . .	411
	Weiguo Xiao and Yurui Huang	
<b>55</b>	<b>Research on the Urban Public Transport Route Accounting System</b> . . .	421
	Zhike Han, Quan Pan and Bowen Yang	

<b>56</b>	<b>Empirical Research on Rural Residential Construction of Financial System</b> . . . . .	429
	Wei Wang, Hongrui Zhang and Zhenxiang Cui	
<b>57</b>	<b>Study on Income Distribution Based on Money Exchange Model</b> . . .	437
	Xiaoye Shang	
<b>58</b>	<b>Study on Long-Effect Mechanism of Securities Investor Education</b> . . . . .	445
	Yunlei Huo	
<b>59</b>	<b>Study on Influences of Fair Value on Risk Management of Commercial Banks and Coping Strategies</b> . . . . .	453
	Boyao Wei	
<b>60</b>	<b>Study on Financial Development Based on Dynamic Panel Data Model</b> . . . . .	459
	Huizhong Liu, X. Tian, Xiaoyin Hou and Yuhang Li	
<b>61</b>	<b>Second-Order Factor Analysis on Content Structure of Small Loan Customer</b> . . . . .	465
	Luo Liu and S. Chen	
<b>62</b>	<b>Innovation on Supply Chain Financial for Loan Indicator Analysis</b> . . . . .	473
	Peng Li	
<b>Part IV Education in Management Science I</b>		
<b>63</b>	<b>Research on Curriculum Reform Based on Probability Theory and Mathematical Statistics</b> . . . . .	481
	Xiaohong Liu, Qilei Feng, Yongli Zhang and Shujuan Yuan	
<b>64</b>	<b>Research on Aesthetic Psychology of Effect of Art Acceptance</b> . . . .	487
	Lu Shao	
<b>65</b>	<b>Efficient Scheme to Improve Engineering Practice Ability of Undergraduate Students Based on Opening Laboratory</b> . . . . .	495
	L. Cui	
<b>66</b>	<b>Efficient Teaching Model of Participatory Constructing in Plant Protection Teaching</b> . . . . .	501
	F.-B. Kong, W.-H. Li and M.-W. Shi	

<b>67</b>	<b>Research on Safe Routes Based on the Relevant Laws. . . . .</b>	<b>507</b>
	Ying Xi and Baozhen Pang	
<b>68</b>	<b>Research on Coupling Relationship Between Campus Stability and Social Prosperity . . . . .</b>	<b>513</b>
	Meiqin Guo and Baozhen Pang	
<b>69</b>	<b>Study on Applying Implicit Learning Theory in Nursing Teaching . . . . .</b>	<b>521</b>
	Xuexia Zhang	
<b>70</b>	<b>Coupling Effects of Regional Economy and Local Universities Construction . . . . .</b>	<b>529</b>
	L. Chen	
<b>71</b>	<b>Analysis on the Psychological Adjustment of College Students Based on the Principle of Self-Management . . . . .</b>	<b>537</b>
	Xue Wang, Jingzhi Wang and Lijuan Zhang	
<b>72</b>	<b>Study on Cooperative Learning Teaching Mode in University Tennis Teaching . . . . .</b>	<b>545</b>
	Nian Tang and Peng Li	
<b>73</b>	<b>Application of Heuristic Teaching Method in Art Education . . . . .</b>	<b>553</b>
	Wei Wei	
<b>74</b>	<b>Research on Further Education of Teachers in Middle School . . . . .</b>	<b>561</b>
	Guomin Li and Ruihong Wu	
<b>75</b>	<b>Research on Sports Consumption of University Students . . . . .</b>	<b>569</b>
	Guomin Li	
<b>76</b>	<b>Practical Teaching Research of College Art Design . . . . .</b>	<b>577</b>
	H. Liu	
<b>77</b>	<b>Study on Ability of Undergraduate Scientific Research . . . . .</b>	<b>585</b>
	Rongfang Wang	
<b>78</b>	<b>Research on Quality of Full-Time Professional Degree Postgraduate Education . . . . .</b>	<b>593</b>
	Chunjun Zhu	
<b>79</b>	<b>Virtual Artistic Training Scheme Based on Music . . . . .</b>	<b>601</b>
	Xiaohong Zhu	

<b>80</b>	<b>Research on Environment Construction of University Harmonious Campus Based on Cultivation of Innovative Talents</b> . . . . .	609
	He Xiao	
<b>81</b>	<b>Research on Ideological and Political Education of College Students in Mobile Phone Environment</b> . . . . .	617
	H. Xiao	
<b>82</b>	<b>Teaching Reform of Advanced Mathematics Teaching Practical</b> . . .	625
	Shujuan Fu and Hui Zhao	
<b>83</b>	<b>Study on Teaching Quality of Music Teachers in Colleges Under Quality Education Background</b> . . . . .	631
	Na Wang	
<b>84</b>	<b>Study on Chinese Painting Freehand Brushwork.</b> . . . . .	639
	Rong Zhuang	

## Part V Bioinformatics and Applications

<b>85</b>	<b>Molecular Cloning and Sequences Analysis of Chalcone Synthase Gene from <i>Fagopyrum Tataricum</i>.</b> . . . . .	649
	Huangyuan She, Shaohong He, Zhi Zhou and Qitang Zhang	
<b>86</b>	<b>Automatic Isolation of Carpal-Bone in Hand X-Ray Medical Image</b> . . . . .	657
	Shengnan Hao, Yuhe Han, Jide Zhang and Zhanlin Ji	
<b>87</b>	<b>Study on Medical Education Based on E-Learning</b> . . . . .	663
	Yujuan Zhou	
<b>88</b>	<b>Research on ACE Gene I/D Polymorphism of Men and Effects of HiHiLo on SPO<sub>2</sub>.</b> . . . . .	671
	D. Zhou, Yang Hu, Y. Li, L. Yi and Jing Nie	
<b>89</b>	<b>Study on Biological Effect of Plasticizer</b> . . . . .	679
	Yutao Gong, Minling Gao and Chunxiao Sun	
<b>90</b>	<b>Research on Human Hematopoietic Function by Medical Ray at Different Doses Management</b> . . . . .	685
	Xiangke Cao, Qingzeng Qian, Fuhai Shen, Qian Wang and Junwang Tong	



- 91 High-Performance Liquid Chromatographic Method for the Determination of Bisphenol A, Nonylphenol and Octylphenol in Sewage.** . . . . . 691  
Qingzeng Qian, Xiangke Cao, Qian Wang, Yanhua Cao, Suying Rong and Sujing Yu
- 92 Joint Torque Calculation Model Based on the Relationship Between Individual Muscle Force and Surface Electromyography** . . . . . 699  
Jianfeng Wu, Haiying Li, Bing Xu and Xiaojian Liu
- 93 Prognosis of Hyperuricemia in Patients with Acute Cerebral Infraction** . . . . . 707  
Yanbo Peng, Xin Xiong, Yu Su, Zhuo Wang, Jingyue Wang, Xiaojing Zhao and Dali Wang
- 94 Adults Prevalence of Metabolic Syndrome in China's Tangshan . . .** 713  
Lixiang Zhang, Bo Hu and Xiaoyu Liu
- 95 Prevalence and Risk Factors of Metabolic Syndrome** . . . . . 721  
Xiaoyu Liu, Yunqiu Liu and Xuan Lan
- 96 Combined Toxic Effects of DBP and DEHP on Sperm in Male Mice** . . . . . 729  
Yulan Hao, Guoying Zheng, Qingzhao Li, Houjun Xu, Yanshu Zhang and Licheng Yan
- 97 Effect of Soyasaponin on Pulmonary Tissue Apoptosis of Silicotic Fibrosis Rats** . . . . . 735  
H. Xu, Y. Su, Qingzhao Li, Jianhui Wu, Yulan Hao, Hongmin Fan, Manman Wang, Nan Liu and Guoying Zheng
- 98 Surface Reconstruction of Bilateral Skull Defect Prosthesis Based on Radial Basis Function** . . . . . 741  
Lei Zhou, Yang Song, Jianhui Wu, Huilan Li, Guobin Zhang and Chunling Sun
- 99 Research of New Method of Developing Blood Fingerprints with RDZ.** . . . . . 749  
Xiaomei Zhang
- 100 Study of Fuzzy Analytic Hierarchy Process in Clinical Nursing . . .** 757  
Mei Sun, Siyuan Tang, Yujia Ren, Fen Jiang and Binbin Ji
- 101 Study on Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System** . . . . . 765  
Yun Lu and Zhenzi Xu

**102 Anti-Arthritic Effects of Chondroitin Sulfate and Type II Collagen in Collagen-Induced Arthritis Mice . . . . . 773**  
Anjun Liu, Hui Zhang, Ying Chen, Hongshuo Chen, Huihui Liu and Xiaodan Guo

**103 Different Ozone Processing Conditions on Grapes Storage Quality . . . . . 781**  
Jie Wu, Jing Xu and Fei Zhu

**Part I**  
**Computer Engineering and Applications I**

# Chapter 1

## Research on UIG Cooperation Management Mode for Complex Large-scale Innovative Projects

Xiaofeng Guo and Zhigong Wu

**Abstract** We make clear the concept of complex large-scale innovative projects and take an analysis of its type and nature, and then illustrate the important position of cooperation management in complex large-scale innovative projects. On the basis of determining the design principles, we begin to researching by combining with characters of complex large-scale innovative projects and principles of synergetics. Finally, we build an UIG cooperation management model by choosing relationships, organization, information, task, target and external factors as order parameter of cooperation management.

**Keywords** Complex large-scale innovative projects • UIG • Cooperation management model

### 1.1 Introduction

During the process of building an innovative country and establishing a regional innovation system, more and more complex large-scale innovative projects emerging. In this case, we must absorb forces widely to achieve the project's goal. And then it will promote the economy and society developing good and fast. Be faced with the complex large-scale innovative projects, University-Industry-Government (UIG) is becoming an important force through cooperation that based on resource sharing. Complex large-scale innovative projects have many features like complexity, broad-scale and innovation [1]. In order to coordinate the relationship between UIG and establish the principle of cooperation, we must build UIG cooperation management model. Only in this way, can it pushing the complex large-scale innovative project's goal comes true.

---

X. Guo (✉) · Z. Wu

School of Economics and Management, North China Electric Power University, Beijing, China  
e-mail: ncepuxf@163.com

## 1.2 Features Analysis of Complex Large-scale Innovative Projects

### 1.2.1 Definition of Complex Large-scale Innovative Projects

Complex large-scale innovative project is a dynamic open system that composed of a large number of unique, complex and interrelated subsystems or elements. It has the target for innovation but be bound with time, budget and resources [2, 3]. According the connotation of a complex large-scale innovative project, there are many types. The first is complex large-scale engineering construction projects, like Shanghai World Expo 2010, the Three Gorges Project and the Beijing-Shanghai high-speed rail. The second is complex large-scale cultural and sports projects, like Olympic Games and Asian Games. The third is complex large-scale aerospace innovation projects, like Shenzhou series of spacecraft and China's own designed aircraft C919. The fourth is complex large-scale military projects, like aircraft carrier. The fifth is complex large-scale technological innovation projects, like Silicon Valley, Zhongguancun, China Optical Valley, China Electric Valley and Technology Park in many universities. The main words in all headings (even run-in headings) begin with a capital letter. Articles, conjunctions and prepositions are the only words which should begin with a lower case letter.

### 1.2.2 Characteristics of Complex Large-scale Innovative Projects

Characteristics of complex large-scale innovative projects are different, but they show some common features, which are shown as follows:

*Complexity:* Complexity is the basic characteristic of complex large-scale innovative projects, including technical complexity, organizational complexity, task complexity, goal complexity and environmental complexity.

*Innovation:* Innovation is an important feature of complex large-scale innovative projects. The innovation of complex large-scale innovative projects is reflected as knowledge has become the first element of projects implementation, and technological achievements are the main innovation form. In the process of projects implementation, it should be played the advantages of schools, industry and government. In this way, it will put policy-orientation and research-development-achievements-production into a complete integration. And form the covation chain finally.

Uncertainty the actual results of complex large-scale innovative projects implementation may deviate from the basic scheme of the forecast. Therefore, they are likely to face potential danger and uncertainty, such as uncertainty of technical equipment and production processes, uncertainty of production capacity,

uncertainty of construction funds and duration, uncertainty of the project life and uncertainty of government policies and regulations.

### **1.3 Important Role of UIG Cooperation Management in Complex Large-scale Innovative Projects**

UIG Collaborative Management originated in the west countries, and expanded along with the development of higher education. In recent years, the cooperation among universities, industries and government is emerging in China. Some regions combined with their actual to establish UIG cooperation mode by their practice, which has had a positive impact of varying degrees in different times and in different contexts. Today, with the complex large-scale innovative projects constantly emerging, UIG collaborative management occupies an important place.

Firstly, the complex large-scale innovative projects have the characteristics as wide involves, strong comprehensive, intensity investment and depend on interdisciplinary research. And it needs to fully mobilize universities, industries and government forces to form the complementary advantages, such as resources, capital, policy from government, science and technology innovation and market transformation advantage from industries, talent and research advantages from the universities. Through the integration of resources, we will reach a win-win situation.

Secondly, in the era of knowledge economy, knowledge is the foundation of the social and economy development. As the creators of knowledge and communicators, the university became an important part of the innovation system. In UIG cooperation, the enterprises are the mainstay of technological innovation, and the University has the talent and knowledge innovation, especially the great advantage of basic research and application research. In the long-term, basic research has great strategic significance and potential economic value, which is critical for many complex large-scale innovative projects. Therefore, in the model of UIG cooperation in complex large-scale innovative projects, university should full play its important role, becoming an important force to promote the UIG cooperation for sustainable development.

Thirdly, practice has proved that, the success of complex large-scale innovative projects in engineering, culture, sports, or technology, are all result from the cooperation among universities, businesses and governments. Such as the 2010 Shanghai World Expo, the 2008 Olympic Games, the Shenzhou series of spacecraft, as well as Silicon Valley. In these various fields, the cooperation between universities, corporations and governments have full play an important role. Therefore, strengthening the cooperation of universities, industries and governments in complex large-scale innovative projects have a great significance to promote the national development in economic and social areas.

## **1.4 UIG Cooperation Management Model Designing of Complex Large-scale Innovative Projects**

According to the synergetics theory, there are lots of factors that affect the cooperation management level, quality and efficiency of complex large-scale innovative projects. It is not impossible to attend to every detail in the management, and the key is to find and deal with the order parameters that play decisive role in cooperation management [4, 5]. Embarking from characters of complex large-scale innovative projects and principles of synergetics theory and combing with design principle, we design the framework of UIG cooperation management model of complex large-scale innovative projects, which is shown below.

### ***1.4.1 Relation Cooperation***

Relation cooperation is the premise for implementing complex large-scale innovation projects. Proceeding with such innovative projects, you must select and determine the appropriate participants according to the characteristics, requirements, target of the project, and make clear the relationship, status and responsibilities between each other. The selected and determined university, enterprise and government during the relation cooperation constitute the main body of cooperative organizations. Simultaneously its corresponding institutions participate in the innovative activities and cooperation management of innovative projects. These institutions include university's cooperation office, national provincial or ministerial level laboratory, project center, state-level university science and technology garden, innovation garden and so on, enterprise's cooperation office, research and development center, production department, marketing department and so on; Government's cooperation office, manages the functional departments, the state-level high technology and new technology development zone, the industrial garden area, the technical garden area and so on.

### ***1.4.2 Organization Cooperation***

On the basis of relation cooperation, each participant and the relevant departments compose the management institutions for joint management, which is organization cooperation. In accordance with the project objectives, we should identify institutional responsibilities, division of labor, and reduce internal friction, remove obstacles so as to guarantee the project can be implemented effectively. Organization cooperation is realized in the form of self-organization of UIG cooperation management alliance. Its members are made up of all kinds of people, and establish some institutions such as management coordination and consultation, evaluation (Fig. 1.1).

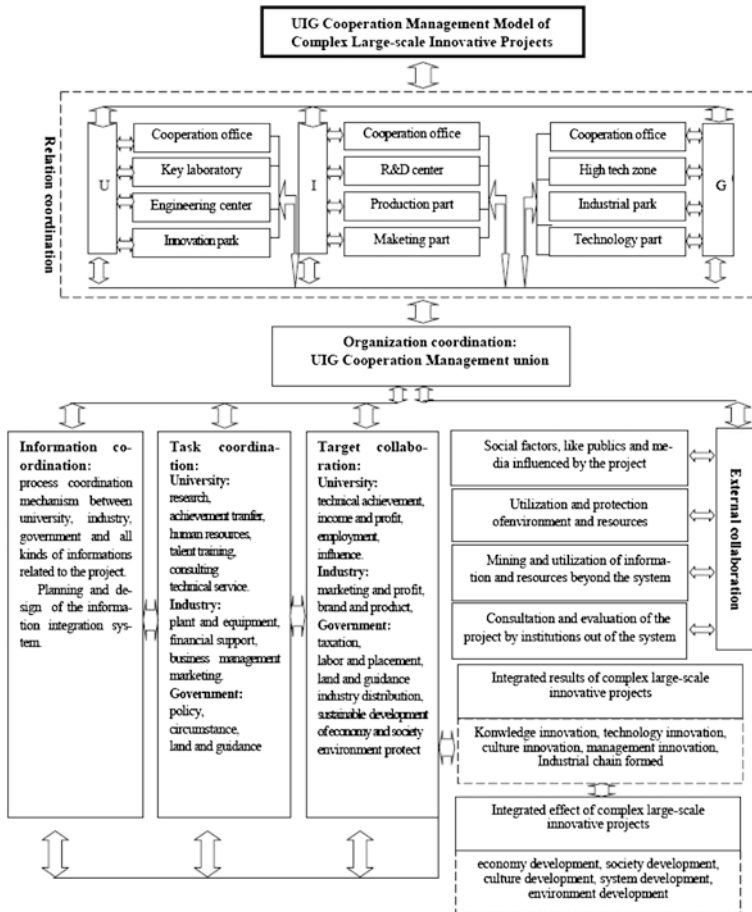


Fig. 1.1 Organization cooperation is realized in the form of self-organization of UIG cooperation management alliance

### 1.4.3 Information Cooperation

Information cooperation is the collection and screening of a variety of information in complex large-scale innovative projects by using various technologies and methods in order to make correct, prompt processing and feedback. Management institutions and each participant should establish a mechanism for information exchange and sharing, and communicate with each other regularly or irregularly. Because of the differences of each participant in value orientation, share resources and division, there will be an information asymmetry. Information cooperation can effectively solve the resulting benefits of the game from this game. Informational cooperation is that UIG Information Management Alliance and its members



collect, analyze and process various kinds of information associated with this project, establish information cooperation process mechanism, plan and design the information integration system.

#### ***1.4.4 Task Cooperation***

Task cooperation is carried out by cooperative organizations decomposing on innovative projects tasks that are undertaken separately by each participant. As the project continues to expand, it is necessary to allocate and complete a new task until the end as soon as each stage of the task is complete. In this process, cooperative organizations should make the necessary integration, configuration and optimization to relevant resources of the parties involved according to the requirements of the project. To successfully complete the task and ensure quality of the project, cooperative task also requires the organizations and each participant to schedule and adjust the division and cooperation of labors in a timely manner. Due to the multi-participant, complex task, wide involvement, complex relation, there are many risks in the implementation of innovative project, such as technical risk, financial risk, management risk, market risk and so on, which can be effectively avoid by task cooperation. Task cooperation mainly means the superiority supplementary, division of labor and cooperation of university, enterprise, government. For example, university undertakes the technical research, the achievement shift, the manpower support, the personnel training, the technical consultation and so on; enterprise undertakes the workshop supply, the equipment facility, the fund collection, the achievement transformation, the market development and so on; the government undertakes the policy support, the fund support, the safeguard uses, the attraction of fund support, the industrial guidance and so on.

#### ***1.4.5 Target Cooperation***

Target cooperation is the starting and destination of complex large-scale innovative projects implementation. All parts involved in the project are also pursuing that. However, on the one hand, because of all the participants are in different positions and perspectives, the value orientation of the participants will be different, so there will be coupling in their targets, that means they have common consistent aims, but also different goals. On the other hand, the complex large-scale innovative project tends to be long-term and strategic, so it will have long and ultimately objectives, and staged goals. These two factors should be coordinated very well. Target cooperation is very important to the effects of collaboration management. It can balance the interests and value pursuits of all parties and can maximize achievements and integrate effects of projects. It is the choice of university, industry and government in different targets, such as university is

pursuing technology achievement, transformation and innovation projects benefits, school influence. Industry pays more attention to efficiency, brand, market share and product potential. And government concerns revenues, settlement of labor, environmental protection, resource efficient, stable economic and social development.

#### ***1.4.6 External Cooperation***

The complex large-scale innovative projects and all parts make up a complex system, and it is not closed and exclusive, but open and inclusive. The evolution process of system is influenced by inside and external elements. From the system external perspective, the implementation of projects is related with region, society and public factors, even influence interests, survival and development directly. Therefore, in order to ensure the innovation projects promoting smoothly, external collaboration is indispensable. First, they should pay attention to the media and public reaction, strengthen communication, pay great attention to the positive publicity and guidance. Second, they should be realistic and utilize the resources and advantages, reduce energy consumption and carbon emissions, and protect environment effectively. Third, they should seek broad political resources and external social support to form outside system required by projects. Fourth, they should actively invite related experts and authoritative institutions in the field for the consultation, evaluation, management and financial aspects for the future of projects. External collaboration mainly is the system of external resources development and utilization and evaluated by the related factors outside of UIG coordinated management. Most importantly, UIG collaborative management of complex large-scale innovative projects can get integrated achievements, such as knowledge innovation, technology innovation, cultural innovation, management innovation and new technology, green environment industry chain and the formation of industry cluster. Then, it will produce integrated effects, including the development of economy and society, science and technology, culture and environment.

### **1.5 Summary**

The increasing of complex large-scale innovative projects is a new challenge for multilateral management. UIG cooperation management mode put forward a good way to solve the problem. This chapter, based on the features of complex large-scale innovation projects, we construct an UIG cooperation management mode that is suitable for them. With the development of China's innovative society and the emergence of complex large-scale innovative projects, UIG cooperative management mode will play a more and more important role in future society.

## References

1. Le X, She X (2011) Research on cooperative management pattern innovation of large engineering projects. *J Eng Manag* 1:056–060
2. Wei L (2006) Research of synergic management for construction projects based on elements. *Huazhong Univ Sci Technol* 14:158–160
3. Pan K, Bai L (2006) Management coordination theory and application. *Economy Manag Publishing House* 12:53–61
4. Yi Y, Liu Y (2003) The coordination mechanism and effect analysis on organizational resources. *Econom Manag* 16:12–16
5. Playle P (2011) Cooperation management an essential enabler for advanced technology development in the US. *SAE World Congr And Exhibition* 1:785–794

# Chapter 2

## Research of Internal Temperature Distribution for Liver Tissues Under Laser Irradiation

Hanzhou Hao, Rugang Zhong, Yongxing Wang, Chenwu Liu and Xuebin Zhong

**Abstract** Exposure to lead causes a number of diseases, including mild mental retardation resulting from loss of IQ points, as well as increased blood pressure, gastrointestinal effects. Several other disease outcomes have been associated with exposure to lead, but evidence is considered insufficient at this time for a quantitative assessment of their impact on health to be made here. Lead, due to its multiplicity of uses (e.g. leaded petrol, lead in paints, ceramics, food cans, make-up, traditional remedies, batteries), is present in air, dust, soil and water to varying degrees. Each of these media can act as a route of human exposure, through ingestion or inhalation and, to a small degree for organic lead compounds, dermal absorption. Human exposure can be assessed directly, through body burden measurements (lead in blood, teeth or bone) or indirectly, by measuring levels of lead in the environment (air, dust, food or water).

**Keywords** Lead • Exposure • Human • Health risk

### 2.1 Lead Hazards to Human Health

Human exposure and effects of lead in humans were reviewed by the International Panel of Chemical Safety in 1995 [1]. According to the review, in humans, lead can result in a wide range of biological effects depending upon the level and

---

H. Hao (✉) · C. Liu · X. Zhong  
Resources and Environment College, Land and Water Resources Research Center of the Middle Reaches of Yangtze River, Hubei University of Science and Technology, Xianning 437100, Hubei, China  
e-mail: haohz110@163.com

R. Zhong  
Resources and Environment College, Hubei University of Science and Technology, Xianning 437100, Hubei, China

Y. Wang  
Xianning City Environmental Protection Bureau, Xianning, China

duration of exposure. Effects at the subcellular level, as well as effects on the overall functioning of the body, have been noted and range from inhibition of enzymes to the production of marked morphological changes and even death in some cases. Such changes occur over a broad range of doses. Due to developmental, neurological, metabolic and behavioural reasons, children are more vulnerable to the effects of lead exposure than adults.

Human exposure to low levels of environmental lead is inevitable, since lead is ubiquitous and one of the most widely dispersed contaminants. Among the population groups, children are the subpopulation of concern for lead exposure. They are exposed to more lead than adults due to their behaviours such as playing on the floor or outdoors, sucking on objects, and hand- to-mouth activity, which is normal developmental activity. The high gastrointestinal absorption of lead of children also causes higher uptake of lead to the system, which may lead to irreversible damage to a susceptible nervous system during its developing stage. Although classical lead poisoning is a rare occurrence worldwide these days, developmental effects in children caused by low level exposure to lead are well acknowledged.

Human exposure and effects of lead in humans were reviewed by the International Panel of Chemical Safety in 1995 [1]. According to the review, in humans, lead can result in a wide range of biological effects depending upon the level and duration of exposure. Effects at the subcellular level, as well as effects on the overall functioning of the body, have been noted and range from inhibition of enzymes to the production of marked morphological changes and even death in some cases. Such changes occur over a broad range of doses. Due to developmental, neurological, metabolic and behavioural reasons, children are more vulnerable to the effects of lead exposure than adults.

Lead is the most studied metal and knowledge about adverse health effects of lead, especially in high concentration, are well known but the effects of low concentration long term exposure are still under study, especially during the last decade.

Lead binds to the sulphhydryl (SH) groups of proteins, but the basic mechanism of the lead toxicity is not yet established. Increasingly more is known about molecular effects of lead. Among other effects lead displaces calcium and zinc inside proteins, has an affinity for cell membrane, interferes with mitochondrial oxidative phosphorylation and impairs activity of calcium dependent intracellular messengers and protein kinases. Lead may inhibit DNA repair and exert genotoxic effects and affects sodium, potassium and calcium ATP-ase. Therefore the toxic effects of lead may involve several organ systems including: nervous system (central and peripheral), cardiovascular, haem biosynthesis, kidney, reproduction, the immune system, alimentary systems, and hepatic system.

Health effects induced by environmental lead exposure (i.e. at lower doses of lead exposure) are associated with effects on nervous system, effects on haem biosynthesis and effects on blood pressure.

Effects on nervous system—Both cross-sectional and prospective study were focused mostly on neuropsychological development in children and they

confirmed that children represent a group being particularly at risk, especially from neurobehavioral effects.

Effects on nervous systems include a constellation of effects like decreases in IQ, poor school performance, problems with impulse control and attention deficits. Meta-analyses of the studies have concluded that doubling Pb-B from 10 to 20 than 10  $\mu\text{g}/\text{dL}$  is associated with an average loss of IQ of 1–3 points. The relationship between IQ and lead exposure is very strongly linked even at low level of lead exposure.

More recent studies of Lanphear et al. [2] showed that cognitive deficits are associated with Pb-B concentration below 5  $\mu\text{g}/\text{dL}$ . Social and emotional dysfunctions and academic performance deficits are correlated with increased lead exposure. Prospective studies support hypothesis that changes are irreversible or at least long lasting up to adulthood. Different investigators focused on different behaviours e.g. tests of fine motor skills, language, memory and learning, attention, and executive functioning, so that no investigation assessed a complete spectrum of neuropsychological functions.

A recent study of Nevin [3] demonstrates that (besides reduction in IQ) widespread exposure to lead is likely to have profound implications for a wide array of undesirable social behaviour. The neurotoxicity of lead is of particular concern, because evidence from prospective longitudinal studies has shown that neurobehavioral effects, such as impaired academic performance and deficits in motor skills, may persist even after Pb-B levels have returned to normal. Although no threshold level for these effects has been established, the available evidence suggests that lead toxicity may occur at B-Pb levels of 10–15  $\mu\text{g}/\text{dL}$  or possibly less [4].

Effects on blood pressure—Effects of lead on blood pressure and kidney are evident at high concentration in occupational settings and animal studies, but less evident in the general population. There are a few studies on general population dealing with effects of lead on blood pressure. Rothenberg et al. (2002) examined effects of blood and bone lead on blood pressure between 1995 and 2001. They found out that in normotensive pregnant women each 10  $\mu\text{g}/\text{dL}$  increase in calcaneus bone lead was associated with a 0.70 mm-Hg increase in third trimester systolic blood pressure and 0.54 mm-Hg increase in diastolic blood pressure. The NHANES III study showed similar results. Effects of lead on blood pressure at higher levels were confirmed by animal studies.

Cancer—The evidence for carcinogenicity of lead and several inorganic lead compounds in humans is inconclusive. Classification of IARC is class 2B: ‘The agent (mixture) is possibly carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans’ [5]. The US Department of Health and Human Services has determined that lead and lead compounds are reasonably anticipated to be human carcinogens based on limited evidence from studies in humans and sufficient evidence from animal studies, and the US EPA has determined that lead is a probable human carcinogen.

## 2.2 Human Exposure

### 2.2.1 *Lead in the Diet*

The daily intakes vary by country, and the sources of lead will vary with the diet. In the EU, fruits and vegetables, cereals and bakery wares and beverages are major sources of lead, together supplying most of the intake [6]. In Japan, the daily intake of lead per person in the year 2004 is estimated at 26.8  $\mu\text{g Pb/person/day}$  [7]. The main contribution came from rice (25 %), other vegetables and seaweeds (20 %), seasonings and beverages (18 %) and fish and shellfish (4 %) [7]. The average dietary lead intake of an adult Finnish person is estimated to be 17  $\mu\text{g Pb/day}$ . The sources of dietary lead intake in the Finnish population are fish and canned fish (23 % of total dietary lead intake), root crops, vegetables, fruits and berries (17 %), grain and grain products (15 %), juices and other drinks (12 %), milk and milk products (11 %), meat and meat products (9 %), alcohol (7 %) and other food sources (6 %).

### 2.2.2 *Ingestion of Soil and Dust*

For infants and young children, lead in dust and soil often constitutes a major exposure pathway and this has been one of the main concerns regarding the exposure of the general population. The intake of lead is influenced by the age and behavioural characteristics of the child and the bioavailability of lead in the source material. Dust (in homes as well as in streets) and soil may contain high lead concentrations and are significant sources of exposure of children. In particular, dust in homes painted with paint containing lead pigment, and soil around lead-emitting industries may contain very high lead levels. The maximum uptake in infants seems to occur around 2 years of age, and is higher in the summer than in the winter. The hand-to-mouth behaviour of children is important for lead intake [2], and even small babies, unable of grasping objects, receive much of their lead exposure from mouthing their own fingers.

### 2.2.3 *Lead Intake via Inhalation of Ambient Air*

Airborne lead may contribute significantly to exposure, depending upon factors such as use of tobacco, occupation, proximity to motorways, lead smelters, etc., and leisure activities (e.g., arts and crafts, firearm target practice). In countries where leaded gasoline is still used, inhalation of emissions is a major lead exposure pathway. In particular proximity to heavily trafficked roads may influence airborne lead exposure.

### 2.2.4 Lead Intake via Drinking Water

With distribution of drinking water, the water may be contaminated with lead from lead pipes, lead-soldered copper-pipes, lead-containing brass-joints for plastic pipes, or from other parts of the water system. In particular, acidic and soft water has the potential for dissolving lead. The level is then dependent upon the time during which the water did dwell in the pipe. The lead content of drinking water may vary considerably. Hence, intakes of about 1  $\mu\text{g}/\text{day}$  or less have been reported from Sweden, whereas a study in Hamburg, Germany, in an area where lead pipes are common in old plumbing systems, showed a large variation in the lead concentration in tap water:  $<5\text{--}330 \mu\text{g}/\text{L}$  [8]. Among the samples a mean of 15  $\mu\text{g}/\text{L}$  was found. High concentrations of lead in tap water are of special concern for bottle-fed babies when formula feeding is prepared from the tap water.

## 2.3 Reference Levels

Provisional tolerable weekly intake—The joint FAO/WHO Expert Committee on Food Additives has established a provisional tolerable weekly intake (PTWI) of 25  $\mu\text{g}/\text{kg}$  body weight (equivalent to 3.5  $\mu\text{g}/\text{kg}$  of body weight per day) [9]. The Committee considered the results of a quantitative risk assessment and concluded that the concentrations of lead found currently in food would have negligible effects on the neurobehavioural development of infants and children. The Committee noted, however, that examples of foods with high levels of lead remain in commerce.

**Acknowledgments** This study was supported by the National Natural Science Foundation of P.R. China (No. 41171256, 41071069), Health Department of Hubei Province of P.R. China (No. JX4B49), Educational Commission of Hubei Province of China (Q20102803).

## References

1. IPCS (1995) Inorganic lead—environmental health criteria 165 international programme on chemical safety. World Health Organ Geneva Switzerland 38:93–99
2. Lanphear B, Dietrich K, Auinger P, Cox C (2000) Cognitive deficits associated with blood lead concentrations  $<10 \mu\text{g}/\text{dL}$  in US children and adolescents. Public Health Rep 115:521–529
3. Nevin R (2000) How lead exposure relates to temporal changes in IQ. Violent crime and unwed pregnancy. Env Res 83:1–22
4. Chioto LM, Jacobson SW, Jacobson JL (2004) Neurodevelopmental effects of postnatal lead exposure at very low levels. Neurotoxicol Teratol 26:369–371
5. IARC (1987) Lead and lead compounds. Organolead compounds. Summ Eval Lyon France 23(4):49–56 (Suppl 7)



6. EU SCOOP (2003) Assessment of the dietary exposure to arsenic, cadmium, lead and mercury of the population of the EU member states. Reports on tasks for scientific cooperation. Report of experts participating in task 3.2.11. Directorate-general health and consumer protection. European Commission, Brussels
7. Japan submission (2005) Review of scientific information on lead. Ministry Environ Gov Japan Tokyo 2:94–103
8. Fertmann R, Hentschell S, Dengler D, Janssen U, Lommel A (2004) Lead exposure by drinking water: an epidemiological study in Hamburg, Germany. *Int J Hyg Environ Health* 207:235–244
9. FAO/WHO (2002) Summary of evaluations performed by the joint FAO/WHO expert committee on food additives. *LEAD Latest Eval 1999 21(4):48–54*

# Chapter 3

## Battlefield Target Selection Based on RBF Neural Network and Evidence Theory

Lixin Wang, Xisheng Jia, Mei Zhao and Wensheng Li

**Abstract** Under the condition of information war, it's necessary to choose target with scientific and reasonable method for its complex artillery battlefield environment. Thus, based on the index system of artillery battlefield target selection, this paper proposed a new approach of using Radial Basis Function (RBF) neural network and evidence theory together for target selection problems. This method integrates expert evaluation data with the evidence theory and identifies whether the target is selected with RBF neural network. The case simulation result proves that RBF neural network is more superior to BP neural network on target selection. This method also provides the artillery commander with a decision-making reference of the target selection.

**Keywords** Target selection • RBF neural network • BP neural network • Evidence theory • Index system

### 3.1 Introduction

With rapid development of information war, artillery battlefield environment becomes much more complicated, so it's unnecessary to beat all targets in the battlefield, and how to correctly select targets according to the enemy targets and our army combat intention will become more important. As far as we all know, there are many approaches for artillery battlefield target selection, such as Model Simulation, Comprehensive Assessment, Analytic Hierarchy Process, and Fuzzy Comprehensive Evaluation, etc. [1]. All methods above are with strong subjectivity and inadequate expert data. So we proposed a new approach of using RBF neural network and evidence theory together in this paper for target selection problems. This method has extensive application prospect due to its characteristics of simple structure, rapid convergence and strong robustness. By integrating expert

---

L. Wang (✉) · X. Jia · M. Zhao · W. Li

Department of Management, Shijiazhuang Mechanical Engineering College, Shijiazhuang, China  
e-mail: 546098465@qq.com

evaluation data with the evidence theory and RBF neural network, it can scientifically and effectively identify artillery battlefield targets.

### 3.2 Index System of Artillery Battlefield Target Selection

There are many factors that influence target selection in complex artillery battlefield environment. Thus, we should choose target based on military requirement and combat capabilities, and put starting point on relationship between target and artillery battlefield system, thereby to realize the goal of destroying enemy warfare system and weakening the enemy resistance and war potentials. According to the principle above, we choose seven indexes to compose the index system of artillery battlefield target selection, including target center of gravity effect  $C_1$ , target chain effect  $C_2$ , consistency of the target and the combat mission  $C_3$ , the degree of target threaten to our army  $C_4$ , combat capabilities of our army  $C_5$ , ratio of expenses and effect for attacking target  $C_6$  and target data reliability  $C_7$ .

### 3.3 Integration of Target Evaluation Data and Evidence Theory

After the index system of artillery battlefield target selection is established, it still requires several experts and commanders to evaluate multiple targets. Then integrate the evaluation data with evidence theory to help choose the target. In this way, the target can be effectively recognized and without having to resort to prior probability.

#### 3.3.1 Evidence Combination Method

Evidence combination is critical to evidence theory, which is often used to abstract the basic probability assignment and belief function ( $Bel$ ) by integrating different evidences. There are several combination methods for evidence theory, so far as we know; the original combination method is Dempster's rule of combination. It can be defined as follows [2]:

Assume that  $Bel_1, Bel_2, \dots, Bel_n$  is the belief function in the same recognized frame,  $m_1, m_2, \dots, m_n$  is the corresponding basic probability assignment, and  $A_i, A_j, A_k, \dots$  is the corresponding focal element. Now let:

$$K = \sum_{A_i \cap A_j \cap A_k \cap \dots = \phi} m_1(A_i)m_2(A_j)m_3(A_k) \cdots < 1 \quad (3.1)$$

Then, the belief function  $Bel$  combined by  $Bel_1, Bel_2, \dots, Bel_n$  can be calculated by the following basic probability assignment function  $m$ :

$$m(A) = \begin{cases} 0 & A = \phi \\ \frac{1}{1-K} \sum_{A_i \cap A_j \cap A_k \cap \dots = A} m_1(A_i)m_2(A_j)m_3(A_k) & A \neq \phi \end{cases} \quad (3.2)$$

In the formula, the basic probability assignment function of  $A$  reflects the credible degree to  $A$  itself,  $K$  represents the degree of conflict between evidences.

Dempster's rule of combination is a rigid AND computing method. This method can focus on the support to the common target and weaken the influence of conflict targets for their multiple focal elements of belief functions in proportion to the basic probability assignment. However, there is something illogical with Dempster's rule of combination in combining multi conflicting evidences. Therefore, reference [3] presented a new combination formula, in which, the evidence's conflicting probability is weighted and distributed according to the average extent of support to every proposition. This new combination formula improves the reliability and rationality of the combination results, even if the highly conflicting evidences, ideal combination results can also be obtained. Consequently, we adopt this combination formula for data integration of the artillery battlefield target. The new combination formula is as follows:

$$m(A) = \begin{cases} 0 & A = \phi \\ \sum_{A_i \cap A_j \cap A_k \cap \dots = A} m_1(A_i)m_2(A_j)m_3(A_k) \dots + Kq(A) & A \neq \phi \end{cases} \quad (3.3)$$

Where,  $K = \sum_{A_i \cap A_j \cap A_k \cap \dots = \phi} m_1(A_i)m_2(A_j)m_3(A_k) \dots$ ,  $q(A) = \frac{1}{n} \sum_{1 \leq i \leq n} m_i(A)$ .

### 3.3.2 Step of Integration of Target Evaluation Data

Supposed that:  $G = \{G_1, G_2, \dots, G_n\}$  represents the set of enemy artillery battlefield targets;  $P = \{P_1, P_2, \dots, P_m\}$  represents the set of artillery battle experts or commanders, and the importance of each expert is same;  $C = \{C_1, C_2, \dots, C_7\}$  represents the set of target option indexes;  $H = \{h^1, h^2, \dots, h^t\}$  represents the set of index evaluation ranks;  $C_{ijkl}$  represents the value of evaluating the index  $C_l$  of target  $G_j$  by expert  $P_i$  according to the evaluation rank  $h_k$ , here, provide  $0 \leq C_{ijk} \leq 1$  ( $i = 1, 2, \dots, m$ ;  $j = 1, 2, \dots, n$ ;  $l = 1, 2, \dots, 7$ ;  $k = 1, 2, \dots, t$ )

The first step: according to the combination Eq. (3.3), combining the information of evaluating the index  $C_l$  of target  $G_j$  by  $m$  experts, thereby to get the probability assignment function  $m_{ijl}(h_k) = c_{ijkl}$ .

The second step: grading different evaluation rank of each index, and then multiplying  $m_{ijl}(h_k)$  by  $H = \{h^1, h^2, \dots, h^t\}$  correspondingly, thus to get the comprehensive evaluation value  $m_{jl}$  of each target.

### 3.4 Target Selection Model Based on RBF Neural Network

According to the target selection index system, we construct a target selection model based on RBF neural network to identify whether the target is selected.

#### 3.4.1 Basic Ideas of RBF Neural Network

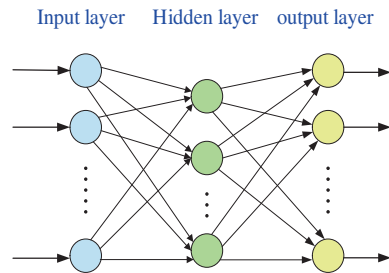
RBF neural network is a kind of feed forward neural network with three layers, including input layer, hidden layer and output layer, see Fig. 3.1. Input layer nodes only transfer the input signal to the hidden layer; there are a variety of activation functions for hidden layer nodes, in this paper we adopt the gauss function which is easy to program for activation function; the activation function of output layer nodes is linear function, thus its output is actually the linear combination of gauss function [4]. These gauss function is often called base function (or nuclear function) that is used to calculate the input vector and Euclidean distance in center.

The basic ideas of RBF neural network is that using the radial basis function as a base of hidden layer, thereby to form a hidden layer space. Then the hidden layer converts the input vector and transforms the input data to another space, which make the linear inseparable problem in original space can be divided in another space. The training process of RBF neural network is actually a process of adjusting layer weights and threshold values.

#### 3.4.2 RBF Neural Network Model

The comprehensive evaluation value  $m_{ji}$  of each target index will be regarded as input data of RBF neural network, thus to form the RBF neural network model, see Fig. 3.2. The number of input layer nodes is 7, respectively corresponding to the comprehensive evaluation value of the target selection index  $C_1 \sim C_7$ ; while the number of hidden layer nodes is uncertain, which is often obtained from the

Fig. 3.1 The structure of RBF neural network



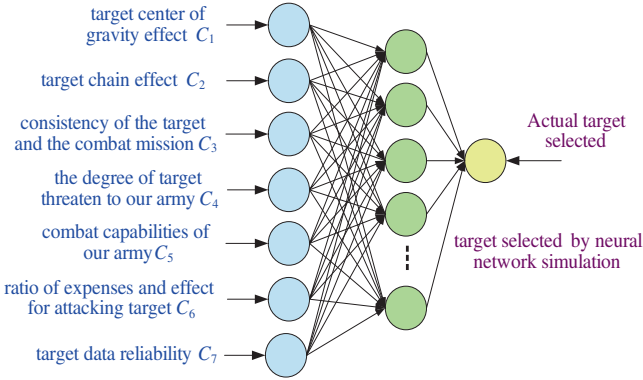


Fig. 3.2 RBF neural network model used for target selection

empirical formula; The number of output layer nodes is 1, in which, if output 0, the target is not selected, if output 1, the target is selected.

### 3.5 Case Validation

Assumed that there are 14 enemy targets to choose in a maneuver, each target has 7 evaluation indexes, each index has four evaluation ranks, that is  $H = \{h_1, h_2, h_3, h_4\} = \{\text{very strong, stronger, strong, little strong}\}$ , and in accord, each evaluation rank has a score of  $\{1, 0.8, 0.6, 0.4\}$ . First, we will invite several experts to evaluate those targets, and then the evaluation data is integrated with evidence theory. According to the two steps of data integration above, the comprehensive evaluation value  $m_{jl}$  ( $j = 1, 2, \dots, 14; l = 1, 2, \dots, 7$ ) of each target can be obtained. See Table 3.1, in which the calculation process is omitted.

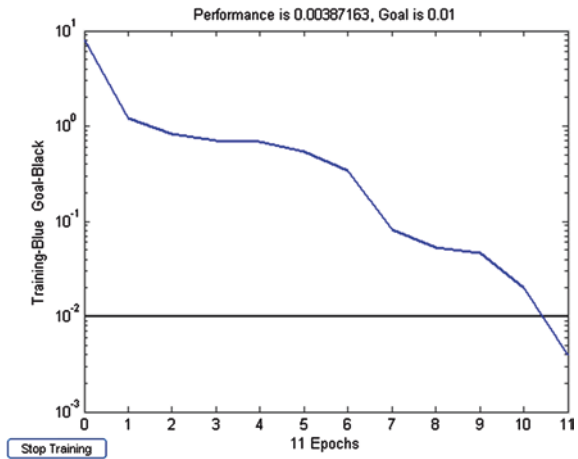
According to the target selection model based on RBF neural network in Fig. 3.3, the comprehensive evaluation values of 14 targets  $G_1 \sim G_{14}$  are regarded as input samples, and the actual options of 14 targets are regarded as output samples. Besides, supposed that the average error of the goal is 0.01 [5], the spread speed of the radial basic function is 5, and the maximum number of the dormant nerve cell is 14.

Then, RBF neural network can start training and studying, see Fig. 3.4; the network capability achieves the error level of 0.01 after 11 trainings. The simulation result of RBF neural network is shown in Table 3.1. We can see that, the simulation output values of actual non optional targets are similarly equal to 0, the error is under 3 %; and the simulation output values of actual optional targets are similarly equal to 1, the error is under 4 %. That means the simulation result is completely in accord with the actual options. The model is proved to be good and effective for artillery battlefield target selection.

**Table 3.1** Test data used for RBF neural network simulation

Optional targets	The comprehensive evaluation value $m_{jl}$ of each target index							Actual target selected	RBF neural network simulation result	BP neural network simulation result
	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_6$	$C_7$			
$G_1$	0.3938	0.3350	0.0853	0.5805	0.7726	0.3559	0.2643	0	-0.0243	0.0406
$G_2$	0.6838	0.9629	0.9061	0.3771	0.3493	0.8961	0.4417	1	0.9993	0.9954
$G_3$	0.0119	0.1315	0.7159	0.2570	0.5100	0.4071	0.2406	0	-0.0038	0.0717
$G_4$	0.7953	0.3812	0.6879	0.3041	0.5656	0.2870	0.3566	1	0.9931	0.9179
$G_5$	0.2589	0.2175	0.4808	0.8406	0.1457	0.0350	0.4018	0	0.0020	0.0878
$G_6$	0.2092	0.4818	0.9261	0.7646	0.4890	0.3966	0.5032	1	0.9965	0.9238
$G_7$	0.7634	0.6747	0.4515	0.1629	0.5124	0.3187	0.3965	1	1.0120	0.9086
$G_8$	0.9315	0.3193	0.9985	0.4526	0.9360	0.4051	0.4626	1	1.0053	0.9407
$G_9$	0.2301	0.1294	0.1298	0.0547	0.0083	0.3611	0.4821	0	-0.0041	0.0248
$G_{10}$	0.5742	0.4627	0.5535	0.2887	0.1234	0.5521	0.6283	1	1.0046	0.8234
$G_{11}$	0.3635	0.3429	0.4338	0.5111	0.1381	0.1622	0.2764	0	0.0034	0.1874
$G_{12}$	0.4727	0.2272	0.4065	0.1509	0.1995	0.6699	0.3073	0	0.0306	0.1693
$G_{13}$	0.7796	0.7231	0.5817	0.2999	0.2026	0.6103	0.4528	1	0.9615	0.9869
$G_{14}$	0.6040	0.9159	0.3622	0.7589	0.6522	0.3922	0.4169	1	1.0238	0.9269

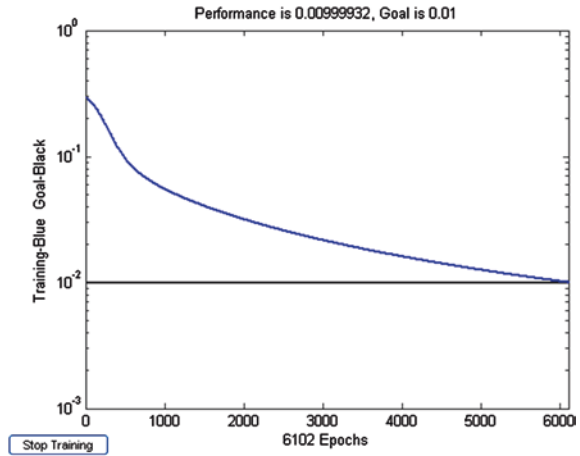
**Fig. 3.3** RBF neural network training result



On the other hand, we can use BP neural network to choose the target in the same case situations. The training result is shown in see Fig. 3.4 the network capability achieves the error level of 0.01 after 6,102 trainings.

If comparing the two simulation results above, we can see that, the simulation result of RBF neural network is better and closer to the actual value than BP neural network. Moreover, the average relative error of RBF neural network is 1.17 %, and the average relative error of BP neural network is 8.27 %. Therefore, RBF neural network is much more fit for artillery battlefield target selection.

**Fig. 3.4** BP neural network training result



### 3.6 Summary

In this paper, we proposed a new approach of atiliary battlefield target selection. This method synthesizes merits of evidence theory and RBF neural network to recognize atiliary battlefield target. First, the targets are evaluated by several experts, and the expert evaluation data will be integrated with evidence theory, then 14 groups of data samples will be extracted from the integrated expert data and put into RBF neural network for training and testing, finally output the simulation result. In this way, target recognition becomes more simple and easily owing to its much more rapid calculation speed and powerful non-linear mapping ability. If we increase samples of expert evaluation data, the precision of simulation result can be greatly improved.

### References

1. Xinsheng D (1993) Evidence theory and decision-making based on artificial intelligence. Renmin Univ China Press 28(15):111–114
2. Hu X, Ying F (2003) Research on united-fire combat theory. Natl Defense Univ 21(18):141–146
3. Li B, Wang B, Wei J (2002) An efficient combination rule of evidence theory. J Data Acquisition Process 17(20):34–36
4. Shiyi Shen (1998) Application of Neural Network Theory. Science 145(157):11–14
5. Shuxian Zhu, Renjie Zhang (2007) Comparison with BP and RBF neural network used in face recognition. Chin J Sci Instrum 56(44):375–379



# Chapter 4

## Data Synchronization of Earthquake Precursor System Based on Log Optimization Algorithm

Qingjie Liu, Wang Chen and XiaoYing Wang

**Abstract** In based on user-defined operation database synchronization log's earthquake precursor network observation system, stations and regional centers database's operation log table exists the same data multiple update, delete records, because of data pre-processing and data re-collection. The same data with multiple log operations affect the efficiency of the precursor data exchange. For this problem, we propose an optimization algorithm for the operation log, by calculating and merging record in the operation log table and leaving the last operation log of data records, we can greatly reduce the network traffic and improve the efficiency of database synchronization.

**Keywords** Data exchange • Operation log • Log optimization • Data transaction isolation

### 4.1 Introduction

In the earthquake precursor network observation system now running, the data synchronization between the databases relies on the Oracle original database synchronization mechanism and Oracle's DB-link plus trigger [1, 2]. Due to the complexity of the paths of data exchange, the huge amount of data sources, and the intricacies of data source types, together with the station registration and cancellation mechanism, trigger deadlocks caused by inconsistencies of data often happen, and account for obstructions of the DB-link [3], so that the data exchange fails. In the latest precursor data management system based on N-tier architecture,

---

Q. Liu (✉) · X. Wang

Department of Disaster Information Engineering, Institute of Disaster Prevention Science and Technology, San He, Hebei Province,  
e-mail: tolqj@sohu.com

W. Chen

Institute of Geophysics, China Earthquake Administration, Beijing, China  
e-mail: 578043315@qq.com

we use a new data exchange strategy—the data exchange strategy which is based on user-defined operation database log, and whose whole process is in control [4, 5]. This log data based on user operation synchronization has been widely used, traditional log just saves the update action and related data in chronological order, but this log stores the data which is updated involved globally unique primary key [6, 7]. As precursor data may have the business need of same data multiple pre-treatments, and multiple update actions on the same record for the higher level data, only the last update is effective. So we use the log compression by computing and merging the logs, retaining only data exchange log information and related logs, thereby we can reduce network data traffic and improve the efficiency of data exchange. We know this way will popularize.

## 4.2 Data Exchange and Data Operation Log

### 4.2.1 Path of Data Synchronization

In the earthquake precursor network observation systems based on distribution, the synchronization between the databases is a core technology of the observation system. In earthquake precursor observation system, the data is synchronized from the non-node station database to the node station database, from the node station databases synchronization to the regional databases, from the regional central databases to the national central database, and then distributed to the academic databases from the national central database. In academic central database, it formed the packaged data and backflow to the national central database. The Fig. 4.1 shows part of paths of synchronization data flow in precursor network observation systems.

From the figure, we can know, the earthquake precursor network observation system is a typical two-way synchronization database system.

### 4.2.2 Time of Data Synchronization

The database Synchronization is divided into real-time data synchronization and asynchronous data synchronization based on synchronization time. Real-time data synchronization is a technology which means once data source is updated; in real time date is synchronized to the target database. Real-time data synchronization can ensure real-time data consistency between the data source and data destination, and protect the integrity of the applications in a distributed environment, reduce the technical difficulty of the development, and decrease the complexity of the application. When the data source data is updated, real-time data synchronization will instantly capture the change data, and updates the changes broadly to the

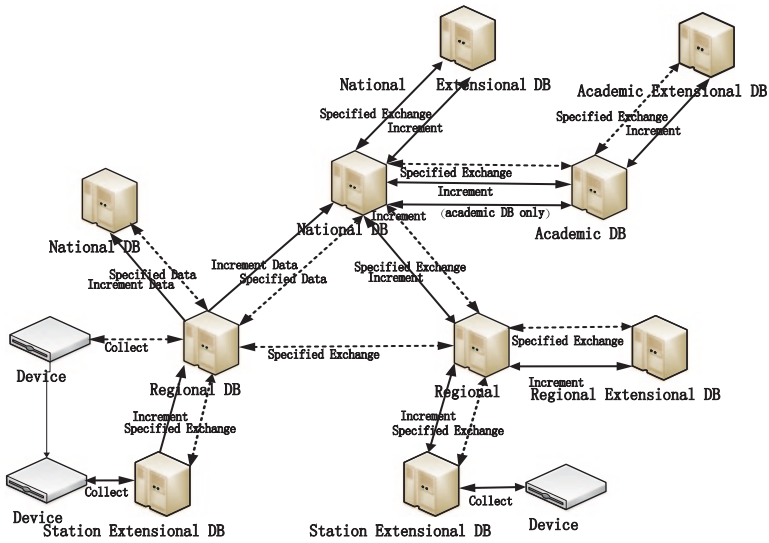


Fig. 4.1 Path of synchronization in precursor network observation systems

data destination. Because of high real-time requirements, real-time data synchronization technology should be used when the data update frequency is low, the data change is little, and the data synchronization in the high-bandwidth, highly reliable LAN or private network environment.

Asynchronous data synchronization is data database synchronization technology which is a delay distribution of data update and data access. It possesses high reliability and flexibility with on-demand synchronization, but it is complex when compared to real-time data synchronization technology. With asynchronous data synchronization, incremental data log stored in the synchronization source database, users can be flexible to run data synchronization according to network conditions, data priority, path, user needs and other conditions.

Earthquake precursor network observation system is a large-scale distributed application system with low bandwidth, high data throughput, multi-path, its synchronous content changes frequently and its nodes lie across the whole country. So the using asynchronous data synchronization technology meets the needs of earthquake precursor observation and actual network conditions better.

### 4.2.3 The Application of Log Optimization for Database System

Database operation log data synchronization among the distributed databases is broadly used in the major mainstream database products: customized copy from

Sybase, the DB2 data connection bridge, DBLink snapshot refresh by Oracle, replication/subscribe services in Microsoft SQL Server. These technologies all get incremental data by capturing the incremental logs, and then synchronize the two terminals or multi-terminal, one-way or two-way data synchronization. Widely used in major mainstream databases, database synchronization based on the log has become a database synchronization standard technique, and the key technology about reliability, flexibility, scalability of relation data synchronization.

Data synchronization efficiency plays a key role on the availability of a variety of application systems. The factors of the database synchronization efficiency are various: network bandwidth and degree of obstruction, the data update frequency, the size of data. Routine databases logs based on the database manufacturers are mainly developed for transaction security, and save the various versions of the data related to each change data. However, in asynchronous data synchronization mode, when a record of the source database has been frequently modified, logs will record each change and produce a lot of log entries, and then database logs spread to the destination databases. That leads to the same record being repeatedly modified, while only the last modification is valid, resulting in waste of resources. As only the last data update log is valid, so if we can optimize the database log, we will reduce the data synchronization data, reduce network bandwidth load, reduce unnecessary data update, thereby enhancing the efficiency of data synchronization.

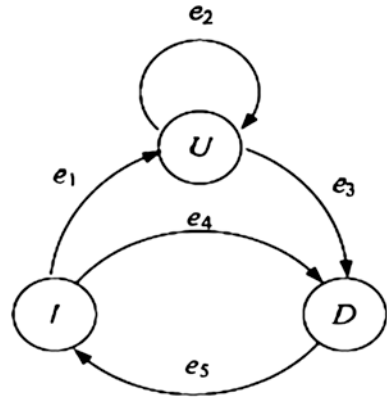
In the earthquake precursor network observation system, database synchronization is characterized by vast paths of demand, frequent synchronization content adjustment, general network conditions, synchronization frequent registration and cancellation in source and destination, unidirectional and bidirectional synchronization coexist, point-to-point synchronization and point-to-multipoint synchronization coexist, partially synchronization and intact synchronization coexist. But the log user interface provided by the database vendor is a black box, we can't operate log accurately to meet application demands. So practically we use user-defined operation database synchronization log to capture the data changes, use user-defined log interface and data operation interface to achieve the high flexibility, scalability, reliability of data synchronization program. This kind of user-defined database operations log is also known as virtual logs or simulated logs.

## **4.3 Log Optimization Algorithm and Steps**

### ***4.3.1 Database Log***

User-defined operation log is the basic of precursor data exchange, it is a collection of incremental data update activities record in the entire database. Any update

**Fig. 4.2** Operation log state diagram



operation for any exchange of data (such as the insert, update, delete) will log the primary key, table name, action, the number of stations, measuring point number and other information of the corresponding data into the virtual log table.

We define an access component of the unified access platform subsystem in earthquake precursor network observation system to achieve the interceptor function. Checking the synchronization flag of the data access interface, database operation logs can be saved to the virtual log table. We define modification sequence of the record with primary key id which is in table P from data operation log table as Sequence (T, v). With the compression of Sequence (T, v), we can effectively reduce the data transmission amount in data synchronization process.

Tv is defined as the record of the modification of v in table T. Only the insert, update, delete actions are possible changes to TV, so we have a State diagram to show all the states and processes in Fig. 4.2.

Among them, the nodes mean all possible modification operations to TV (the insert, update, delete), vectors with ‘e’ head mean all possible transitions. The vector e4 stand for that TV data is deleted; the vector e2 stand for that TV has experienced several updates. We define set M {m} to express state transitions collection in the Fig. 4.2 recorded.

$$\begin{aligned}
 M \{m\} = & \{ \{I \rightarrow D\}, \\
 & \{I \rightarrow U \dots U\}, \\
 & \{I \rightarrow U \dots U \rightarrow D\}, \\
 & \{D \rightarrow I \rightarrow U \dots U\}, \\
 & \{U \dots U\}, \\
 & \{U \dots U \rightarrow D\}, \\
 & \{U \dots U \rightarrow D \rightarrow I\} \\
 & \}
 \end{aligned}$$

‘...’ means N times data operation to TV; m is a set of possible modifications to record tv. So, regardless of what state is the Sequence (T, v) can be hashed a set with N ms in it.

### 4.3.2 Principles of Optimization

Assigning insert, delete, update three operating node that  $I = 1$ ,  $U = 0$ ,  $D = -1$ , we define Value (m) as the sum of the node value in a path. So, here come the following conclusions:

Value (m) = 1, before m operation occurs, TV does not exist in the data table, the log is added to the data table in the process of m operations.

Value (m) = -1, before m action occurs, the data table TV, the log is deleted in the process of m operation.

Value (m) = 0, although we can't determine if tv exists in the data table, but we are able to confirm if before m occurs the tv exists in the table, then after m occurs, the data still exists.

Sequence (T, k) is a sequence of N ms, so the above conclusion is the same with the sequence set Sequence (T, v).

### 4.3.3 Log Optimization Algorithm

When Update operations need to be done, database operations log should run first. And for each Sequence (T, v), we compute Value (Sequence (T, k)) to run strategies.

Value (Sequence (T, k)) = 1, first retrieve the operation log table to tell whether there is a log containing this record. If the result is true, then we retain the last operation log, write nothing, otherwise, we will add an insert record of the corresponding record to log.

Value (Sequence (T, k)) = -1, first retrieve the operation log table to tell whether there is a log containing this record. If the result is true, then we retain the last operation log, write nothing, otherwise, we will add a delete record of the corresponding record to log.

Value (Sequence (T, k)) = 0, first retrieve the operation log table to tell whether there is a log containing this record. If the result is true, then we retain the last operation log, write nothing, otherwise, we will add an update record of the corresponding record to log.

By the virtual optimization log, in the system that needs to be updated frequently, we are able to reduced amount of data transmission obviously during the data synchronization network. Virtual log table only stores table name, keyword, and method of operation of the update data, does not record the specific operation records. Comparing to traditional database log, its storage space can be neglected. Based on the above log optimization method, we can merge multiple tv operations through the calculation of the Value (Sequence (T, k)), and only run the last work to avoid waste of resources, and increase the data synchronization efficiency.

**Table 4.1** Data exchange operation log structure

Field name	Definition	Data type
RecordIndex	Record index	Number (38)
TableName	Table name	Varchar2 (50)
Operation	Operation	Varchar2 (20)
UUID	Universal unique id	Varchar2 (255)
StationID	StationID	Varchar2 (5)
PointID	PointID of device	Varchar (1)

## 4.4 Realization of Log Optimization Algorithm in the Earthquake Precursor Observation System

### 4.4.1 Operation Log Design

In the earthquake precursor observation system, we have to synchronize data from and to appointed devices. Because data operation log need the field of appointed devices, we should pick up the operation log of appointed devices from virtual operation log during the incremental data synchronization process. According to this requirement, the precursor data exchange needs an operation log table with structure as shown in Table 4.1.

### 4.4.2 Pseudo Code of Log Optimization Algorithm

Optimization pseudo code of Insert action

```

Read all trace and parameter initialization
  Loop from begin currentLogId-maxId
    find current Data's pk
    if find identical log
      keep the current log
    endif
    else
      insert current Data's log insert action
    end else
  end loop

```

Optimization pseudo code of Update action

```

Read all trace and parameter initialization
  Loop from begin currentLogId-maxId
    find current Data's pk
    if find identical log
      keep the current log
    endif
    else

```

```

insert current Data's log update action
end else
end loop
Optimization pseudo code of Delete action
Read all trace and parameter initialization
Loop from begin currentLogId-maxId
  find current Data's pk
  if find identical log
    keep the current log
  endif
else
  insert current Data's log delete action
end else
end loop
    
```

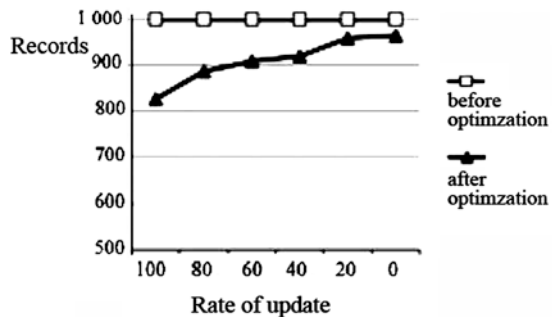
### 4.4.3 Test Environment and Results

With entity objects of data unified access platform, we simulated 100 duplicate data collection, 1,000 repeatedly processing the data, and random implementation of the operation to insert, delete, or update operation every 30 ms among the 10,000 lines of precursory observation data and record the operation log. To ensure the number of data in the test library will not change much, we prepared same amount of insert, update, and delete virtual log records. As shown in Table 4.2, we got the average results from the tests.

**Table 4.2** Test data

Insert	Delete	Update	Before optimizing	After optimizing
0	0	1,000	10,000	8,432
100	100	800	10,000	8,873
200	200	600	10,000	9,124
300	300	400	10,000	9,256
400	400	200	10,000	9,421
500	500	0	10,000	9,886

**Fig. 4.3** log optimization results and the rate of update





From the test results we can see that with the frequency of update increases, the log optimization results are also improved, when the all 1,000 pretreatment entries ready to be updated are update actions, the log can be optimized to about 85 % of the raw log. Even update take the proportion of 0 %, it is still compressible to 98.4 %. This is mainly because the optimized log throw out part of log due to data reacquisition. Figure 4.3 shows the relationship between update operations and log optimization. It can be seen in the data exchange, the optimization of the log can reduce the number of log records that need to be transmitted, to improve data synchronization efficiency.

## 4.5 Conclusion

In this paper we designed and implemented a data synchronization program in the earthquake precursor system, which is based on log optimization algorithm, to improve the efficiency of precursor data exchange. This program particularly suit the high-distributed database network environment with low network speed, frequent update business requirements exist on the same record in lower-level database, and the high requirements of data consistency. Higher requirements of data consistency as in financial, telecommunications applications, you can also use this optimization algorithm by modifying virtual database operation log structure or setting the transaction isolation. This log optimization algorithm, as we see in this paper, has generality, and promotional value.

**Acknowledgments** Teachers' Fund for Scientific Research Fund of the China Earthquake Administration (20110115) And Earthquake, Research special (201008002).

## References

1. Lin Y, Kemme B (2005) Middleware based data replication providing snapshot isolation. In: SIGMOD '05 Proceedings of the 2005 ACM SIGMOD international conference on management of data, vol 1, pp 144–148
2. Zhi NY, Shan W (2007) Virtual log-based data replication solutions. *Comput Sci* 34(3):78–82
3. Jin SH, Zhao JC (2009) Data synchronization in distributed heterogeneous database system. *Yunnan Univ* 35(5):68–72
4. Zhang H, Dong XS, WeiGuo W (2006) Optimized data synchronization mechanism based on the log merges. *Mini-Comput Syst* 27(12):2183–2188
5. Zhen Z (2002) Research and implementation of heterogeneous database synchronization system, vol 1, pp 134–137
6. Philip A, Bernstein NG (1981) Concurrency control in distributed database systems. *ACM Comput Surv* 13(2):81–83
7. Garcia-Molina H, Wiederhold G (1982) Read-only transactions in a distributed database. *ACM Trans Database Syst* 7(2):19–22

# Chapter 5

## Research on Green Supply Chain Operation

Yongming Liang and Yao Xiao

**Abstract** The green supply chain management implementation including purchasing raw materials, product design, product manufacturing and product distribution, product circulation, user consumption and recycling, etc., the participants including suppliers, manufacturers, distributors and retailers, users and logistics business. The green supply chain management is still exist many obstacles, green supply chain management from design, procurement, production, marketing, consumption for the corresponding management.

**Keywords** Green • Supply chain • Logistics

### 5.1 Introduction

At present, the world economy has entered a rapid development stage, between each industry depends on more closely, the enterprise circulation become the key to the development of the enterprise [1, 2]. The development of the industry for the society created a lot of wealth, to the life of people to a great convenience, also USES of a lot of energy, made a lot of junk, causing havoc of the environment. How can ability in the development of economy at the same time reduce the damage to the environment, and with the minimum of pay to maximize the return to be the theme of the study?

### 5.2 The Connotation of Green Supply Chain

The so-called green supply chain is compared with the traditional sense of the supply chain, the traditional supply chain is a raw materials by access, and transformed into finished and semi-finished products, and products will be sent to

---

Y. Liang (✉) · Y. Xiao  
Shanghai Ocean University of Economics and Management, Shanghai, China  
e-mail: 820079538@3qq.com

customer the hands of the facilities and network of distribution channels. He has no consideration of sustainable development and health development [3, 4]. We put forward the green supply chain is to optimize and improve the reasonable allocation of resources, improve and realization and the environment are compatible, the raw material supply, manufacturing process, product sales, consumer use components, realize products from development to raw material supply, processing and packaging, storage, transportation, sale and use and disposal, recycling and so on a series of activities of the set.

The management of the supply chain with the enterprise of the nature of the different and different, because of the enterprise in complexity and different, but the supply chain is inevitable existence, how to carry out the effective management of supply chain, for an enterprise's sustainable development, for the sustainable development of the enterprise [5]. Enterprise implementation of green supply chain management is a complicated process, implementation including material purchasing, product design, product manufacturing and product distribution, product circulation, user consumption and recycling, etc., the participants including suppliers, manufacturers, distributors and retailers, users and logistics business. With the enterprise different types, supply chain management is also different emphases, involving the scope of different, but are to understand the management of the supply chain is the focal point in value-added, make product production, circulation every link of the elements involved to optimize and control, so as to achieve the best combination state, maximum effect, produce the maximum benefit.

### ***5.2.1 The Green Supply Chain Management Connotation Includes the Following Aspects***

The green supply chain management, should cover the whole life cycle

Products from the raw material processing to get circulation, can cause to the environment pollution, therefore, must carry on green supply management, its scope includes the whole life cycle. This is the green supply chain management scope; it is the responsibility of every enterprise.

### ***5.2.2 The Green Supply Chain Management is the Process of the Sustainable Development of Enterprise***

The sustainable development of the enterprises and sustainable development is not based on environmental damage based on any responsible enterprise must social responsibility. The traditional supply chain management is a single economic goals for enterprise, realize a subject economic benefit; And green supply chain management in the pursuit of the main body of the economic benefit outside, still should

pursue the coordinated development of the energy and environment, to make the economy development sustainable and bear must social responsibility. From long term goal said, pursuing economic benefits and pursue the harmonious development of nature is not incompatible, is consistent aim, only consider long ago, considering the future generations to realize the sustainable development of the enterprise.

### ***5.2.3 The Green Supply Chain Management Needs to the Public, the Government, the Enterprise Common Participation***

Products from design to recovery, among all the sections of the including raw materials procurement, design processing, product circulation, consumption, waste recycling, for every man, so we all have a duty have a responsibility, should act, practice green management, reduce the pollution of the environment. The upstream and downstream enterprise to enterprise participation, prepare a sustainable development of green supply management standards, save energy and increase recycling utilization degree, the realization enterprise sustainable development. In addition, as the government should play an important role in the management of the supply chain, the cross-regional and three-dimensional characteristics, the government should fulfill the coordination and regulate the responsibility, make corresponding legal constraints and policy support.

## **5.3 The Green Supply Chain Management at Present Difficulties**

### ***5.3.1 Public Environmental Protection Consciousness Weak***

Our country is still in the rapid economic development, after its enterprise interests of the partial enlargement is one-sided, the public is not strong environmental protection consciousness, the economic level and relevant. Some enterprise is at the shadow and loses the substance, crisis consciousness, sometimes only the government or the environmental protection department under the pressure and take environmental protection measures, sometimes even just to cope with a check. Lead to treatment after pollution and pollution vicious circle, and thus cannot achieve the entire product green process.

### ***5.3.2 Enterprise Management Lag***

The green supply chain management mode of the management of enterprise depends on the degree, so also along with the enterprise management and varies. So there is no the destiny of the experience, the enterprise needs to according to

the circumstance of oneself, embarks from the reality, in order to solve practical problems as a breakthrough, enterprise income as the goal, and the green supply management, reduce the production process of the waste of resources, to save energy and reduce the pollution of the environment, ensure enterprise and faster and better development.

### ***5.3.3 Technical Barriers Influence the Implementation of the Green Supply Chain***

Our country enterprise in technology especially green technology and environmental management knowledge in experience, there is even the very big disparity. So in the green supply chain management was caused when the rising costs, lead to enterprise profit is reduced, and most companies and the cost on to their downstream enterprise, this has caused the whole line have implementation of green supply chain power, even if want to implement also the meeting is weak.

#### **5.3.3.1 Social on “Green Products” Level of Acceptance**

Now the “green products” or a “luxury”, the price is expensive, the number of rare, it is difficult to common people’s home. Therefore, the economic level of backward and the effect of mass consumption habits, and the public on “green products,” the cognitive and accept need a process.

## **5.4 The Green Supply Chain Management**

The green supply chain management as shown in Fig. 5.1.

### ***5.4.1 Green Design***

Green design is the core of green supply management. Green design from the sustainable development at the height of the design of the product function, request the design of the product should be based on the conservation of resources, reduce the cost principle, the optimization of each section of design parameters, and realize the maximization of the product function. Through the green design, the product should be safe, manufacturing product conform to standardization, modular, the product has removable use properties and quality standards. The ultimate goal is to achieve the best of the ecological and economic benefits.

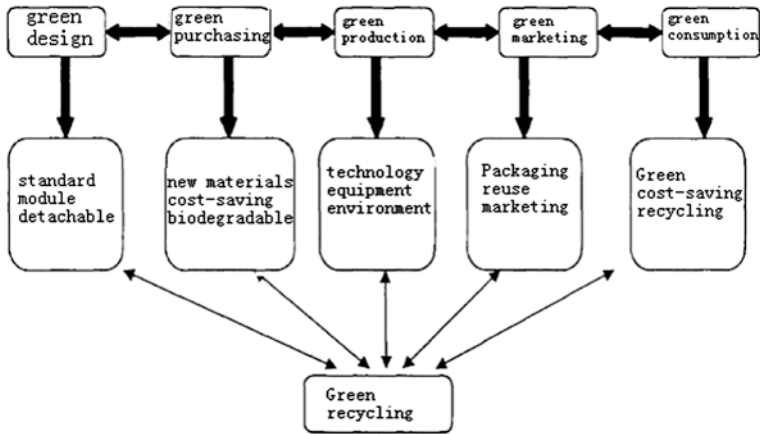


Fig. 5.1 The green supply chain management

### 5.4.2 Green Purchasing

As a product of the initial link, procurement is the foundation of the product manufacture, directly influence the quality of the products and the cost. Purchase the materials themselves should have advanced, quality, production low energy consumption of materials, the material is the use of reasonable, save, recycling and meet the requirements of modern engineering, etc. Requirements of products purchasing to do quality, cost optimization, also require vendors to shortcut, instant, this needs the purchase side and suppliers to establish the green environmental protection standards of behaviour, form, the supply of saving green management system.

### 5.4.3 Green Production

Green save production technology is the key of green supply, production process needs to consume large amounts of energy, the production process of the waste, toxic harmful waste water, waste gas and solid waste in the green production can sell at a discount greatly, noise and vibration and so on also will produce cause pollution, therefore, the use of advanced production technology to reduce production process of pollution, the implementation of the green production. The green production enterprise shall be required with the development of economy and the progress of science and technology, put forward in time to update goals, the requirements in the enterprise management of environmental protection, reflect everywhere consider green, actively participate in the community environment clean and tidy activity, to the staff and the public to green propaganda, set up the green enterprise image.

#### ***5.4.4 Green Marketing***

Green marketing requirements in their business enterprise analysis enterprise characteristic and status, and on the basis of collecting and green technology, green market information, reasonable price for green, and guide consumers green consumption, the right to display the target market and green enterprise image. To enhance the consumer products of the enterprise's popularity and satisfaction and loyalty and in the consumers' mind set up the business enterprise green image.

#### ***5.4.5 Green Consumption***

Green consumption is green supply the continuation of strong vitality, also is vital to the survival of enterprises, to promote and push green consumption and get recognition is a powerful weapon to win the market, the enterprise should from product design to pay attention to environmental protection, provide support for green consumption, such as design of the green packaging, recyclable packaging. Make consumers with the minimum cost the most environmental protection for maximum service, thus enterprise also is met with the lowest cost, and obtain the highest return value.

In short, the green supply chain with the development of economy, people strengthening of environmental protection consciousness, will be more and more be taken seriously, green supply chain mode will continue to develop and progress, research of green supply chain operation to enterprise development, benefit to the public welfare, we have to take the practice green supply chain management to become their own conscious effort to get the biggest economic benefits and social benefits, environmental benefits.

### **References**

1. Zhu Q, Sarkis J (2004) Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *J Oper manage* 22:112–115
2. Christensen L (2002) The environment and its impact on the supply chain. *Int J Retail Distrib Manage* 1:156–159 (Bradford)
3. van Hoek RI (2002) Case studies of greening the automotive supply chain through technology and operations. *Int J Technol Manage* 2:144–148 (Geneva)
4. McIntyre K, Smith HA, Henham A, Pretlove J (1998) Logistics performance measurement and greening supply chains diverging mindsets 20. *Int J Logistics Manage* 1:167–171
5. Lamming R, Hampson J (1996) The environment as a supply chain management issue. *Br J Manage* 5:123–129 (Chichester)

# Chapter 6

## CBI-Based Assisted Internet ESP Teaching Mode

Xiaohua Zhu

**Abstract** CBI teaching based on network assisted condition emphasizes the integration between language teaching and learning and the subject content learning, which has important significance for the English for specific purposes (ESP) teaching. This article has firstly analyzed the present state of ESP teaching of universities in China, and introduces the concept of CBI teaching into ESP teaching based on the need of ESP courses teaching, then puts forward the contents for CBI-based net-assisted ESP teaching mode and its requirements for teaching and learning in order to provide reference to ESP teaching in colleges and universities.

**Keywords** CBI • ESP • Assisted internet teaching mode

### 6.1 Present Situational Analysis for ESP Courses

#### 6.1.1 *Unscientific Curriculum*

Although domestic colleges and universities arrange ESP courses as Compulsory courses, most schools put them in the third year or fourth year. Many students could not go to the class because of work or looking for work or other reasons. At the same time, these courses are generally less with shorter than 2 semesters and 1 h weekly [1].

#### 6.1.2 *Weaker Teacher Team*

Teachers for specialized courses always undertake the task of teaching ESP courses at colleges and universities in China. In spite of their rich specialized

---

X. Zhu (✉)

Tourism Department of Chongqing Education College, Chongqing, China  
e-mail: zhuxh77@163.com



knowledge, their English language listening and speaking ability is limited or on the lower level. And they always use translation teaching method to finish their teaching [2]. Some of universities hire teachers with excellent English comprehensive ability for foreign language college take on ESP teaching task. Although these teachers have strong language skills, insufficient professional knowledge result in that the teachers have to finish their teaching according to the books [3].

### ***6.1.3 Single Teaching Mode***

Most of colleges and universities use single teaching mode for classroom teaching and students' study for ESP have to be limited. Teachers are the main parts for class teaching time as arranger, leader, teacher, and evaluators and use explanation as the main and only way to teach [4]. Students' learning interesting is low due to lack of the chances of taking part in classroom activities.

### ***6.1.4 Teaching Material Lagged Behind***

ESP teaching materials are classified into two kinds including theoretical explanation and practical training. Although all teaching materials cover each fields of the subject, the specialized knowledge fall behind. At the same time, teaching materials do not reflect professional preferences without integration between theorized explanation and practical training, causing to waste time for selecting suitable teaching materials [5].

## **6.2 CBI Teaching Concepts into ESP Teaching**

### ***6.2.1 CBI Teaching Idea***

Content based instruction (referred to as CBI), refers to that teachers arrange the teaching content according to learners' needs for one subject knowledge, rather than teaching based on the language knowledge listed on the syllabus. The CBI came from immersion program Montreal Canadian in 1960s. It carried on the teaching about mathematics, history by using the target language to improve their language abilities. This way was used to put learners into language environments with discipline teaching activities to learn the target language. Experimental results prove that the implementation of CBI into teaching has better effect than the teaching with the traditional teaching ways such as by using language to teach language.

## ***6.2.2 Theoretical Basis for CBI***

### **6.2.2.1 Dornyei Foreign Language Learning Motivation Theory**

Hungarian scholar Dornyei presents a comprehensive learning motivation theory in 1990s on based on previous studies. The theoretical framework classifies the language learners' motivation into three dimensions: language, learner and learning environment. Dornyei leaning motivation theory shows that foreign language learning motivation is not only related with learning subject and with learning object and with the related learning situation.

### **6.2.2.2 Constructivist Learning Theory**

Learning is the Process of Learners' Actively Constructing Internal Mental Representation

The process of learning is not the transferring for knowledge from teachers to learners, but the process of self construction for knowledge based on the acquired information and their own background knowledge and experience.

The Learning Process is a Double-way Construction Process

Constructivism believes that the process of constructing includes the meaning construction for new information by using the original experience beyond the information provided and contains the reform and reorganization for the original experience.

Learning Has Social Feature

Constructive learning theory thinks that people with different cultural background and social experiences need inter communication and collaboration to form the construction for knowledge and meanings.

Learning Needs Situation

Constructivism believes that learning occurs in authentic learning tasks. Simulated learning task could stimulate learners' initiative to learning interesting and the objective activity is the source of constructing knowledge.

## ***6.2.3 Basic Requirement for CBI into ESP Teaching***

It is feasible to put CBI teaching concept into ESP teaching because the object for ESP courses in colleges and universities are learners in higher grades, who have strong professional knowledge foundation and comprehensive English language ability. At the same time, higher requirement are put forward to satisfy the learners' needs for professional trainings and practices.

### **6.2.3.1 Rich Corpus of Teaching Content**

Student activities mainly focus on the understood and meaningful information as well as the tasks based professional working posts by using the target language with exact learning purpose.

### **6.2.3.2 Interdisciplinary Teaching Team**

Teachers ESP courses should not only have excellent English language skills, but also have comprehensive understanding about the subject knowledge and the required abilities for undertaking the works for special professional posts related with the learners' specialties. At the same time, skills for organizing classroom teaching are also necessary.

### **6.2.3.3 Flexible Teaching Mode**

Especially, ESP teaching mode should show learners' main position and teachers' leading role during the process of teaching.

## **6.3 Research About Assisted Internet ESP Teaching Mode Based on CBI**

### ***6.3.1 Interactive ESP Classroom Teaching Model Based on CBI***

#### **6.3.1.1 Multimedia Assisted Interactive Teaching Model**

Compared with the traditional interactive teaching mode, multimedia interactive teaching mode emphasizes the multimedia platform for promoting interactions between teacher and learners. The model is constructed as follows:

Teachers use multimedia to present teaching main points and problems discussed in future;

Teachers guide students to participate in demonstrations and give presentations;

Learners state conclusion and put forward to their views;

Teachers sum up and put forward some suggestions based on learners' presentations.

#### **6.3.1.2 Application of Multimedia Assisted Interactive ESP Teaching Mode**

The author states the application of multimedia assisted interactive ESP teaching mode into the course of *Tourism English*, which has been taught by me for many years.

Teaches Present the Teaching Contents in Multimedia Based on Requirements Given by Special Industry to the ESP Courses

The aim of Tourism English course is to train tour guide concerning foreign affairs with qualified skills. And the teaching contents are divided into several parts based on the guiding working steps. Working places are the dividing points for the main modules which are places of airport, on the bus, hotel and scenic spots.

Teacher presents the Fig. 6.1 on the screen of computer. It is convenient and effective for the learners to understand the teaching aim and teaching contents. And learners could quickly know the teaching main parts based on the arranged credit hours for each main modules and sub-modules.

Teachers use practical classroom activities such as questions, group discussion and role-play to link the teaching contents

Tourism English is an interdisciplinary course combined professional knowledge and English language skills. Most of learners have master knowledge related Guide Business during the process learning. Teacher use the way of asking questions to inspire students to take part in the practical classroom activities. At the same time, group discussion could help students to set up good learning situations to provide a sound foundation for finishing the role-play tasks. Meanwhile, because some of learners lack the ability of transferring specialized knowledge into English language, teacher show the key words on the screen or broadcast a short film with lots of key words and sentences structures by using big screen or video while asking questions and arranging the group discussion in order to provide enough effective information input to ensure that learners.

The Main Modules Are the Cohesion for Each Unit and the Sub Modules Are the Base for Practical Training.

Although most materials for *Tourism English* are arranged based on the working process, the contents for them are messy. The main reasons for that is that the authors do not clearly show the different tasks in the same working places, which increase learners' learning load. Based on practical teaching for many

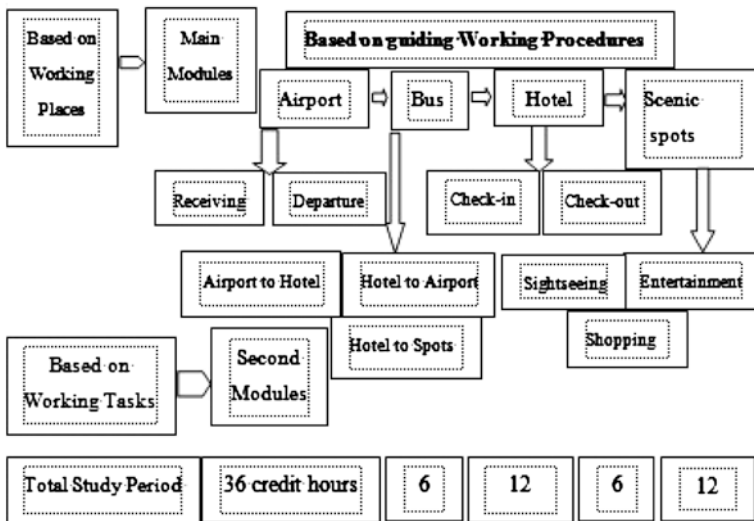


Fig. 6.1 Curriculum

years, the author concludes that the teacher could receive good teaching results by presenting the main modules and sub-modules. Specifically, the teaching contents are divided into four main modules including airport, coach, hotel and scenic spots based on the main guiding working places. Teacher should present the different tasks at the same guiding working places by using multimedia. At the same time, Comparison and contrast both similar and different points. Sub-modules are the base for practical training. Different tasks at the same guiding working places may be presented in different units, learners' presentation for procedure of guiding could help them clearly master the working details, especially, these working could help students know the belongings for each working tasks and lay a solid foundation for the practical training of whole guiding working procedures.

Vig Laboratory Simulates Practice, Supplementary Multimedia Teaching Corpus

Learners' practical training could carry on in the language lab or Vig training room. Multi functional training rooms provide learners with facilities with sound recording, video recording and playback. These assisted multimedia practical trainings stimulate learners to participate in classroom teaching activities, and most importantly, learners could clearly know the mistakes made by themselves or their team members during their simulated practical training and revise their working details by watching the video about their practical training or other groups'. What's more, different groups use different specialized key words to finish their working tasks; all their practical trainings are copied by audio or video to provide rich corpus resources for the curriculum construction and future professional construction.

The Teachers and Students All Participate in the Evaluation for Teaching and Learning

Different from the traditional evaluation system, assisted multimedia interactive ESP teaching mode leads learners as the important subjects of the evaluation system with peer assessments among learners and groups. Most importantly, learners could take part in the construction of evaluation system. Teacher put the evaluation system on the computer-assisted classroom teaching platform, learners could adjust the system after reasonable procedures with reasonable reasons. Each learner has the right to participate in scoring and gives reasons for your score. Teacher also has the right to give score to each one, but his score is not the dominant standards of grading for learners.

### ***6.3.2 CBI-Based Assisted Internet Learning and Teaching Mode***

#### **6.3.2.1 Assisted Internet Learning and Teaching Mode**

As a result of the limit of classroom teaching time, internet assisted learning teaching mode in university teaching has become the essential part of teaching and

learning in universities. Internet assisted learning and teaching mode is a model of practical platform based on internet.

### **6.3.2.2 Design for Assisted Internet Learning and Teaching Mode**

Internet assisted learning and teaching platform mainly adopts three layers system architecture. And the application for the whole platform is divided into the presentation layer, business logic layer and data access layer. There are four main modules including supporting platform, content management, and homework online and solving problems on web. The arrangement for the backstage can be authorized including maintenance for roles for being teachers and administrative roles with multiple levels. Management for the users' information includes maintenance for the information about learners, teachers and administrators. System settings include whether to open the users' registration, whether does the registration need manual review, whether do the answering for the web questions need review.

Content management module is about all the integration of information related with contents.

Before their publication, authorized administrators and teachers need to set different content types. For example, the first type includes notice, teaching plan, teaching resources and teaching calendar. The platform can be set the multiple content types, such as the first type of teaching resources can be set 2 second types including teaching courseware and past year's exam paper. It is necessary to choose the corresponding content types before releasing a specific content submitted by the online text editor. The released content could be browsed with landing.

Model of answering questions is designed based on the current popular forum mode. Authorized administrators and teachers set up different plates (according to the arrangements for each chapter of the course). Users can issue their problems into the corresponding plate and all the users can discuss and answer them. When teachers find that one of their questions is the popular and hot topic among learners, they could put them at the beginning of the interface for a period of time so that all other learners can browse to the problems and take part in the solution of these problems.

The designing for the platform use the Asp.Net combined with SQL Server database. The operation of database in the data access layer depends on the data access application black from Microsoft Enterprise Library.

### **6.3.3 Application for the Assisted Internet ESP Teaching Mode**

The author presented the network course *Tourism English* last year, which is completed based on the assisted network ESP teaching mode including information, arrangement and interaction and so on. The teachers are authorized as the administrators for the network platform and have the authority to allow the learners

through the registration. After registering, all the users could download the teaching planning, teaching courseware and previous exam papers about Tourism English through the platform.

The teachers are authorized as the administrators for the network course and have the authority to allow the learners through registration. The registered learners can download the teaching plan, teaching courseware and previous years' exam papers about the course Tourism English on the network platform. As the founder for the network platform, the author provides lots of expanding resources including information about foreign tourist business, guiding working procedures, video and audio about the guides' working based on the teaching target for the course and its function for the training professional personnel. Registered learners can freely choose the topic and the context of the topic by BBS, QQ and so on. At the same time, learners can provide their views about questions in the area of Answering Questions.

## 6.4 Conclusion

Assisted internet ESP teaching mode based on the theory CBI effectively put the technology and science into the specific English teaching and learning in colleges and universities. It can integrate professional knowledge with English language skills and provide learners with many opportunities of autonomous learning and practical training.

## References

1. Gass MS (1997) Input, interaction and the second language learner, vol 34(45). Lawrence Erlbaum Association, New Jersey, pp 68–71
2. Holec H (1981) Autonomy and foreign language learning, vol 12(34). Pergamon Press, Oxford, pp 123–126
3. Sinclair B (1997) Learner autonomy: the Cross-cultural question, vol 26(139). I-A TEFL Newsletter, London, pp 55–59
4. Vgotsky LS (1978) Mind in society, vol 23(12). Harvard University Press, Cambridge, pp 113–117
5. Lam G, Rossiter D (2007) Gong-a free web voice tool for language learners. IT in Education Symposium 02(56):56–59

# Chapter 7

## Strategy of Timing Backup ORACLE Database

Chunrong Xue

**Abstract** This chapter designed a logical backup of Oracle database. Logical backup is mainly backup some data files, and saves data file to another location. In this paper used EXP way to do logical backup of database, at the same time, implemented timing settings backup. The timing settings backup strategy can be achieved all data based on Oracle database a complete automatic data backup on database server data. Timing backup Oracle database strategy has certain advantages in security, economy and reliability than others.

**Keywords** Timing • Logical backup • Oracle

### 7.1 Introduction

Oracle Database is an extremely powerful database management system. The Oracle database has a safe, reliable and efficient performance, that most of the software using Oracle as the core database Page [1]. As the most widely used large database, Oracle database security is very important, which is directly related to the stability of the system operation and unit normal operation. As a data security strategy, backup is the most basic method to avoid data loss.

Physical backup and logical backup are two of the Oracle database backup strategy [2]. Physical backup is backup some files which is necessary to run Oracle database, including database data files, control files, archive files. Physical backup is commonly used RMAN tools. Oracle Database physical backup can choose offline (cold) backup and online (hot) backup. Logical backup is mainly backup some data files, and saves data file to another location. The general way is EXP and EXPDP. Compared with physical backup, the biggest advantage of logical backup is which can detect data block damage when exported and terminated export

---

C. Xue (✉)

Department of Mathematics and Information Science, Weinan Teachers College,  
Weinan 714000, Shaanxi, China  
e-mail: xue\_chunrong@126.com



process. When next time perform logical backup, it is need to repair damage to the table. In this paper, we use EXP way to do logical backup of database.

Database backup strategy is a combination of a variety of database backup. A good backup strategy is necessary to ensure the security and stability in the database, uninterrupted operation, but also to ensure that the backup workload is not too large [3]. Oracle database backup can not be like Ms SQL Server database through their own job scheduling to create an automatic backup, For Oracle database users, each using manual method is obviously very troublesome and painful.

Database backup strategy can be achieved all data based on Oracle database a complete automatic data backup on database server data. At 00:01 in the morning every day, it is automatic to begin saving backup file in the backup of the server's hard disk partition E (backup point in time and path can be change), creating a date named directory to save the day-backup files in order to facilitate system administrator regularly to transfer copied file or burn the archive, such that provide a complete backup solution for data security.

## 7.2 Design and Implementation of Oracle Timing Backup

In Windows2003 Server operating system and Oracle10 g database system environment, we develop applications by PowerBuilder, and achieve automatic backup of Oracle database. Set the task within scheduled time to run backup, save a lot of operating time, improve work efficiency.

### 7.2.1 Software Design Flow Chart

Software design flow chart shown in Fig. 7.1.

### 7.2.2 Key Backup Script

In this paper we develop applications by PowerBuilder to implement Oracle database backup on a regular EXP-way. Key backup script is as follows:

```
int i
String ls_logname
SetPointer ( HourGlass! )

For i = 1 to UpperBound(is_users_list)
    st_state.text = ' Backup '+is_users_list[i] +'data.....'
    ls_logname = "logs\"+ is_users_list[i] + string (today (),'yyyy-mm-dd')
+"log"
    FileDelete(ls_logname)
```

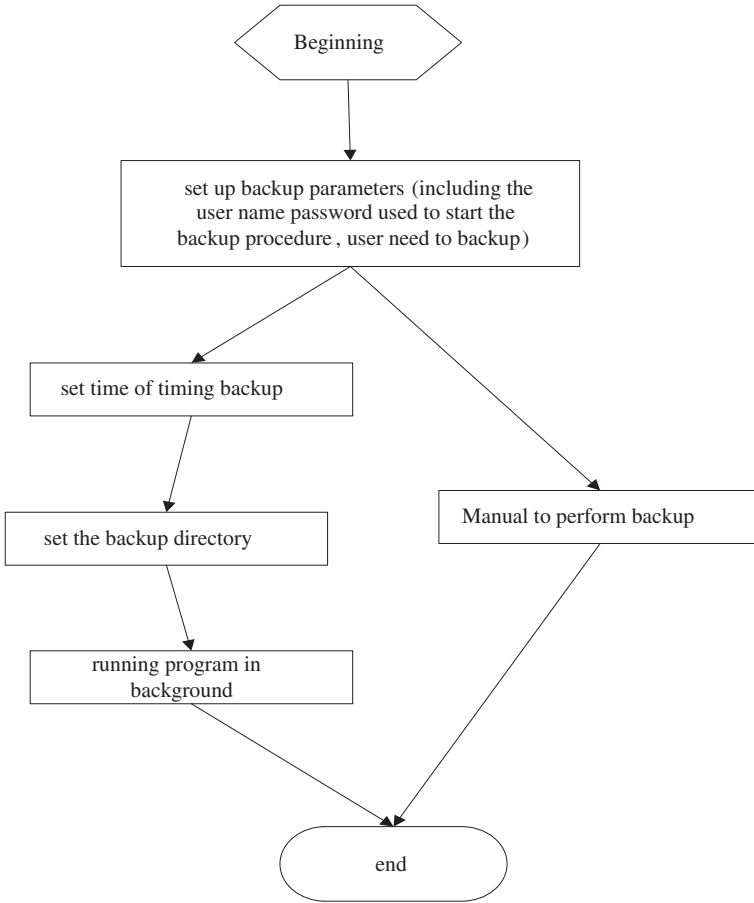


Fig. 7.1 Flow chart

If ib\_cancel then goto label\_cancel

```

ls_run = "exp userid = " + is_usDAT*??erid + "/" + is_logPass &
        + " owner = " + is_users_list[i] + " " &
+ " buffer=4096 file="+gs_BackupDir+"\ "+ls_date+"\ " + is_users_list[i]
+ ".dmp" &
        + "log=log\ "+ is_users_list[i] + string (today (),'yyyy-mm-dd')
+ ".log"

//li_rtn=run (ls_run,Minimized!)
li_rtn = WinExec(ls_run,0)
    lb_exit_loop = false
Do while not lb_exit_loop
  
```

```

        If wf_BackupIsSuccess () < 0 then// result is failing
            st_state.text = 'Backup '+is_users_list[i] +' is failing.'
            li_failure++
        End if
        lb_exit_loop = true
    End if

    Do While Yield ()
        Loop
        If ib_cancel then goto label_cancel
    Loop

    If not li_rtn>32 then
        MessageBox("warning","~n "+ is_users_list[i] +" failed backup of the
        database user!")
    End if
    st_state.text = ' User '+is_users_list[i] +' data backup completed.'
Next
SetPointer (Arrow!)

If li_failure = 0 then
    st_state.text = ' Backup all user data is complete。 '
elseif li_failure > 0 then
    st_state.text = "+string (li_failure)+' users backup data backup fails.'
End if
Return

label_cancel:
st_state.text = ' Operation has been canceled.'
SetPointer (Arrow!)

```

## 7.3 User Interface and Operating Procedures of Oracle Timing Backup

### 7.3.1 User Interface

This chapter implements backup settings and change point in time and path with PowerBuilder development. Interface is follows (Fig. 7.2).

### 7.3.2 Operating Steps

Users can write the above string command to a batch file and let the system run the batch file automatically when logging in successfully each time, then achieve

Fig. 7.2 User interface of automatic backup database

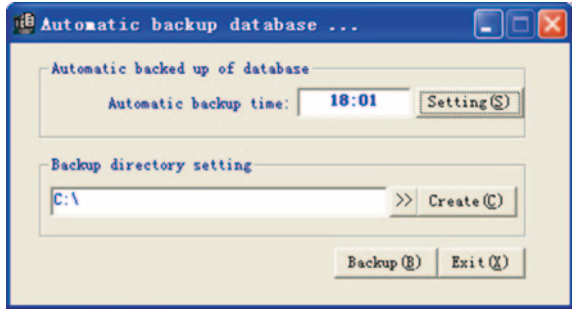


Fig. 7.3 Background running



the purpose of automatic backup favorites, the following is a specific implementation steps:

- Start the application,
- Enter “automatic backup time”, such as “00:01”, click “Settings” button to make the settings take effect,
- Enter or select a backup directory, if the directory does not exist, click the “Create” button to create the input catalog,
- Set user name and password of Oracle backup in configuration file backup.ini,
- When setup is complete we can click the “Start Backup” button to test backup settings are correct,
- Completion of the above settings, click on the minimize button, the software transferred to running in the background, as shown in Fig. 7.3,
- Set is completed, when the next time “00:01” system automatically start backup.

## 7.4 Conclusion

The main job of database backup and recovery is to grasp the best time to copy the data to prevent data loss can not be restored in fault condition. How to reduce complexity of database management, and establish a centralized online timing backup system has a very important significance. Timing backup ORACLE database strategy described in this chapter, after a lot of practical operation, has a great role in improving efficiency in Oracle database backup, holds certain advantages in security, economy and reliability.

**Acknowledgments** This project is supported by Shaanxi Province Natural Science Fund (No.2011JM1010); this project is supported by Weinan Science and technology projects Fund (No.2011YKJ2).

## References

1. [U.S.]Page Jr, WG (2000) Oracle 8/8I development manual. Mechanical Industry Press, Beijing, vol45, pp 14–16
2. Jia D (2002) ORACLE DBA the core technology parsing. Electronic Industry Press, Beijing, vol62, pp 215–217
3. Wang Q, Song S (2002) ORACLE database management system backup strategy and example. *Comput Eng* 37(12):262–264

# Chapter 8

## Study of Relationship Between Inorganic Polymer Concrete Cracks and Strain Based on Fractal Theory

Yan Yan, Zhean Lu, Xiaochun Fan, Dingguo Cao, Jianju Li and Yiping Wang

**Abstract** Inorganic polymer concrete (IPC) is a new building material, since it has abundant raw materials, inexpensive, and has little pollution to environment during its manufacturing process and needs little time to condense to high strength; these have caused the domestic and foreign material researchers of great interest. The flexural failure process of inorganic polymer concrete beam was studied based on the mechanical test, fractal analysis were done of the crack pictures getting during the test process were analyzed by using MATLAB program and the results show that: the crack development of inorganic polymer concrete beam under lode has fractal feature and box dimension can be a quantitative indicator of the crack condition; The relationship between box dimension and mechanical property of the beam is analyzed and the quantitative relation curves of them were fitted.

**Keywords** Inorganic polymer concrete • Reinforced beam • Crack development • Fractal theory • Box dimension

### 8.1 Introduction

Inorganic polymer concrete (IPC) is a new building material, it is a cementitious material similar to Portland cement concrete (PPC), which is reaction generated by slag, fly ash, etc. in a strong alkali solution it was caused the wide attention

---

Y. Yan (✉) · X. Fan  
School of Civil Engineering and Architecture, Wuhan University of Technology,  
Wuhan 430070, China  
e-mail: y6013810@163.com

Z. Lu  
Hubei Key Laboratory of Road, Bridge and Structural Engineering, Wuhan University  
of Technology, Wuhan 430070, China

D. Cao · J. Li · Y. Wang  
The Ninth Engineering Corps of China Airport Construction, Chendu 611430, China

J. Li  
e-mail: jiuzongdui0@163.com

of scholars because of its more excellent performance than PPC in many respects [1, 2]. 1995, Guoqiang and Xuejun [3] published “Theory of Fractal Applied to gradation aggregate”, which can be considered the first attempt that fractal theory was applied to the concrete field in china, opened up a new field for the research of the theory of fractal. Maosen et al. [4] proof that under load, distribution of cracks in reinforced concrete structure surface has fractal characteristics. Qian [5] researched the load crack developing rule on the concrete surface and the corresponding effect on the infection of the reinforcing steel bar erode is studied by means of fractal theory.

### 8.2 Test Introduced

In the experiment, the IPC and PPC has similar concrete cubic anti-pressure. Concrete mix proportion is shown in Tables 8.1 and 8.2.

A reinforcing IPC beam and a reinforcing PPC beam has been made, specimen numbers were IPC and PCC, the section size of test beams is  $b \times h = 100 \text{ mm} \times 200 \text{ mm}$ , span is  $L = 2,000 \text{ mm}$ . Parameters of test beam are shown in Table 8.3; reinforcement drawing is shown in Fig. 8.1.

**Table 8.1** Mix of IPC

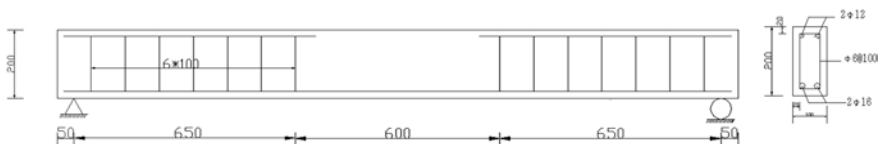
Powder (kg/m <sup>3</sup> )	Fly ash (kg/m <sup>3</sup> )	Activator (kg/m <sup>3</sup> )	Sand (kg/m <sup>3</sup> )	Stone (kg/m <sup>3</sup> )
200	200	180	615	1,262

**Table 8.2** Mix of PCC

Water (kg/m <sup>3</sup> )	Cement (kg/m <sup>3</sup> )	Sand (kg/m <sup>3</sup> )	Stone (kg/m <sup>3</sup> )	Super plasticizer (kg/m <sup>3</sup> )
340	136	633	1,298	2.04

**Table 8.3** Parameters of test beam

The number of test beams	Section size $b \times h$ (mm <sup>2</sup> )	Span $L$ (mm)	Reinforced diameter (mm)	Reinforcement ratio (%)
IPC	100 × 200	2,000	16	2.34
PCC	100 × 200	2,000	16	2.34



**Fig. 8.1** Reinforcement figure of test beam (Units mm)

### 8.3 Test Device and Loading Scheme

Test device and loading scheme is shown in Fig. 8.2; locations of concrete strain sensor are shown in Fig. 8.3, numbers of concrete strain sensor are a, b, c, d, e; locations of longitudinal bearing force reinforcement strain sensor are shown in Fig. 8.4.

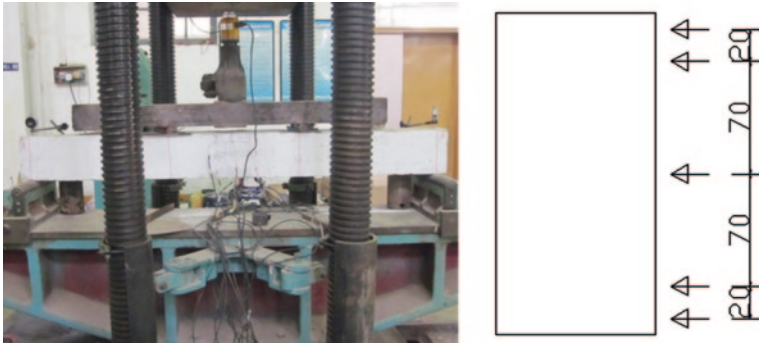
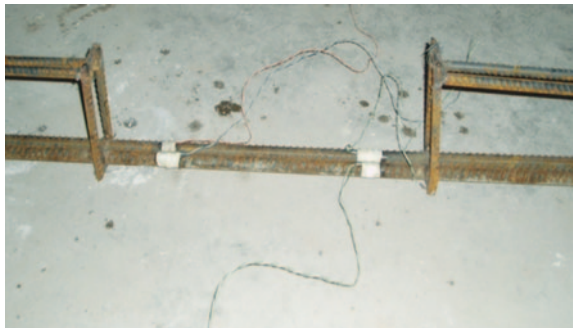


Fig. 8.2 Loading figure of test beam

Fig. 8.3 Locations of concrete strain sensor (Units mm)



Fig. 8.4 Locations of steel strain sensor





**Table 8.4** 28d concrete cubic anti-pressure

Test block number	Compression strength value (Mpa)
IPC	56.7
PCC	63.8

**Fig. 8.5** Crack distribution diagrams of test beam IPC**Fig. 8.6** Crack distribution diagrams of test beam PPC

## 8.4 Test Results

### 8.4.1 Concrete Cubic Anti-Pressure

Concrete cubic anti-pressure is shown in Table 8.4.

### 8.4.2 Distribution of Cracks in the Specimen Surface

Distribution of cracks after the test is shown in Figs. 8.5 and 8.6.

### 8.4.3 Load-Strain Relationships of Test Beams

In this experiment, longitudinal bearing force reinforcement strain and the concrete surface strain of the test beams was measured; stress-strain curves of the beams are shown in Figs. 8.7 and 8.8.

## 8.5 Analysis of Test Results

### 8.5.1 Fractal Dimension Calculation Results of Test Beams Under Different Load Levels

Currently, the most commonly feasible convenient method used to study the surface cracks to request fractal dimension is the box-counting. The specific method is to cover the object distribution area with square grid of side length  $r_0$ , count if

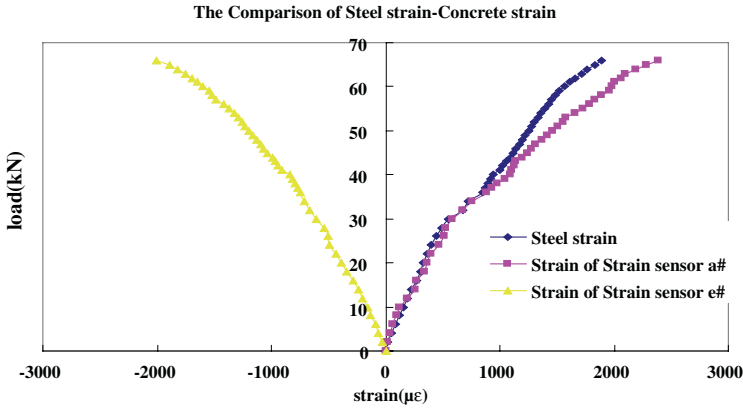


Fig. 8.7 Steel strain & concrete strain of beam IPC

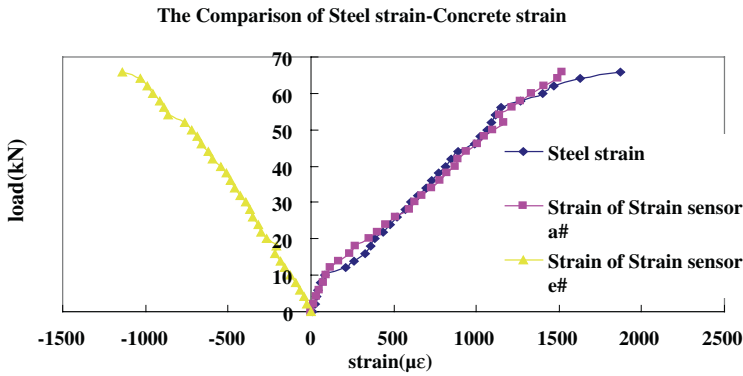


Fig. 8.8 Steel strain & Concrete strain of beam PPC

Table 8.5 Box dimension of test beam IPC

Load (kN)	28	32	36	40	48	52	56	60
Box dimension of side A	1.068	1.093	1.137	1.159	1.170	1.198	1.212	1.222
$r^2$	0.962	0.983	0.954	0.986	0.976	0.984	0.996	0.988
Box dimension of side B	1.100	1.118	1.146	1.150	1.154	1.156	1.178	1.193
$r^2$	0.975	0.984	0.985	0.997	0.987	0.988	0.984	0.992

Indicate  $r$ —linear correlation coefficient, side A and side B expressed the two sides of the beam

the box contains elements of the object and statistics the number of the grid containing graphic elements  $N(r_0)$ , change the mesh density by Changing grid size  $r$ , and count the number  $N(r)$  of grid covered with cracks. The experimental results were analyzed by using matlab to calculate box counting dimension of cracks'

digital image [6]. Fractal dimension of beam IPC and beam PPC under different load levels is shown in Tables 8.5 and 8.6.

### 8.5.2 Relationship Between the Box Dimension and the Strain of Concrete and Steel

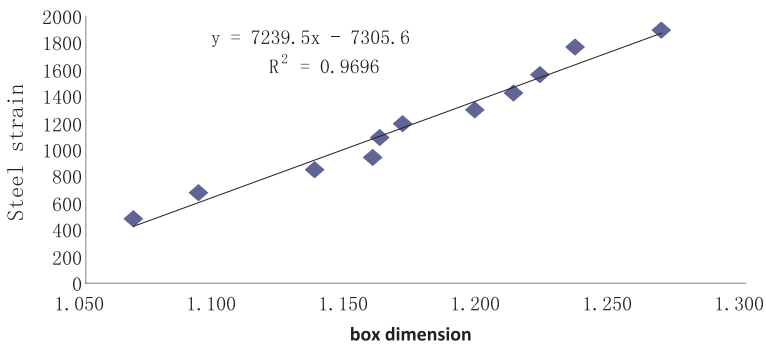
The fractal dimension and strain of concrete and steel was fitted under different load levels. For example, side A of the beams, fitting relationship was shown in Figs. 8.9, 8.10, 8.11 and 8.12.

Figures 8.9–8.12 shows that, there was a good linearity relationship between longitudinal bearing force reinforcement strain and box dimension under load, so were concrete strain [7]. As the fractal dimension increases, the steel strain of beam IPC increases more rapidly than beam PPC; in the same steel strain, the box dimension of beam IPC is relatively small; in the same crack state, the IPC strain was 1.5 times more than PPC strain. It shows that the deformation capacity of IPC is better than PPC, therefore, cracks of IPC developed slowly than PPC under the same load [8].

**Table 8.6** Box dimension of test beam PPC

Load (kN)	28	32	36	40	44	48	52	56	60
Box dimension of side A	1.123	1.149	1.177	1.207	1.219	1.242	1.259	1.269	1.281
r <sup>2</sup>	0.978	0.992	0.996	0.983	0.995	0.996	0.996	0.988	0.992
Box dimension of side B	1.164	1.182	1.197	1.212	1.230	1.243	1.265	1.271	1.293
r <sup>2</sup>	0.977	0.992	0.990	0.985	0.964	0.994	0.991	0.980	0.967

Indicate r—linear correlation coefficient, side A and side B expressed the two sides of the beam



**Fig. 8.9** Relation graph between box dimension and steel strain of beam IPC

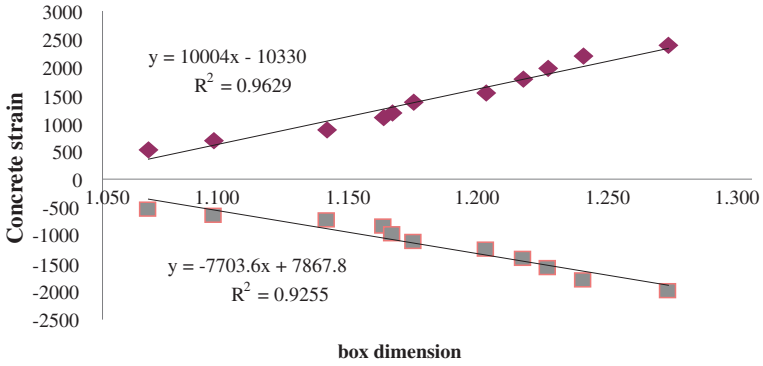


Fig. 8.10 Relation graph between box dimension and concrete strain of beam IPC

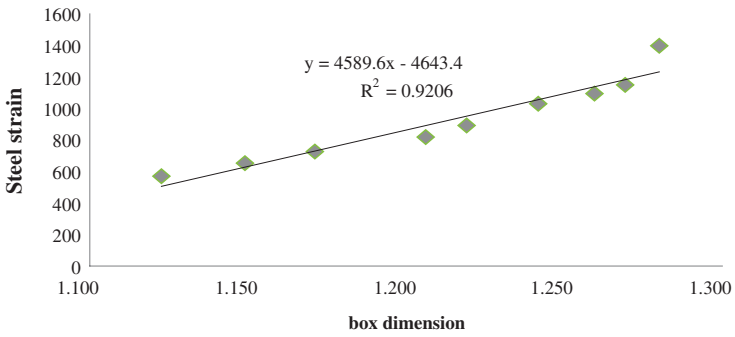


Fig. 8.11 Relation graph between box dimension and steel strain of beam PPC

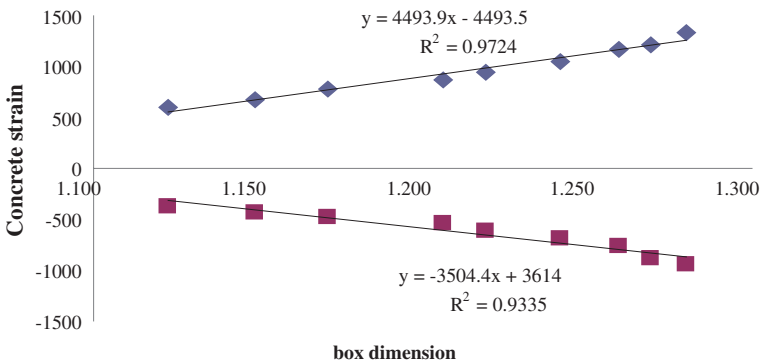


Fig. 8.12 Relation graph between box dimension and concrete strain of beam PPC

## 8.6 Summary and Conclusion

The following conclusions were drawn from this study as listed below:

1. Through the processing of crack pictures in the experiment, it is proved that crack development of the side of beam IPC has fractal characteristics, reinforced inorganic polymer concrete can be researched based on fractal theory, and the test beams' box dimension under different load levels had been obtained;
2. To calculate the surface crack's fractal dimension of self-similarity specimens based on box-counting, relationship between fractal dimension and the load was studied, and according to measured values of steel strain and concrete strain, variation of strain with fractal dimension variation of the specimen surface-cracks was analyzed;
3. Results displayed a good linear relationship between beam cracks and box dimension under all load levels, with the load increasing the fractal dimension appeared linear growth, the box dimension shows linear growth with stress strain or concrete strain of the middle cross section of test beams. Therefore, fractal dimension of reinforced concrete beam cracks in the surface can be used to analysis stress state of reinforced concrete members.
4. Compared to PPC beams, box dimension of IPC beams grow with the strain more slowly, under the load, the crack of reinforced IPC beams extended more slowly.

## References

1. Duxson P, Fernández-Jiménez A, Provis JL et al (2006) Geopolymer technology: the current state of the art. *J Mater Sci* 5(9):204–214
2. Kim D, Lai H, Chilingar GV et al (2006) Geopolymer formation and its unique properties. *Environ Geol* 2(1):280–286
3. Li G, Deng X (1995) Theory of fractal applied to gradation aggregate. *Concrete* 3(1):3–7
4. Cao M, Wang T, Zai A (2005) Experimental study on fractal characterization in damages of concrete structures. *Rock Soil Mech* 2(10):360–367
5. Wang Q (2008) Application of fractal theory on study of cracks' developmental orderliness on the surface of reinforced concrete component. *Qingdao Univ Technol* 30:87–93
6. Zhang Z, Dong F, Wu Y (2005) Estimation of fractal dimension for 2-D gray image. *Comput Appl* 4(12):93–96
7. Li Y, Xie H, Liu J (2008) Study on computing method of fractal dimension of RGB image. *Chin J Rock Mech Eng* S1:2779–2784
8. Peng R, Xie H, Ju Y (2004) Computation method of fractal dimension for 2-D digital image. *J China Univ Min Technol* 4(1):390–397

# Chapter 9

## Research on Product Recovery Forecast in Remanufacturing Based on Weighted Markov Chain

Zhanfeng Zhou

**Abstract** In order to determine the number of recycled products and solve the uncertain problem in product recovery. This paper used Weighted Markov Chain to establish a forecasting model, set up a classification standard of Markov Chain by using mean–variance method and established the state transition probability matrix through sorting the data, at last predicted the number of recycled steel by regarding the standardized autocorrelation coefficients as weights. The results show that the model is accurate and has a good application.

**Keywords** Remanufacturing • Product recovery • Weighted markov • Forecast

### 9.1 Introduction

With the development of social economy, more and more countries begin to pay attention to the importance of the recycling utilization of resources and protection of ecological environment problem, how to deal with product recycling, remanufacturing and recycling utilization issues will become the constraints for enterprise long-term development. Remanufacturing is a general term in a series of technical measures and activities including repair and modification of waste products as the guide of product life cycle design and management theory, as the standard of high quality, high efficiency, energy saving, material saving, environmental protection and in order to achieve waste materials performance improvement also known as the “green manufacturing” [1]. Product recovery is the primary condition for remanufacturing [2].

---

Z. Zhou (✉)

Institute of Mechanical and Electrical Engineering, XI'AN Technological University,  
Xi'an, China

e-mail: nwpuzhouzhanfeng@163.com

Current research on remanufacturing product recovery is mainly concentrated in Qualitative analysis, such as analysis and comparison of product recovery mode, formulation of product recovery policy, foundation of product recovery standard and so on. Quantitative prediction on the number of recycled products is still very rare at present. This paper researched the forecast on the number of recycled products on this background [3, 4].

## 9.2 Recycled Product Forecasting Model

The current forecasting methods can be divided into qualitative forecasting methods and quantitative forecasting methods. Qualitative forecasting methods gave a qualitative result on the basis of the statistical data by using visual comparison, so this method was very subjective and inaccurate. Commonly used quantitative forecasting methods were time series analysis method and probability and mathematical statistics method. Remanufacturing in our country just began to develop, historical statistics data about product recovery was insufficient and at the same time, the number of recycled product was influenced by many factors such as economy, market, policy, so it was too random. The time series method ignored the influence of random factors, when the time series did not change significantly, it was difficult to establish a more accurate prediction model. Probability and mathematical statistics methods required a lot of historical statistics, when the sample size was small and it was difficult to determine the probability distribution of the prediction object. Markov chain was a kind of special stochastic process, Using the Markov chain to build the prediction model can solve stochastic problems and at the same time the required sample size was small, the accuracy and stability was high, so it was widely used in many fields such as agriculture, hydrology, weather and stock prediction [5, 6]. Traditional Markov Chain were the Markov Chain based on absolute distribution and Markov Chain based on probability summation, Markov Chain based on absolute distribution considered that the founded Markov Chain meet the homogeneity property and Obviously, this was lack of factual basis. Markov Chain based on probability summation considered that the role played by absolute probability of every kind of step Markov Chain was same, this was unscientific. The weighted Markov chain improved the traditional Markov chain and can adequately, reasonable use all information in the sample, so the predictive result was accurate and stable. The main steps of using the Weighted Markov Chain to predict the number of the recycled products are as follows:

Collecting the historical data about product recovery and establish the data sample. Numbered lists should use the “Numbered Item” style.

Calculating the sample mean and variance and establish the grading standard of sample value to determine state space of Markov chain E, where, can calculated by Eq. 9.1 and can calculated by Eq. 9.2.

$$\bar{x} = \sum_{i=1}^n x_i \quad (9.1)$$

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}} \tag{9.2}$$

Determining the sample data is state according to standard of classification.

Calculating the Markov state transition probability  $p_{ij}^{(m)}$  corresponding to every step and establishing the state transition probability matrix, where  $p_{ij}^{(m)}$  means the probability that state “i” transited to state “j” after m steps.

Calculating the autocorrelation coefficients  $r_k$  and standardized it, determining the weight  $\omega_k$  of Markov under every step, where  $r_k$  can be calculated by Eq. 9.3 and  $\omega_k$  can be calculated by Eq. 9.4.

$$r_k = \frac{\sum_{l=1}^{n-k} (x_l - \bar{x})(x_{l+k} - \bar{x})}{\sum_{l=1}^n (x_l - \bar{x})^2} \tag{9.3}$$

$$\omega_k = \frac{r_k}{\sum_{k=1}^m |r_k|} \tag{9.4}$$

Calculating the weighted sums of every probability under the same state and determining the predictive probability  $P_i$  of this state, where  $P_i$  can be calculated by Eq. 9.5,  $\max \{p_i, i \in E\}$  was the final state.

$$P_i = \sum_{k=1}^m \omega_k \times p_i^{(k)} \tag{9.5}$$

### 9.3 Example in Application

This paper collected the number of recycled steel from 1971 to 1990 in Shandong Province and used the Weighted Markov model to predict. The number of recycled steel from 1971 to 1990 was shown in Table 3.1 [7].

Calculating the sample mean  $\bar{x}$  and variance  $s$ , the result was shown as follows:

$$\bar{x} = \sum_{i=1}^{20} x_i = 61.86, s = \sqrt{\frac{\sum_{i=1}^{20} (x_i - 61.86)^2}{19}} = 23.3$$

Using mean–variance method to divide the Markov is chain into five states, as shown in Table 9.2.

According to Tables 9.1 and 9.2 is determining the state of the number of steel of every year, as shown in Table 9.3.

Establishing the state transition probability matrix under every step, the result was shown as follows.



**Table 9.1** Number of recycled steel from 1971 to 1990

Years	Quantity
1971	24.58
1972	25
1973	24
1974	36
1975	55.5
1976	34.02
1977	38.5
1978	70.5
1979	74.2
1980	79.3
1981	74.54
1982	92.3
1983	100.18
1984	90.02
1985	75.77
1986	74.1
1987	56.4
1988	64.5
1989	66.7
1990	81

**Table 9.2** Standard of dividing state and numerical range

State	Standard of dividing state	Numerical range
1	$X < \bar{x} - s$	$X < 38.56$
2	$\bar{x} - s \leq X < \bar{x} - 0.5s$	$38.56 \leq X < 50.21$
3	$\bar{x} - 0.5s \leq X < \bar{x} + 0.5s$	$50.21 \leq X < 73.51$
4	$\bar{x} + 0.5s \leq X < \bar{x} + s$	$73.51 \leq X < 85.16$
5	$X \geq \bar{x} + s$	$X \geq 85.16$

**Table 9.3** State of the number of steel of every year

Years	State
1971	1
1972	1
1973	1
1974	1
1975	3
1976	1
1977	2
1978	3
1979	4
1980	4
1981	4
1982	5
1983	5
1984	4
1986	4

(continued)

**Table 9.3** (continued)

Years	State
1987	3
1988	3
1989	3
1990	4

**Table 9.4** Autocorrelation coefficients from one step to five steps

r <sub>1</sub>	r <sub>2</sub>	r <sub>3</sub>	r <sub>4</sub>	r <sub>5</sub>
0.8046	0.5802	0.4160	0.2915	0.1446

**Table 9.5** Weight from one step to five steps

ω <sub>1</sub>	ω <sub>2</sub>	ω <sub>3</sub>	ω <sub>4</sub>	ω <sub>5</sub>
0.3597	0.2594	0.1859	0.1303	0.0647

$$P^{(1)} = \begin{bmatrix} \frac{3}{5} & \frac{1}{5} & \frac{1}{5} & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ \frac{1}{5} & 0 & \frac{2}{5} & \frac{2}{5} & 0 \\ 0 & 0 & \frac{1}{5} & \frac{3}{5} & \frac{1}{5} \\ 0 & 0 & 0 & \frac{1}{3} & \frac{2}{3} \end{bmatrix}, P^{(2)} = \begin{bmatrix} \frac{3}{5} & 0 & \frac{2}{5} & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & \frac{1}{4} & \frac{1}{4} & \frac{2}{4} & 0 \\ 0 & 0 & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ 0 & 0 & 0 & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

$$P^{(3)} = \begin{bmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & \frac{1}{3} & \frac{2}{3} & 0 \\ 0 & 0 & \frac{2}{5} & 0 & \frac{3}{5} \\ 0 & 0 & \frac{1}{3} & \frac{2}{3} & 0 \end{bmatrix}, P^{(4)} = \begin{bmatrix} \frac{1}{5} & \frac{1}{5} & \frac{2}{5} & \frac{1}{5} & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \frac{1}{2} & \frac{1}{2} \\ 0 & 0 & \frac{1}{5} & \frac{2}{5} & \frac{2}{5} \\ 0 & 0 & \frac{2}{3} & \frac{1}{3} & 0 \end{bmatrix}$$

$$P^{(5)} = \begin{bmatrix} \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{2}{5} & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & \frac{1}{2} & \frac{1}{2} \\ 0 & 0 & 0 & \frac{3}{4} & \frac{1}{4} \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

Calculating the autocorrelation coefficients, the result was shown in Table 9.4.

Standardizing the autocorrelation coefficients and calculating the weight of every step, the result was shown in Table 9.5.

Forecasting the state of number of recycled steel from 1988 to 1990, the results was shown in Tables 9.6, 9.7 and 9.8.

Result from Table 9.9 showed that the Weighted Markov forecasting model was very accurate in the prediction of number of recycled steel from 1988 to 1990.

**Table 9.6** Predictive state of number of recycled steel in 1988

Years	State	Step	Weight	1	2	3	4	5
1983	5	5	0.0647	0	0	1	0	0
1984	5	4	0.1303	0	0	2/3	1/3	0
1985	4	3	0.1859	0	0	2/5	0	3/5
1986	4	2	0.2594	0	0	1/3	1/3	1/3
1987	3	1	0.3597	1/5	0	2/5	2/5	0
Weighted value				0.0719	0	0.4563	0.2738	0.1980
Predictive state				3				

**Table 9.7** Predictive state of number of recycled steel in 1989

Years	State	Step	Weight	1	2	3	4	5
1984	5	5	0.0647	0	0	1	0	0
1985	4	4	0.1303	0	0	1/5	2/5	2/5
1986	4	3	0.1859	0	0	2/5	0	3/5
1987	3	2	0.2594	0	1/4	1/4	2/4	0
1988	3	1	0.3597	1/5	0	2/5	2/5	0
Weighted value				0.0719	0.0649	0.3738	0.3257	0.1637
Predictive state				3				

**Table 9.8** Predictive state of number of recycled steel in 1990

Years	State	Step	Weight	1	2	3	4	5
1985	4	5	0.0647	0	0	1	0	0
1986	4	4	0.1303	0	0	1/5	2/5	2/5
1987	3	3	0.1859	0	0	1/3	2/3	0
1988	3	2	0.2594	0	1/4	1/4	2/4	0
1989	3	1	0.3597	1/5	0	2/5	2/5	0
Weighted value				0.0719	0.0649	0.3615	0.4496	0.0521
Predictive state				4				

**Table 9.9** Predictive values and residuals

Years	Actual value	Predictive value	Residuals rate (%)	Relative error rate
1988	64.5	61.86	4.09	4.31 %
1989	66.7	61.86	7.26	
1990	81	79.34	2.05	

Using the average value of the interval corresponding to calculate predictive value and error, the result was shown in Table 9.9.

## 9.4 Conclusion

Product recovery was the first step for realizing the remanufacturing, the prediction of the number of recycled products was very important for designing and optimizing the remanufacturing network and resolving other problems. This paper studied the forecast of the number of recycled products, established a forecasting model based on Weighted Markov Chain and used the model to predict the number of recycled steel from 1971 to 1986 in Shandong province. The results showed that the model was very accurate.

## References

1. Liu B, Binshi X, Shi P, Liu B (2011) Research on remanufacturing reverse logistics networks key facilities. *J New Technol Process* 7:69–71
2. Wang X, Liang G (2009) Analysis of reclaiming models of used products based on remanufacturing reverse logistics. *J Mod Manuf Eng* 4:9–11
3. Liu S, Jin Q, Wang P (2006) Analyzing recovery options of end-of-life products. *J China Surf Eng* 19(5):112–114
4. Lin L (2006) Preliminary inquiry on standard of waste products recovery in our country. *J China Stand* 2(5):50–51
5. Jiang X, Chen S (2009) Application of weighted markov scgm(1,1) model to predict drought crop area. *J Syst Eng-Theory Prac* 29(5):179–185
6. Ma L, Wei G, Shen L (2008) Application of weighted markov chain method in annual runoff prediction of Akesu River of xinjiang. *J Water Saving Irrig* 10:44–47
7. Available from: [www.infobase.gov.cn/bin/mse.exe?seachword=%u56DE%u6536%u7E](http://www.infobase.gov.cn/bin/mse.exe?seachword=%u56DE%u6536%u7E)

# Chapter 10

## Relationship Model Between Chlorophyll-*a* and Sediment Nutrients

Hua-Jun Luo, De-Fu Liu and Ying-Ping Huang

**Abstract** The relationship model between chlorophyll-*a* in water body and sediment nutrients in Xiangxi Bay of Three-Gorge Reservoir was established using support vector machine (SVM) method. In surveys, six stations have been investigated on 29 March 2009, 28 March 2010 and 17 August 2010. Using step-wise multiple linear regression method, the important variables (sediment total nitrogen and bioavailable phosphorus) were selected. The parameters in SVM were optimized by leave one out cross validation. The cross validated squared correlation coefficient obtained based on leave one out method ( $Q_{LOO}^2$ ) of the optimal SVM model is 0.7577. The SVM method has been shown to be a useful and powerful tool to construct the relationship model.

**Keywords** Support vector machine • Chlorophyll-*a* • Three-gorge reservoir

### 10.1 Introduction

Three-Gorge Dam (TGD) in China is the world's largest dam, measuring 2,335 m long and 185 m high, and the reservoir created by it has an area of 1,080 km<sup>2</sup> in 2009 [1]. The Xiangxi River, which lies 38 km upstream from the Dam, is the largest tributary in the Hubei portion of Three-Gorge Reservoir (TGR). This river is 94 km long with a watershed of 3,099 km<sup>2</sup> (between 110°25' and 111°06'E long., 30°57' and 31°34'N lat.) [2]. While water impoundment in TGR, the downriver stretch of Xiangxi River was inundated and Xiangxi Bay

---

H.-J. Luo (✉)  
Three Gorges University, Yichang 443002, China  
e-mail: luohuajun@21cn.com

D.-F. Liu  
College of Hydroelectric and Environment, Three Gorges University, Yichang 443002, China

Y.-P. Huang  
Engineering Research Center of Eco-environment in Three Gorges Reservoir Region,  
Ministry of Education, Three Gorges University, Yichang 443002, China

was formed. Then the water flow velocity has dropped to 0.0020–0.0041 m/s [3]. So when water temperature increased in spring, there were algal blooms with prolonged retention time and rich nutrients in Xiangxi Bay.

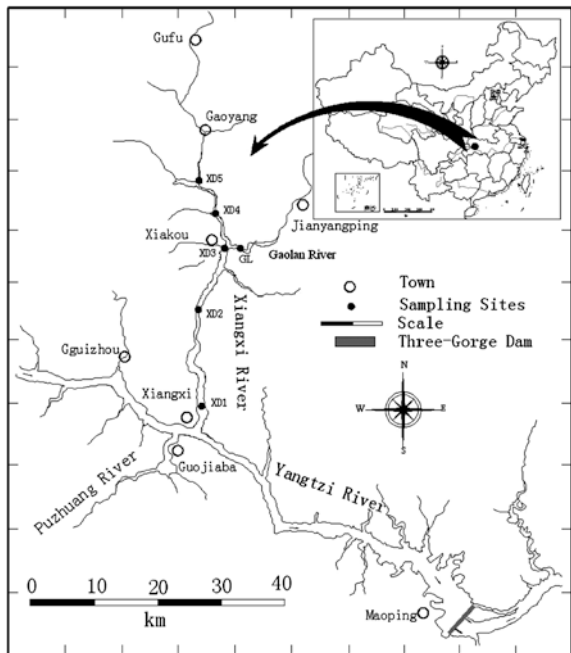
In recent years, the distributions and influences of nutrients in water body of Xiangxi Bay have been studied [4, 5]. However, the sediment plays an important role in water ecosystem as it is both an important source of various dissolved substances and a sink for particulate materials [6, 7]. So the sediment is a “potential source” of nutrients such as nitrogen and phosphorus in water [8, 9]. In this present paper, the spatial and temporal variability of nutrients in Xiangxi Bay sediments were studied, and the relationship model between chlorophyll-*a* in water body and sediment nutrients was established using support vector machine method [10].

## 10.2 Materials and Methods

### 10.2.1 Sampling and Sample Preparation

The sampling was undertaken from six sites of Xiangxi Bay (Fig. 10.1) on 29 March 2009, 28 March 2010 and 17 August 2010. Sites XD1–XD5 is on the Xiangxi River. Site GL is located at the downstream of Gaolan River, which is the largest tributary of the Xiangxi River. Water samples were collected at 0.5 m depth from surface in the middle of the river using a 5 L Niskin sampler (Hydrobios-Kiel). Sediments

**Fig. 10.1** Sediment sampling sites in Xiangxi Bay



with a 15 cm overlying water column were collected using acid-washed PVC core tubes (diameter 65 mm). The overlying water was siphoned off, filtered and stored at 4 °C for analysis. The top 5 cm of sediment cores were segmented and stored in air-sealed plastic bags at 4 °C. Pore water was separated from the sediments by centrifugation (3,000 rpm, 10 min) followed by filtration of the supernatant (passing a Whatman 0.45 µm pore-size filter). Prior to analysis the sediment samples were freeze-dried and ground to pass through a 100-mesh sieve.

## **10.2.2 Sediment Analysis**

### **10.2.2.1 Total Phosphorus**

Freeze-dried sediment (0.7000 g) was put into a 50 ml glass tube, and digested with potassium persulphate and 30 % v/v sulphuric acid. After digestion, the solution was cooled, centrifuged and filtered by Whatman 0.45 µm pore-size filter. Then phosphorus was determined using the ammonium molybdate-ascorbic acid (AMAA) method. A blank was processed simultaneously.

### **10.2.2.2 Bio Available Phosphorus**

Sediment (0.1500 g) was put into a 50 ml glass tube, and 30 ml solution (0.1 M NaOH/1 M NaCl) was added. The tube was covered and the sample was shaken for 8 h, then centrifuged (3,000 rpm, 15 min) and filtered by Whatman 0.45 µm pore-size filter. The filtrate was analyzed for Bio Available Phosphorus (BAP) using AMAA method. A blank was processed simultaneously.

### **10.2.2.3 Total Nitrogen of Sediments**

Sediment (0.1500 g) was put into a 50 ml glass tube, and 20 ml oxidative agent (0.1875 M NaOH, 0.0741 M K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>) was added. The mixture was shaken and then digested for 30 min at 135 °C in high pressure sterilizing kettle. After digestion, the solution was cooled, centrifuged and filtered by Whatman 0.45 µm pore-size filter. The content of NO<sub>3</sub><sup>-</sup> in filtrate was determined as the total nitrogen (TN) content by colorimetry. A blank was processed simultaneously.

### **10.2.2.4 Ammonium Nitrogen of Sediments**

Sediment (1.2500 g) was put into a 50 ml glass tube, and 25 ml NaCl solution (2 M) was added. The solution was shaken for 4 h, centrifuged (3,000 rpm, 15 min) and filtered by Whatman 0.45 µm pore-size filter. The NH<sub>4</sub><sup>+</sup> in filtrate was determined using spectrophotometry. A blank was processed simultaneously.

### 10.2.2.5 Water Samples

Total Phosphorus (TP), TN and Ammonium Nitrogen (NH<sub>4</sub>-N) of pore water and overlying water were determined in the laboratory using State Environmental Protection Administration (SEPA) standard methods. For chlorophyll-*a* (Chl-*a*) analysis, surface water samples filtered through Whatman filters were extracted with cold 90 % acetone and estimated by spectrophotometer.

### 10.2.3 Support Vector Machine

Support vector machine (SVM) is a nonlinear machine learning method. In SVM, the basic idea is to map the data  $X$  into a higher dimensional feature space  $F$  via a nonlinear mapping  $\Phi$  and then to do linear regression in this space. Therefore, regression approximation addresses the problem of estimating a function based on a given data set  $G = \{(x_i, d_i)\}_{i=1}^l$  ( $x_i$  is input vector,  $d_i$  is the desired value). SVR approximates the function in the following form:

$$y = \sum_{i=1}^l w_i \Phi_i(x) + b \quad (10.1)$$

Where  $\{\Phi_i(x)\}_{i=1}^l$  is the set of mappings of input features,  $\{(w_i)\}_{i=1}^l$  and  $b$  are coefficients. They are estimated by minimizing the regularized risk function  $R(C)$ :

$$R(C) = C \frac{1}{N} \sum_{i=1}^l L_\varepsilon(d_i, y_i) + \frac{1}{2} \|w\|^2 \quad (10.2)$$

Where

$$L_\varepsilon(d, y) = \begin{cases} |d - y| - \varepsilon & \text{for } |d - y| \geq \varepsilon \\ 0 & \text{otherwise} \end{cases} \quad (10.3)$$

And  $\varepsilon$  is a prescribed parameter in the insensitive loss function.

In Eq. (10.2),  $[C(1/N) \sum L_\varepsilon(d_i, y_i)]$  is the so-called empirical error (risk) measured by  $\varepsilon$ -insensitive loss function  $L_\varepsilon(d, y)$ , which indicates that it does not penalize errors below  $\varepsilon$ . The second term  $[(1/2) \|w\|^2]$  is used as a measurement of function flatness.  $C$  is a regularized constant determining the tradeoff between the training error and the model flatness?

The minimization of Eq. (10.1) is a standard problem in optimization theory and it can be derived that the weight vector  $w$  equals the linear combination of the training data:

$$w = \sum_{i=1}^l (\alpha_i - \alpha_i^*) x_i \quad (10.4)$$



In this formula,  $\alpha_i$  and  $\alpha_i^*$  are Lagrange multipliers. Thus, decision function becomes the following form:

$$f(x) = \sum_{i=1}^l (\alpha_i - \alpha_i^*) K(x_i, x) + b \tag{10.5}$$

Where  $K(x_i, x)$  is the kernel function? The most used kernel functions include radial basis function (RBF) kernel, polynomial kernel and linear kernel. For the SVM calculations, a MATLAB toolbox was used, developed by Gunn.

### 10.3 Results and Discussion

Surface water chlorophyll-*a* during the observation period in Xiangxi Bay of Three Gorges Reservoir are presented in Fig. 10.2. The sediment nutrients as environmental variables were selected using stepwise multiple linear regression (MLR) method. So the model with two important environmental factors (sediment TN and BAP, Fig. 10.3) was obtained as follows:

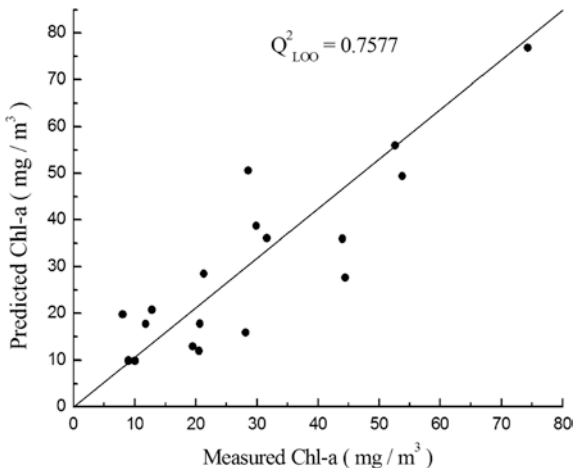
$$Chl - a = -4.7748 + 0.0396TN + 0.0816BAP \tag{10.6}$$

( $R^2 = 0.7041$ ,  $Q_{LOO}^2 = 0.5537$ ,  $S = 10.6513$ ,  $F_{2,15} = 17.8483$ ,  $P = 0.0001$ ,  $N = 18$ ).

The statistical quality of the regression equation was examined using parameters such as the squared correlation coefficient ( $R^2$ ), the standard error ( $S$ ), the Fisher ratio at the 95 % confidence level ( $F$ ), and the cross validated squared correlation coefficient obtained based on leave one out (LOO) method ( $Q_{LOO}^2$ ).

The resulting sediment nutrients factors in Eq. (10.1) decided by stepwise MLR were used for SVM model. The performance of SVM model is related to

**Fig. 10.2** Plot of measured values versus predicted values for Chl-*a* of optimal SVM model



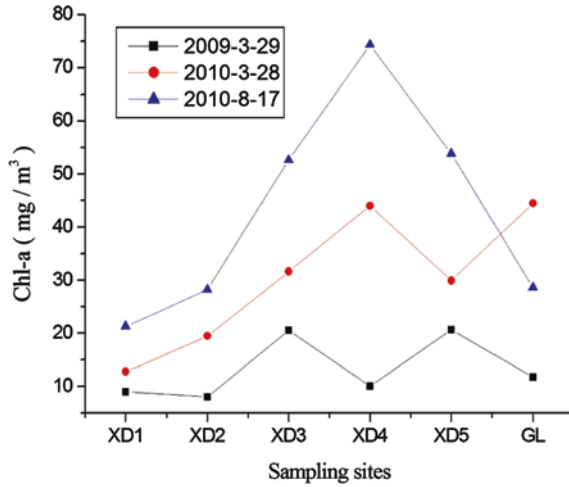


Fig. 10.3 Surface water chlorophyll-a in Xiangxi Bay

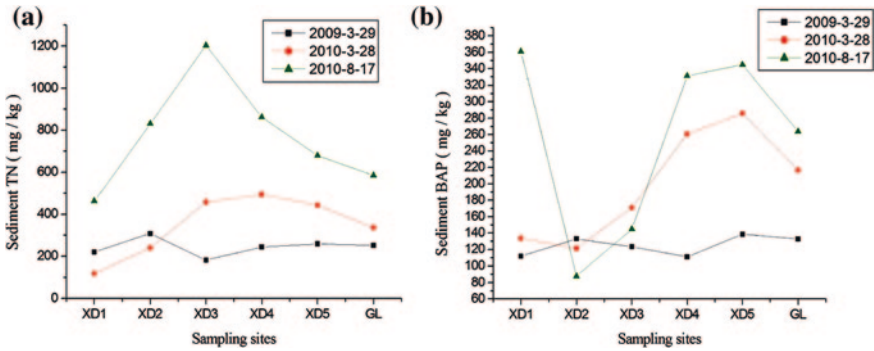


Fig. 10.4 Sediment TN (a) and BAP (b) in Xiangxi Bay

variables as well as the combination of parameters used in the model. So some parameters in SVM (the type of kernel function, the regularization parameter  $C$  and  $\epsilon$ -insensitive loss function) ought to be optimized. In this work, root mean squared error (RMSE) was used as a measurement of generalization in leave one out cross validation (LOOCV) of SVM. Figure 10.4 illustrated RMSE versus  $\epsilon$  and  $C$  with different kernel functions [RBF with a width of  $\sigma = 0.10$ , polynomial, linear] respectively. It was found that the RBF kernel function was suitable to build the SVM model among the three kernel functions. Figure 10.5 illustrates the parameters ( $C$  and  $\epsilon$ ) optimized in SVM with RBF function. Thus the optimal SVM model ( $R^2 = 0.8738, Q_{LOO}^2 = 0.7577$ ) was obtained with the minimum value of RMSE (9.2183) with  $C = 800$  and  $\epsilon = 0.01$  under the RBF kernel

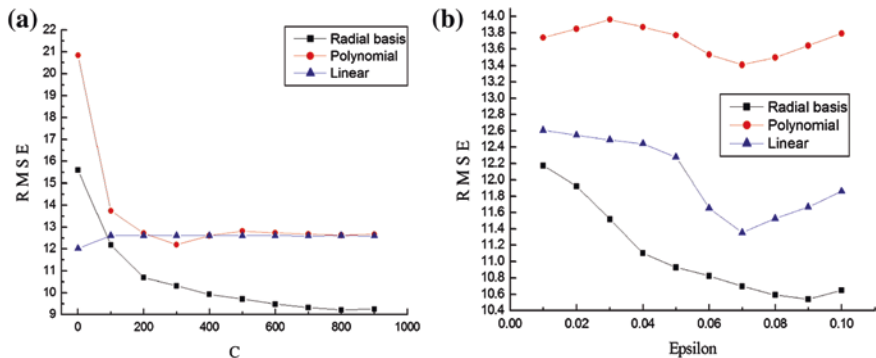


Fig. 10.5 RMSE in LOOCV versus the parameter C with  $\epsilon = 0.01$  (a) and  $\epsilon$  with C = 100 (b)

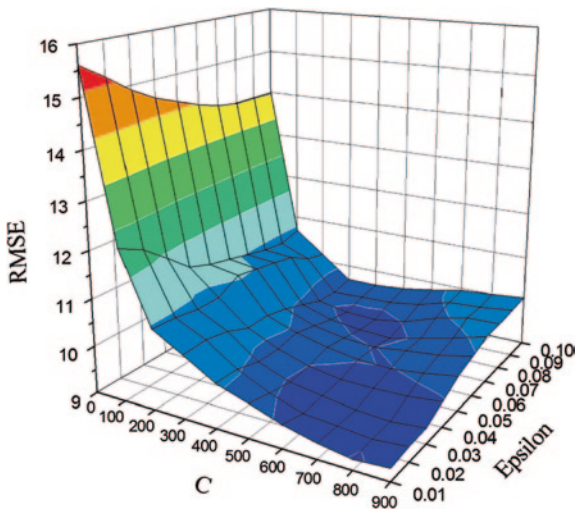


Fig. 10.6 RMSE in LOOCV versus the parameter C and  $\epsilon$  with radial basis kernel function

function. Figure 10.6 shows plots of the predicted values employing LOOCV of optimal SVM versus measured values for Chl-*a*. It can be concluded that the predicted results are in good agreement with the observed ones.

### 10.4 Conclusions

The support vector machine model of chlorophyll-*an* in Xiangxi Bay of Three-Gorge Reservoir was established. Using stepwise MLR method, the important variables (sediment TN and BAP) were selected. The parameters in SVM such as

the type of kernel function, the regularization parameter  $C$  and  $\varepsilon$ -insensitive loss function were optimized by leave one out cross validation.  $R^2$  And  $Q_{LOO}^2$  of the optimal SVM model are 0.8738 and 0.7577, respectively. The SVM method has been shown to be a useful and powerful tool to construct the relationship model between chlorophyll- $a$  in water body and sediment nutrients.

## References

1. Wu JG, Huang JH, Han XG et al (2003) Three-Gorge Dam—experiment in habitat fragmentation? *Science* 300:1239–1240
2. Ye L, Li DF, Tang T et al (2003) Spatial distribution of water quality in Xiangxi River. *China J Appl Ecol* 14(11):1959–1962
3. Wang HY (2005) Effects of the Three Gorges Reservoir on the water environment of the Xiangxi River with the proposal of countermeasures. *Res Environ Yangtze Basin* 14(2):233–237
4. Luo HJ, Liu DF, Ji DB et al (2009) Influence factors analysis to chlorophyll a of spring algal bloom in Xiangxi Bay of Three Gorges Reservoir. *J Water Resour Prot* 3:188–194
5. Yang ZJ, Liu DF, Ji DB et al (2010) Influence of the impounding process of the Three Gorges Reservoir up to water level 172.5 m on water eutrophication in the Xiangxi Bay. *Sci China Tech Sci* 53(4):1114–1125
6. Dai HC, Zheng TG, Liu DF (2010) Effects of reservoir impounding on key ecological factors in the Three Gorges Region. *Procedia Environ Sci* 2:15–24
7. Wang L, Cai QH, Tan L et al (2011) Phytoplankton development and ecological status during a cyanobacterial bloom in a tributary Bay of the Three Gorges Reservoir. *China Sci Total Environ* 409(19):3820–3828
8. Masuda K, Boyd CE (1994) Chemistry of sediment pore water in aquaculture ponds built on clayey ultisols at Auburn, Alabama. *J World Aquacult Soc* 25:396–404
9. Lu XX, Song JM, Li XG et al (2005) Geochemical characteristics of nitrogen in the southern yellow sea surface sediments. *J Mar Syst* 56:17–27
10. Steinman A, Chu XF, Ogdahl M (2009) Spatial and temporal variability of internal and external phosphorus loads in Mona Lake, Michigan. *Aquat Ecol* 43:1–18

# Chapter 11

## Scalable Karatsuba Multiplier Over Finite Field $\text{GF}(2^m)$

Huafeng Chen, Yanbing Jiang and Buping Jin

**Abstract** A scalable architecture for efficient multiplication in finite fields  $\text{GF}(2^m)$  was proposed. The proposed design had symmetric form with  $64 \times 64$ -bit inputs, supporting with any finite fields  $\text{GF}(2^m)$ , where  $m < 320$ , and almost all irreducible polynomials. Due to the introduced fast unbalanced modular reduction method and Karatsuba like algorithm, fast operation was obtained. Unlike the most proposed bit-serial or digit-serial multiplier, data access of the symmetric multiplier was in accordance with the memory access pattern. And it also can be developed to meet the requirement of any  $\text{GF}(2^m)$ , where  $m > 320$ , through tiny change of control logic and register file. The analysis result showed it may improve the operation performance by 50 % over the NIST recommended curve of  $\text{GF}(2^{283})$  comparing with another original method.

**Keywords** Finite field multiplier • Karatsuba algorithm • Fast unbalanced modular reduction method

### 11.1 Introduction

The basic arithmetic operations in finite fields of  $\text{GF}(2^m)$  played an important role in cryptography, such as elliptic curve cryptography (ECC), and the Digital Signature Standard including the Elliptic Curve Digital Signature Algorithm [1], among them, the most important and basic operation was multiplication.

To obtain hardware implementations of multiplier, several schemes were proposed. Most of them were based on polynomial basis (some papers called it standard basis). And the most widely proposed structures were bit-serial or digit-serial [2, 3], that was to say, the two inputs of the multiplier was not with the same length, which always limited itself to certain kind of finite field. Furthermore, they didn't make use of the advantage of the specific application situations such as the

---

H. Chen (✉) · Y. Jiang · B. Jin  
Zhejiang University of Media and Communications, Hangzhou, China  
e-mail: walfen.chen@gmail.com

second term of irreducible polynomials were always with small degree. Then the operation performance was not optimal according to different select of fields and irreducible polynomials [4].

This paper proposed a scalable multiplier with symmetric form of  $64 \times 64$ -bit inputs, which supported with any finite fields  $GF(2^m)$ , where  $m < 320$ , and almost all irreducible polynomials. Fast unbalanced modular reduction method, which made use of the characteristic of the often small degree of the second term of irreducible polynomials, and Karatsuba algorithm were adopted, improving the polynomial multiplication performance through reducing the numbers of multiplications. Fast speed performance could be obtained though the algorithms [5].

This paper was organized as below. Section 11.2 described the Karatsuba like algorithm with 5 terms. Fast unbalanced modular reduction method was introduced with Karatsuba formulae in Sect. 11.3. Then based on the introduced algorithm, a novel architecture was developed in Sect. 11.4. According to the architecture, typical operation performance of multiplication was analyzed in Sect. 11.5. Finally, we made a short conclusion in Sect. 11.6.

## 11.2 Karatsuba-Like Algorithm

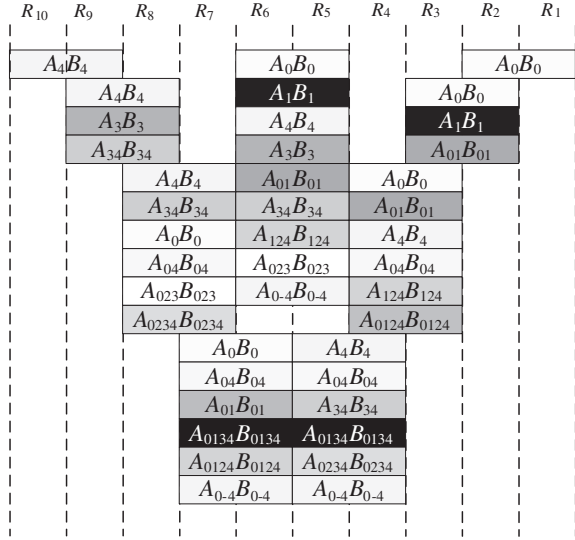
In this section, we introduced a kind of Karatsuba like multiplication algorithm with 5 terms, which implied the method in developing our multiplier architecture. And the situation with 5 terms in multiplication was just one of applications demonstrated. More Karatsuba like formulas were analyzed in, which could all be deployed in our architecture.

In the assumed application with 5 terms, such as  $GF(2^{283})$  recommended both by NIST and certicom, let  $A(x)$ ,  $B(x)$  be two elements of  $GF(2^m)$ , where  $256 < m < 320$ , and  $f(x)$  be irreducible polynomial, then we could compute the polynomial multiplication first to get the result of  $A(x)B(x) \bmod f(x)$ . We described  $A(x)$  and  $B(x)$  with 5 terms of  $A_4A_3A_2A_1A_0$ ,  $B_4B_3B_2B_1B_0$  respectively, each term with 64 bits. Then with Karatsuba algorithm, we got the results in Table 11.1, where  $\ll nW$  meant the result was shifted by  $n$  Words (here, each word

**Table 11.1** Karatsuba like multiplication results with 5 terms

Shift situation	Products items
$\ll 8W$	$A_4B_4$
$\ll 7W$	$A_3B_3, A_4B_4, A_3A_4B_3$
$\ll 6W$	$A_0B_0, A_4B_4, A_0A_4B_0, A_3A_4B_3, A_0A_3B_0, A_0A_2B_0, A_0A_2A_3B_0$
$\ll 5W$	$A_0B_0, A_0A_4B_0, A_0A_1B_0, A_0A_1A_4B_0, A_0A_1A_3B_0, A_0A_1A_3A_4B_0$
$\ll 4W$	$A_0B_0, A_1B_1, A_3B_3, A_4B_4, A_0A_1B_0, A_3A_4B_3, A_1A_2B_1, A_0A_2B_0, A_0A_2A_3B_0$
$\ll 3W$	$A_4B_4, A_0A_4B_0, A_3A_4B_3, A_0A_1A_4B_0, A_0A_2A_3B_0, A_0A_2A_3A_4B_0$
$\ll 2W$	$A_0B_0, A_4B_4, A_0A_4B_0, A_0A_1B_0, A_1A_2B_1, A_0A_2A_3B_0$
$\ll 1W$	$A_0B_0, A_1B_1, A_0A_1B_0$
$\ll 0W$	$A_0B_0$

**Fig. 11.1** Schedule of 5 terms multiplication with Karatsuba like formulae



had 64 bits), two or more digits as subscript denoted the addition operation of relevant terms. For example,  $A_{124}$  denoted the equation of  $A_1 + A_2 + A_4$ .

Thus, we could obtain the operation data schedule as shown in Fig. 11.1, where  $R_i$  ( $1 \leq i \leq 10$ ) were register file storing computation results. All data in each column were accumulated into the designated register. The number of multiplication was reduced from 25 according to schoolbook method to 13, which are  $A_4B_4$ ,  $A_3B_3$ ,  $A_1B_1$ ,  $A_0B_0$ ,  $A_{34}B_{34}$ ,  $A_{04}B_{04}$ ,  $A_{01}B_{01}$ ,  $A_{023}B_{023}$ ,  $A_{124}B_{124}$ ,  $A_{0124}B_{0124}$ ,  $A_{0134}B_{0134}$ ,  $A_{0234}B_{0234}$ , and  $A_{01234}B_{01234}$  respectively. Given corresponding computation and load-store architectures, the multiplication could be speeded fast.

### 11.3 Fast Unbalanced Modular Reduction

Through the polynomial multiplication, we got a result with 10 words. Then we must take modular reduction to restrict it to 5 words so that it could join the next round finite field multiplication, which was the typical process during scalar multiplication.

In order to get fast operation, we considered the fact that the second term of irreducible polynomial was always small. Let  $f(x) = x^m + t(x)$ , the 10 words result be divided into two parts,  $c_h$  and  $c_l$ , being denoted by  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0}$  and  $c_{l4}c_{l3}c_{l2}c_{l1}c_{l0}$  respectively, then we got

$$\begin{aligned}
 AB \bmod f(x) &\equiv (c_{h4}c_{h3}c_{h2}c_{h1}c_{h0}x^{320} + c_{l4}c_{l3}c_{l2}c_{l1}c_{l0}) \bmod f(x) \\
 &= (c_{h4}c_{h3}c_{h2}c_{h1}c_{h0}x^{320-m}(x^m \\
 &\quad + t(x) - t(x)) + c_{l4}c_{l3}c_{l2}c_{l1}c_{l0}) \bmod f(x) \\
 &= (c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot t \ll (320 - m) + c_{l4}c_{l3}c_{l2}c_{l1}c_{l0}) \bmod f(x)
 \end{aligned}$$

The method was called fast unbalanced modular reduction method here. Since the degree of  $t(x)$  was always small, the method could get final 5 words result quickly. The multiplication of  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot t$  or  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot [t \ll (320 - m)]$  reused the same multiplier unit computing the polynomial multiplication or modified multiplier accommodating to both situation, depending on whether  $t \ll (320 - m)$  has more words than  $t$  or not. If  $t \ll (320 - m)$  was divided into the same number of words with  $t$ , we pre-shifted the parameter  $t$  before storing it to memory, then the operation unit needed no more logic, reducing critical time delay. Otherwise if  $t \ll (320 - m)$  had more words than  $t$ , we might shift the computation result of  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot t$  to reduce the multiplication numbers, according to the specific demand in application.

To get the result of  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot t$  or  $c_{h4}c_{h3}c_{h2}c_{h1}c_{h0} \cdot [t \ll (320 - m)]$ , we applied with Karatsuba algorithm again. For example, according to the situation of  $A_5A_4A_3A_2A_1 \times B_2B_1$ , we decomposed the multiplicand into  $A_5A_4 \ll 3W + A_3A_2 \ll W + A_1$ , thus the multiplication operation had the combination form of  $A_5A_4 \times B_2B_1 \ll 3W + A_3A_2 \times B_2B_1 \ll W + A_1 \times B_2B_1$ . For  $A_5A_4 \times B_2B_1$  and  $A_3A_2 \times B_2B_1$ , each could apply with the Karatsuba Algorithm again, then the number of multiplication could be reduced from 10 by school textbook method to 8. And all other situations could be done like this.

### 11.4 Architecture Design

According to the introduced algorithm, we developed the architecture of multiplier as shown in Fig. 11.2, which handled the  $t \ll (320 - m)$  as a whole item. In this architecture, the parameter  $A, B$  and  $t \ll (320 - m)$  were stored in memory  $MEM$ , which had two read ports and one write ports. The two inputs of basic multiplier unit named  $MUL$  came from original  $MEM$  or Register file, or came from the accumulation of original data and register data. Module  $MUL$  completed the basic polynomial multiplication, with three outputs,  $P\_h$  denoting the high 64 bits,  $P\_l$  denoting the low 64 bits, and  $P\_h + l$  denoting  $P\_h + P\_l$ .

Or in another situation, considering  $t$  itself as an item, we developed another architecture which was shown in Fig. 11.3. Module  $LS$  completed the operation of arithmetic left shift. The shift distance was controlled by  $Num$  (i.e.  $320 - m$ ). Then

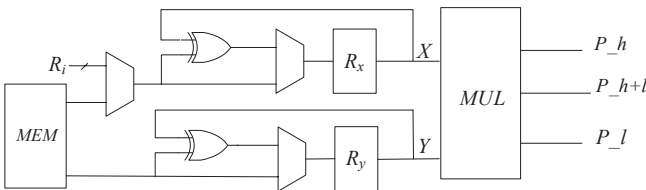
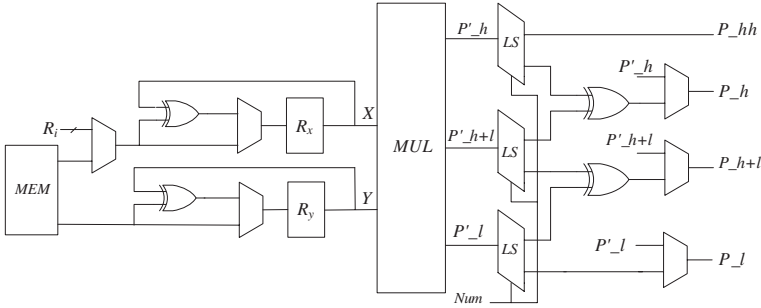


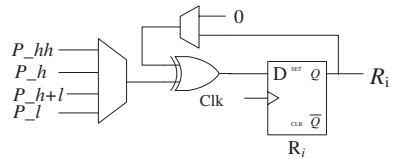
Fig. 11.2 Arithmetic unit of multiplier without shift function





**Fig. 11.3** Arithmetic unit of multiplier with shift function

**Fig. 11.4** Basic register unit



shifted result was divided into two parts: overflow part and remained part, both in 64 bits. At last, according to whether the result should be shifted or not, the four outputs ( $P_{hh}$ ,  $P_h$ ,  $P_{h+l}$  and  $P_l$ ) were obtained.

Each output result was stored in register file. The register file was constructed with the basic register unit shown in Fig. 11.4, where multiplex input  $P_{hh}$  was an optional item decided by whether applying with arithmetic unit in Figs. 11.2 or in 11.3.

### 11.5 Performance Analysis

As a typical application with 5 words, we selected the NIST recommended curve over  $GF(2^{283})$ , which had the irreducible polynomial with  $f(x) = x^{283} + x^{12} + x^7 + x^5 + 1$ . The number of multiplication operation is  $13 + 5 + 1 = 19$ , where 13 denoted the number of multiplication in polynomial multiplication operation, 5 denoted the number of multiplication in first round modular reduction, and 1 denoted the number of multiplication in second round modular reduction.

### 11.6 Conclusion

In this paper, we proposed a novel architecture of finite filed multiplier, which applied with Karatsuba algorithm and fast unbalanced modular reduction method, improving the operation speed performance. Furthermore, the regular multiplier

had the same memory access pattern with classic processor, which was in favor of its adoption in ALU design of probable cryptography processor. To optimize the overall performance, further work will focus on evaluating the considerations among control logic simplification, area cost and timing performance.

## References

1. Naitilan J (2000) National Institute of Standards and Technology (NIST): Digital signature standard (DSS), Federal information processing standards (FIPS) publication 186:2–6
2. Hutter M, Grossschadl J (2003) A versatile and scalable digit-serial/parallel multiplier architecture for finite fields  $GF(2^m)$ . In: Proceedings of ITCC, 63:692–700
3. Nikooghadam M, Malekian E, Zakerolhosseini A (2008) A versatile reconfigurable bit-serial multiplier architecture in finite fields  $GF(2^m)$ . In: Proceedings of CSICC, 53:227–234
4. Huang MQ, Gaj K, El-Ghazawi T (2011) New hardware architectures for montgomery modular multiplication algorithm. *IEEE Trans Comput* 60(7):923–936
5. Karatsuba A, Ofman Y (1963) Multiplication of multidigit numbers on automata. *Sov Phys Dokl* 35(7):595–596

# Chapter 12

## 3D Parametric Design on Chimney-Tray Gas–Liquid Distributor

Pengfei Zhang and Shuyan Wang

**Abstract** The paper presents a 3D parametric design method, relating to utilize the inlaid language-Visual Basic of Applications (VBA) to secondary develop AutoCAD and establish a parametric design program. Compared to 2D Computer-Aid Design (CAD), this method is more efficient and intuitional. Taking the example of chimney-tray gas–liquid distributor, this program can automatically generate the 3D models of chimney-tray gas–liquid distributor with different sizes, just by setting a few parameters. What’s more, distributor’s CAD project drafts could be also obtained through the program by simple data exchange. In this way, manual modeling is replaced by program process, which not only can reduce the duplicated work in the design process but also can enhance the drawing quality and efficiency.

**Keywords** VBA • AutoCAD • 3D parametric design • Gas–liquid distributor

### 12.1 Introduction

Liquid distributors are a key component in packed distillation columns. As a kind of liquid distributors, chimney-tray gas–liquid distributor is widely used in chemical engineering. A good chimney-tray gas–liquid distributor has a direct impact on liquid initial distribution and mass transfer efficiency which are associated with the quality of products, so more attention should be paid to the chimney-tray gas–liquid distributor design process. Up to now, many efforts have been made to find a high efficient way to realize chimney-tray gas–liquid distributor design by the use of AutoCAD. To achieve this goal, some designers proposed that the AutoCAD software can be developed by Autolisp, which has a built-in GUI mini-language for creating model dialog boxes with automated layout and can also take

---

P. Zhang (✉) · S. Wang  
School of Chemical Engineering and Technology, Tianjin University, Tianjin 300072, China  
e-mail: zhangpf@tju.edu.cn

S. Wang  
e-mail: wangshuyan@tju.edu.cn

part in the design process from scheme establishment to sketch drawing. However, the Autolisp itself has some defects, such as limited computation ability and limited modeling function. So Autolisp is not well suitable for 3D parametric design system. In some field of modern industries, 2D design has already been replaced by 3D parametric design. 3D solid models play an important role not only in the respects of communicating information about the structure and assembly relations, but also in the respects of externalizing the designer’s thought process by realizing the visualization of the product [1].

In engineering, the parametric design can be described as the process of transforming a set of parameters and constrains to the CAD system by taking advantage of the completed parametric design program [2, 3], then the CAD can automatically generate the model of the product which meets the specification of customers. In this article, the importance of 3D parametric design is addressed. Strategies and methods of the parametric design system of chimney-tray gas–liquid distributor based on AutoCAD VBA are presented. Parametric design system framework and flow of the program for its development are also discussed before conclusion.

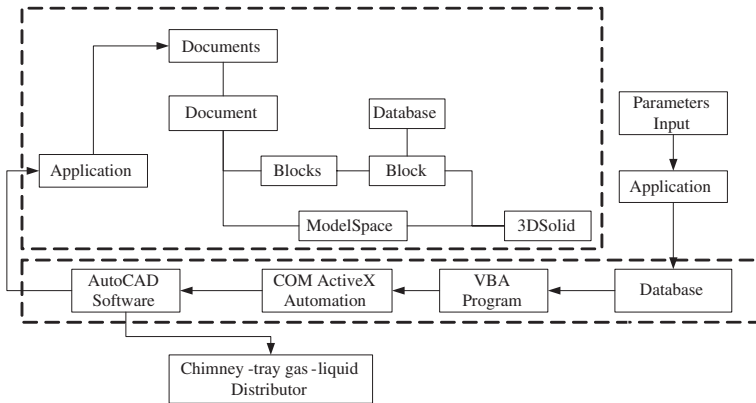
## 12.2 Structure of Parametric Design System

### 12.2.1 Characteristic of Chimney-Tray Gas–Liquid Distributor

The typical chimney-tray gas–liquid distributor used for structured packing can be divided into three parts according to the function: distribution tray, chimney and collecting plate. If the column diameter is less than 3,000 mm, the chimneys are arranged in two rows, otherwise the row is four. Inside wall of the chimney, there are drainage steel angles; the liquid leaves the tray via holes on the chimneys and follows down by the drainage steel angle. At the same time, the gas below rises up along the chimneys. Thus, we can realize that both the liquid and gas distributes evenly. Generally, the size of the distributor varies with the diameter of the column, but the structure is unlikely to change greatly. The differences among different size chimney-tray gas–liquid distributors mainly reflect in length of distribution tray, length of collecting plate, numbers of chimney and so on. These variables are classified detailedly in Table 12.1.

**Table 12.1** Variables of the chimney-tray gas–liquid distributors with different sizes

Distribution tray	Chimney	Collecting plate
Numbers of distribution tray	Numbers of chimney	Numbers of collecting plate
Length of distribution tray	Numbers of drainage steel angles	Length of collecting plate
	Length of chimney	



**Fig. 12.1** Model for parametric design system

If the key parameters can be extracted as driven dimensions, the chimney-tray gas-liquid distributors with different sizes can be easily obtained by adjusting the value of the parameters.

### 12.2.2 Parametric Design System

The chimney-tray gas-liquid distributor design process can be defined by a set of design parameters and values; the system model is shown in Fig. 12.1.

The key parameters are input in the system model through user interface, and then parameters are stored in the database, finally they will be picked up and processed by the parametric design program to build 3D solid model with the aid of AutoCAD. The data transfer and control process is supported by ActiveX Automation technology, which is based on COM standard. This kind of technology makes mutual control between VBA and AutoCAD possible.

## 12.3 Program Realizations

AutoCAD provides powerful drawing functions which are packaged in ActiveX in the form of attributes and methods. Object structure in AutoCAD is a tree structure; the root node of tree hierarchy is application object, based on which other objects are derived. These objects can be referenced in VBA development environment. VBA is an object-oriented programming language; designers can use VBA program codes to realize any drawing function of AutoCAD [4, 5]. What's more, designers can also establish user interface in the VBA environment.

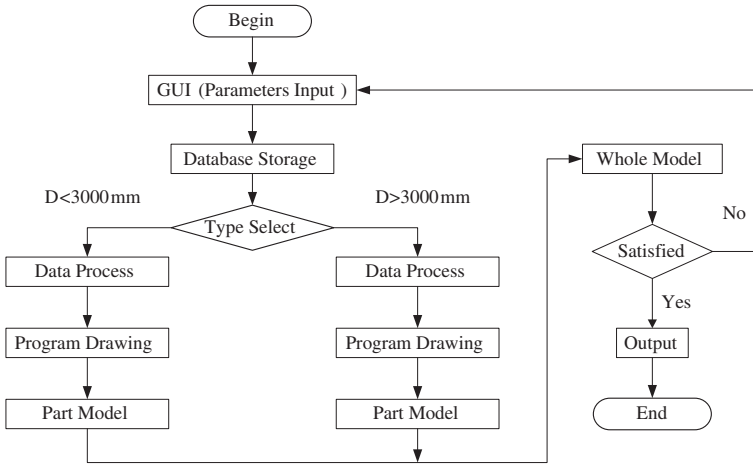


Fig. 12.2 Frame chart of the program

Taking all the factors into account, we can formulate the programming concepts in the VBA development language environment which is a pivotal part of the parametric design system. After the VBA program receives parameters from database, the program divides the chimney-tray gas-liquid distributor into several parts according to the size of manhole which is punched in the column wall. Finally, the program analyzes data of one part, acquires the shape information of this part and conveys instructions to AutoCAD to generate the 3D solid model. After this part is finished, the next part will be operated in the same way until the whole chimney-tray model is generated. The VBA program frame chart is shown below in Fig. 12.2.

The procedures of building user interface and establishing VBA parametric design program will be illustrated as follows.

### 12.3.1 Create a New Project

The steps of creating a new project is: firstly open AutoCAD 2008 and choose “tools”; then click “Macros” and VBA Manger Dialog Box will appear; finally click “new” to create a project. If the project has been created, we just need to load it by click “load” in the VBA Manger Dialog Box.

### 12.3.2 Open the VBA IDE

There are three ways can be used to open the VBA IDE. First, type “VBAIDE” in the command line. Second, choose “tools” and click “Macros” and then choose Visual Basic Editor. Third, press “Alt + F11”.

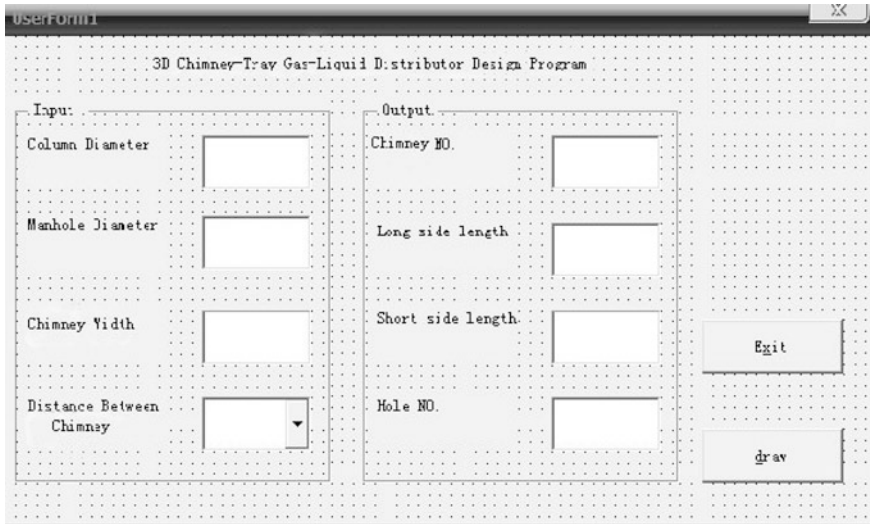


Fig. 12.3 User interface of 3D chimney-tray gas-liquid distributor design program

### 12.3.3 Insert a UserForm and the Related Controls

To add a UserForm to the project, we just need to choose “insert” and then choose “UserForm”. The related controls are added via Toolbox, here we insert two Frame named as Input and Output. In the “Input” frame, we insert five Label named as The 3D Chimney-Tray Gas-Liquid Distributor Design Program, Column Diameter, Manhole Diameter, Chimney Width and Distance Between Chimney, then insert three Text Box and a Combo Box named as txtbox1, txtbox2, txtbox3 and chimney distance. In the “Output” frame, we insert four Label named as Chimney NO., Long Side length, Short side length and Hole NO., then insert four Text Box named as txtbox4, txtbox5, txtbox6 and txtbox7. At last insert one Label named as The 3D Chimney-Tray Gas-Liquid Distributor Design Program and two Command Button named as Exit and Draw (Fig. 12.3).

This UserForm is a kind of dialog box, which is used as the user interface. Furthermore, we expand the function of the user interface, when the program is compiled and executed; we can not only acquire the 3D solid model of chimney-tray gas-liquid distributor, but also acquire some other data which is associated with the operation performance of the chimney-tray gas-liquid distributor [6].

### 12.3.4 Add Codes for UserForm

Because the code of the whole project is very long, here we select part of the code to illustrate. Double-click the UserForm to open the code window and enter the following codes.

### 12.3.4.1 Program Segment of Creating Chimney-Tray Gas-Liquid Distributor

```

Sub create_model()
.....
Dim polyline3(0) As Acad3DPolyline
Dim path As AcadLine
Dim p3(0 To 32) As Double
p3(0) = 43.5 + txtbox3: ..... : p3(32) = 0#
Set polyline3(0) = ThisDrawing.ModelSpace.Add3DPoly(p3)
polyline3(0).Closed = True
Dim region4obj As Variant
region4obj = ThisDrawing.ModelSpace.AddRegion(polyline3)
Dim solid7obj As Acad3DSolid
Dim path7(0 To 2) As Double
Dim path8(0 To 2) As Double
path7(0) = 0#: path7(1) = 0#: path7(2) = 0#
path8(0) = 0#: path8(1) = -(txtbox1 - 203#):
path8(2) = 0#
Set path = ThisDrawing.ModelSpace.AddLine(path7, path8)
Set solid7obj = ThisDrawing.ModelSpace.AddExtrudedSolidAlongPath
    (region4obj(0), path)
.....
End Sub

```

### 12.3.4.2 Some Illustration About the Code

To obtain the 3D solid model, we need to draw section contour in the program. Here the “Add3DPolyline” method is used. Then we use “AddRegion” method to make polyline become region. Finally the “AddExtrudedSolidAlongPath” and “Boolean” method is applied to generate a 3D solid model. We can create 3D chimney-tray model in this way (Fig. 12.4).

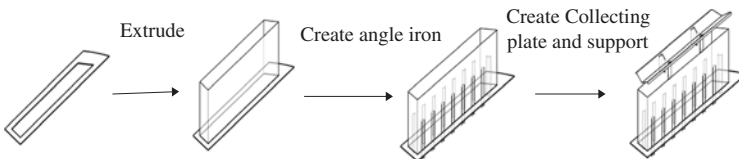


Fig. 12.4 Procedures of generating 3D chimney-tray model



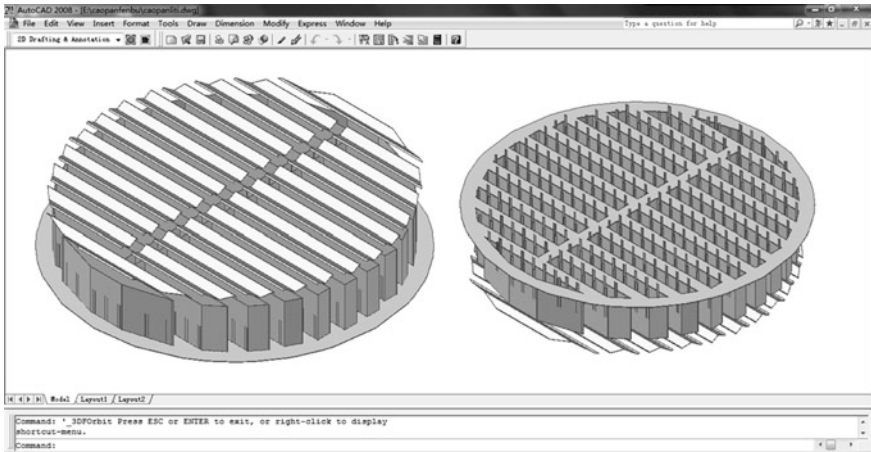


Fig. 12.5 The 3D model of the chimney-tray gas-liquid distributor

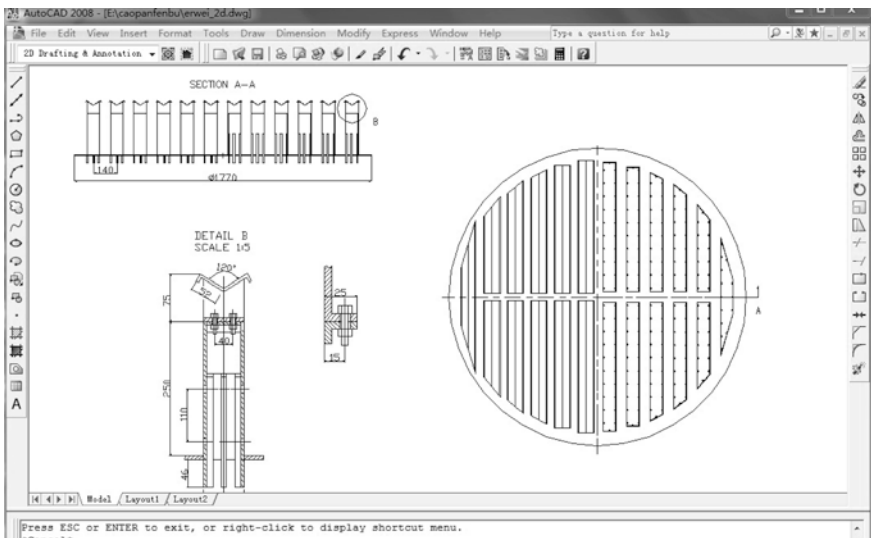


Fig. 12.6 Top view, front view and detail drawings of the chimney-tray gas-liquid distributor

### 12.3.5 Execute the Program

If the parametric design program is compiled correctly, execute the program, and we will obtain the whole 3D solid model of the chimney-tray gas-liquid distributor shown in Fig. 12.5. (The column diameter is 1,800 mm).

Based on the generation of the 3D solid model, some post processing can be done to express the structure of the chimney-tray gas-liquid distributor. Here, two viewports are created in the AutoCAD model space drawing environment, one for the top view, another for the front view and detail drawings (Fig. 12.6).

## 12.4 Conclusions

The secondary development of AutoCAD by taking advantage of VBA makes 3D parametric design possible and provides a design platform which is intelligent, convenient and intuitionistic. In this way, many duplicated work in the drawing process can be avoided and at the same time the drawing quality and the efficiency can be enhanced. As a result of afore-mentioned advantages, 3D parametric design must be widely used in modern industry and design enterprises.

## References

1. Melantoni G (2009) The benefits of 2D parametric design. *J Experience Build Mag* 828:53–57
2. Leng YF, Liu J, Zu F (2011) Parametric design on belt conveyor drums based on VBA. *J Adv Materials Res* 156:1243–1246
3. Inozemtsev AN, Troitsky DI, Bannatyne MWMK (2000) Parametric modeling: concept and implementation. In: 4th international conference on information visualization, 91:504–505
4. Wang Y (1999) Develops AutoCAD2000 application procedure with VBA, vol 47. People's posts and telecommunications press, China, pp 81–83
5. Ye YN (2001) AutoCAD2000ActiveX and VBA reference manual, vol 88. The Chinese electric power press, China, pp 138–142
6. Chen B, Zhou SP, Qiu LB, Peng C (2006) On CAD trough liquid distributor of packing tower. *J Technol Supervision Petrol Ind* 22(8):58–60

# Chapter 13

## Research of Table Tennis Forehand Loop Technology CAI Courseware

**Baowei Zhang**

**Abstract** Applying CAI and multimedia technology to physical education could enhance the teaching effect as well as the guider's teaching ability. Besides, it will definitely stimulate the learners' interests and initiative at the same time. There are about four steps in the process of developing Multimedia Courseware System: material choice, design, writing and operation. Multimedia Courseware is a kind of computer software teaching program which could help to achieve the teaching goal, perform specific teaching content and reveal some teaching strategies. Multimedia sports teaching combines characters, images, sounds, animations and videos, and it motivate students' curiosity and thirst for knowledge with the strong function of computers and psychological hint generated by sounds, lights, colors and images. Simultaneously, flexible ways of expression could improve cognitive environment and learning efficiency.

**Keywords** CAI • Multimedia • Courseware • Table tennis

### 13.1 Instruction

Table tennis is a sports project which led by skills. It contains speed, physical strength, rotation, loop, drop point, rhythm and regulation [1]. Forehand loop, possessing the characteristics of high speed and high rotation speed, is a major technology in table tennis [2]. It is a difficult and key point in the whole basic strokes, and is the most common and crucial one. What's more, it is a necessary score method. In terms of the teaching of the single technology itself, forehand loop technology is comparatively challenging to master so students often make mistakes [3]. The effort of this research is to conduct a preliminary research on the development of table tennis forehand loop technology teaching CAI courseware and make preparations for applying CAI to the process of table tennis teaching.

---

B. Zhang (✉)

Lixin University of Commerce, West Zhongshan Road.2230, Shanghai 200235, China  
e-mail: zhangbaowei@lixin.edu.cn

## **13.2 The Object of Study**

Development and Application of Table Tennis Forehand Loop Technology Multimedia CAI Courseware.

### ***13.2.1 Based on Documents***

Refer to literature materials about computer technology and table tennis forehand loop technology on the basis of the aim and content of the text. Turning to recent materials about multimedia CAI courseware to definitude the situation and orientation of current researches so as to rise the courseware to a relatively higher level in quality and innovation.

Extensively collect articles, images and videos about table tennis game rules, after which, process these materials. Finally, make multimedia courseware using software such as Word, Photoshop, Movie Maker, Author ware, etc.

#### **13.2.1.1 Based on Expert Evaluation**

Before making this courseware, interview and communicate with table tennis professional teachers and experts from School of Computer engineering about the reform in teaching method, the understanding of concept of skills used in playing table tennis, and research and application of courseware, etc. Such preparations could provide suggestions and guidance for the research and help achieve the aim of teaching practice and solving practical problems. After finish making the courseware, invite some experts to identify the content and structure of the courseware and fulfill a table after identification. Lists should either use the “Numbered Item” or “Bullet Item” styles.

#### **13.2.1.2 Based on Questionnaire**

Design a questionnaire about ‘Classification among wrong movements in teaching table tennis forehand loop technology’, and investigate experts of table tennis teaching nationwide.

#### **13.2.1.3 Based on Mathematical Statistics**

Make statistics and analysis of statistics from questionnaires and evaluation tables with SPSS18.0.

### ***13.2.2 Based on Designing Software***

Do research on the operation of Windows2001, 256 million memory, 64 G hard drive, CD of 50 times speed—ROM, scanner, printer.

Choose Windows2001 as the operation system, Macromedia Authorware5.0 as the development tool of the courseware, Poser4.0 to make 3D animation, Adobe Photoshop5.0 to edit images, MicrosoftWord2000 to edit characters.

## **13.3 Guiding Ideology**

Generally speaking, multimedia CAI courseware of table tennis forehand loop provides assistance in teaching students in common classes. Teachers could use the multimedia courseware to perform teaching demonstration, and students may do self-learning through such courseware. The change in teaching methods must be based on the improvement of teaching quality. This courseware regards modern teaching methods as guides, combining modern teaching skills with traditional teaching methods on the basis of the teaching specialty of (Table Tennis Forehand Loop Technology) to construct a new model in teaching table tennis. A vivid and intuitive learning environment with interaction could be provided through the application of the courseware. Fully utilizing those functions like images, animations, voice and videos in the computer could help reform and optimize teaching methods and targets so as to enhance teaching efficiency and quality in all aspects. In conclusion, the basic guiding ideology of our design is to figure out how to make teaching materials. Besides, the design will accelerate the pace of learning progress by conveying those learning materials via different functions of multimedia efficiently.

### ***13.3.1 Analysis of the Structure***

Bruner's theory of the subject basic structure has pointed out that, no matter what subject we teach, it is necessary to make the students understand the basic structure so that they could draw inferences about other cases from one instance. As a result, the key of our teaching method is to study the content, structure, logical relationship and learning skills of the teaching method. The grasp of teaching target has direct effect on the choice of instructional media and the design of teaching units. The guidance of teaching target needed to be noticed in designing CAI courseware. According to (Table Tennis Forehand Loop Technology), here is the teaching target: provide students with vivid and intuitive multimedia learning environment with the courseware, and transmit the content and connotation of (Table Tennis Forehand Loop Technology) to students by using guidance, demonstration and interactive exercises of the courseware to enhance learners' interests, efficiency and actual operation ability. In order to adequately reflect the content

of teaching materials in limited teaching time and space by using various media, the first is not to make all kinds of media according to the sequence and structure of teaching materials but to build up logical structure of knowledge on the basis of the content of teaching materials. After that, identify the knowledge points and proficiency of each unit and choose the media. Secondly, add vivid frames and animation in different angles on the basis of the content and logical structure to enrich classroom instruction, to involve everyone into a situation of knowledge learning, and to deepen understanding of teaching materials.

### ***13.3.2 Development Thought of Courseware***

Extensively collect articles, images and videos about table tennis game rules, after which, process these materials. Finally, make multimedia courseware using software such as Word, Photoshop, Movie Maker, Author ware, etc.

Basic Principles of Courseware Design are Scientific, Practicality, controllability and Generality.

The teaching target of the courseware is to provide a vivid and intuitive learning environment with interaction through the application of the courseware. Fully utilizing those functions like images, animations, voice and videos in the computer could help students establish correct concept of table tennis forehand loop technology and grasp the specification and main point of the actions to enhance the learning efficiency, interests and broaden the scope of knowledge.

### ***13.3.3 Determination of Teaching Content in the Courseware***

In the CAI courseware of table tennis forehand loop technology teaching, the identification of content is a comparatively significant step in the development of the whole courseware. The choice of the teaching content will directly affect the quality and practicality of the courseware.

In order to enhance the generality, practicality and scientific of the courseware, and to make it suitable for both teachers and students, the identification of the content may as well be based on the teaching materials and outline.

### ***13.3.4 The Production of Courseware***

#### **13.3.4.1 Preparation and Production of the Text Materials**

Text materials are the most basic material in the courseware, the mainly of text materials production is the choice of the font, size, and the color, this courseware main choice song typeface, size 16 and black, in order to have the corresponding

primary and secondary content, the font, font size and color made the corresponding adjustment, so that learners can step sizes lesson content of distinguish secondary. First keep the text content found on the website and the information found in the book input word document, then transfer to the courseware through the method of copy and paste, for some special text material, first make in the PowerPoint, then transfer into the courseware, for the special font that can adjust in the Authorware, adjustment can be directly enter in variety of table tennis network of resources and courseware production network to find the desired image, save in three forms: First, Forming BMP, Dib, PCX, TIF and JPG image files are saved directly in the production of courseware folder. Secondly, The desired image using SnagIt capture software graphics grab down into Photoshop be modified, and finally save the form of a JPG button courseware is produced using this method. Thirdly, for some image on the image and books they need, they cannot find the network, using the camera down, and save the form of a JPG in Photoshop processing. JPG is a more familiar type of image is saved, so I in the preparation of the image material am implementing the principles of understandability.

#### **13.3.4.2 The Preparation and Make of the Video Material**

Video is a real record to reality, which has a strong appeal, and an intuitive induction of technical actions.

The video of this courseware takes <<the P.E.-teaching Series—the Action Demonstration of Table Tennis by Tang Jianjun>> as the main basis, and by using multi-media format converter, transforms Rm videos to Authorware-supported format videos, including avi, Inov, I-npg and so on. In addition, when doing video-transform work by Format Factory, you should fill out the start time and the end time of the desired videos, avoiding making excess or useless videos. Some videos which have transformed into swf format should plug in the courseware in the form of the flash video.

#### **13.3.4.3 Preparation and Making of Audio Material**

Sound is a kind of way sending teaching messages and mobilizing the hearing organ of learner to accept knowledge. The sound will make the courseware be full of vitality if it is applied appropriately in courseware. This courseware has two kinds of audio materials: first background music of courseware inserted with MP3 form; second the original explain voice in video.

#### **13.3.4.4 Composing of Script**

The script is the core and main reason of courseware making, which directly influence the quality of courseware making. The script composing of this courseware

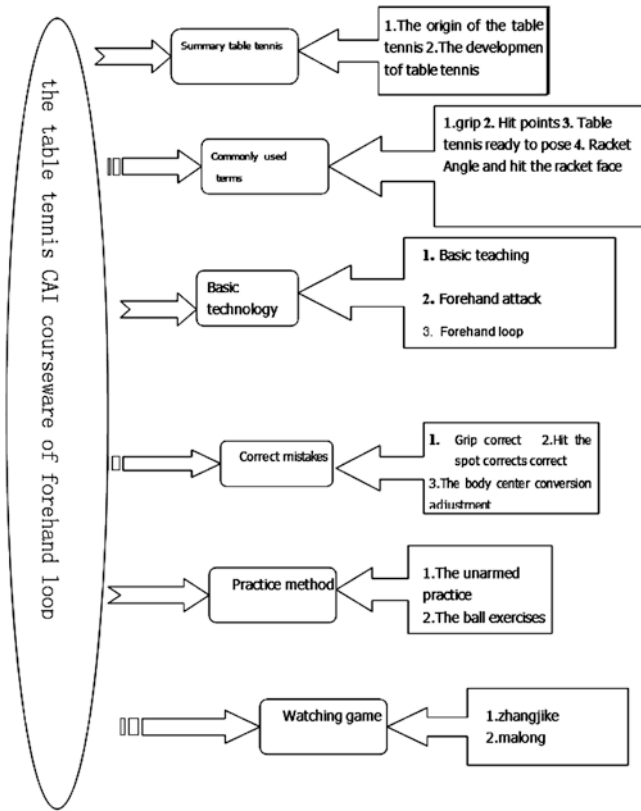


Fig. 13.1 The frame construction of CAI

is in accordance with the <<ping-pong>> authorized by the national institute of physical education teaching materials committee, and also with the reference of other books and images regarding the teaching of forehand arc ball in ping-pong. The frame construction of CAI courseware of forehand arc ball technique in ping-pong please sees the Fig. 13.1.

### 13.3.5 Courseware Characteristics

The operation is simple, easy to use; the function is more complete, the usefulness is stronger; the start of develop is high; use in various way.



### ***13.3.6 Compare the Table Tennis CAI Courseware of Forehand Loop with the Traditional Teaching Assistant Method***

Compare with the forehand loop technique teaching of table tennis use the traditional auxiliary means (for example the slide, the wall map, the videotape and so on), the table tennis CAI courseware of forehand loop has the following some advantage: (1) increase the teaching quantity; (2) increases the forehand fast-break technology of table tennis show-and-tell knowledge covers quantity; (3) the choice of the teaching contents is quickly and accurately, the teaching process accurate control.

## **13.4 Conclusions**

The design of the multimedia teaching and make must prominent characteristics of the contents of teaching materials; the solution should be routine teaching in the difficulty of multimedia development as a breakthrough.

The multimedia of table tennis forehand loop teaching, expand the teaching information transmission way, rich the scene of the students' learning activities, make the teaching activities into a students' autonomous learning process.

## **References**

1. Sun tian ming (1999) Li ping talk about the table tennis course of forehand attack teaching method and means in sport university science and technology of Liaoning sport 5:23–27
2. Sun yan (2004) Ling's investigation and analysis to the CAI courseware of the table tennis forehand fast-break technology teaching Guangzhou sport university newspaper 7:237–239
3. Hubei (2011) The development and application of the combination technical of table tennis left pushes and right attack. Guangzhou University Sports Institute Master's thesis 7:42–43

# Chapter 14

## A Hybrid Genetic Algorithm Based on Harmony Search and its Improving

Wei-Wei Shi, Wei Han and Wei-Chao Si

**Abstract** In order to deal with the shortages of simple genetic algorithm (GA) such as low convergence speed and prematurity, this paper firstly introduced the main process of harmony search algorithm (HS). Then put forward a new hybrid algorithm based on it. This new algorithm integrated the harmony of HS with chromosome of GA appropriately. Furthermore, aiming at reducing computational complexity and saving time of the new algorithm, two improved strategies were given. The experimental results show the new algorithm and its improving are better than the simple genetic algorithm in solution quality, convergence speed and other indicators, and that two improved strategies have their own advantages respectively. It shows that the new hybrid algorithm and its improving are all feasible and effective.

**Keywords** Harmony search • Genetic algorithm • Hybrid • Optimization • Improving

### 14.1 Introduction

Genetic algorithm (GA) is an universal optimal algorithm. It has few requests to the condition of constrain in an optimization problem. So GA can solve a great many actual questions. At present, it has obtained a lot of progress in many fields such as function optimization, machine learning, pattern recognition, image disposal, optimization controller, combinatorial optimization and so on. However, GA also has some shortages such as low convergence speed and prematurity.

---

W.-W. Shi (✉) · W. Han  
Graduate Student's Brigade of Naval Aeronautical and Astronautical University,  
Yantai 264001, Shangdong, China  
e-mail: wtbdoy@163.com

W.-C. Si  
No.1 Department of Naval Aeronautical and Astronautical University,  
Yantai 264001, Shangdong, China  
e-mail: 202sw@sina.com.cn

Recent researches show that the combination of GA and other searching algorithms especially random searching algorithms can greatly improve the performance of GA [1, 2]. So how to find other searching algorithms and combine them organically and effectively is a focus in the current study.

Harmony search algorithm (HS) is a newly emerging algorithm for swarm intelligence optimization. It is a global optimization method and has been applied to many fields [3, 4]. HS comes from the imitation of music creation. Compared to other swarm intelligence optimization methods, the way to get a new solution of HS is through all old solutions' cooperation. Moreover, the fine tuning mechanism is used to improve the local optimization performance.

In this paper, HS is introduced into GA. Then combine them organically. So a new hybrid algorithm is come into being. Its basic design thought and implementation process is introduced. Furthermore two improved strategies for new algorithm are given. The experimental results show the new algorithm and two improved strategies are feasible and effective.

## 14.2 Harmony Search

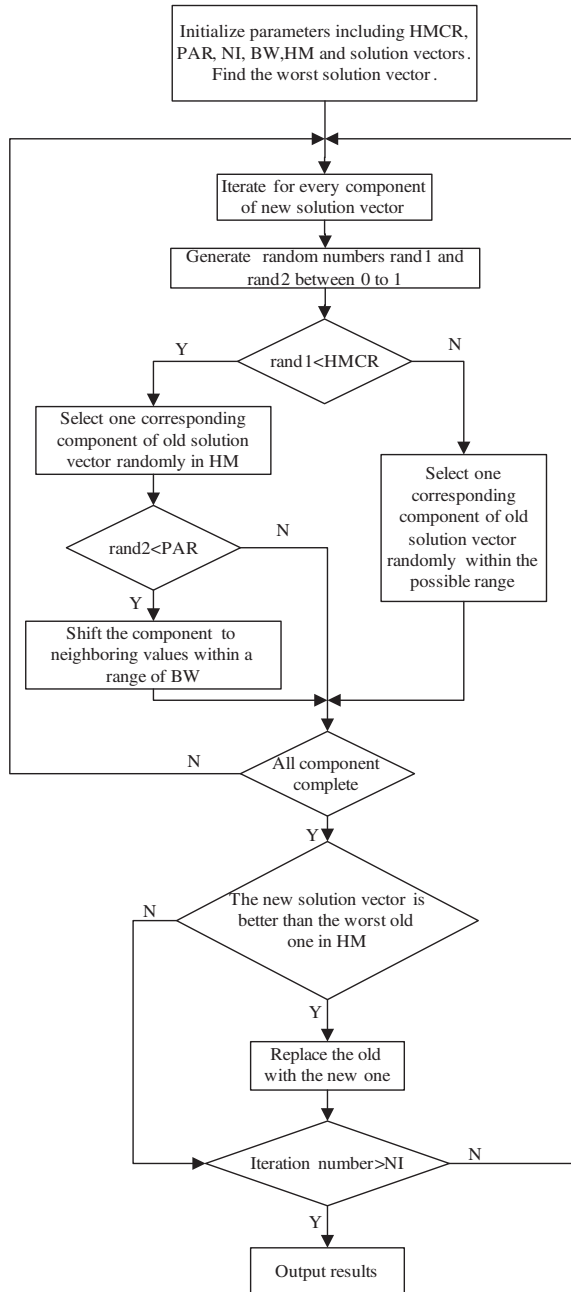
Harmony search algorithm was presented by Geem Z W in 2001 [5]. It is a new intelligent optimization algorithm imitating the music improvisation process where musicians adjust repeatedly their instruments' pitches on their memory searching for a final perfect state of harmony. HS makes an analogy between  $i$ th musical instrument and the  $i$ th decision variable, harmony  $H_j (j = 1, 2, \dots, M)$  formed by all musical instruments and the  $j$ th solution vector, evaluation and the object function.

The main process of HS is that firstly initiate parameters including harmony memory sizes (HMS), harmony memory considering rate (HMCR), pitch adjusting rate (PAR), iteration number (NI), disturbance bandwidth (BW). Then putting HMS harmony (initial solution vectors) generated by random into harmony memory (HM). Search and select randomly in HM by a probability of HMCR for every component of New Harmony (solution vector), otherwise search values randomly within the possible range without considering HM by a probability of  $1 - \text{HMCR}$ . When searching in HM, shift the component of New Harmony to neighbouring values within a range of BW by a probability of PAR. Finally, after forming the New Harmony, if it is better than the worst old harmony in HM, include the New Harmony in HM and exclude the worst old one from HM. This process is repeated until satisfying results are obtained. Figure 14.1 is the flowchart of HS.

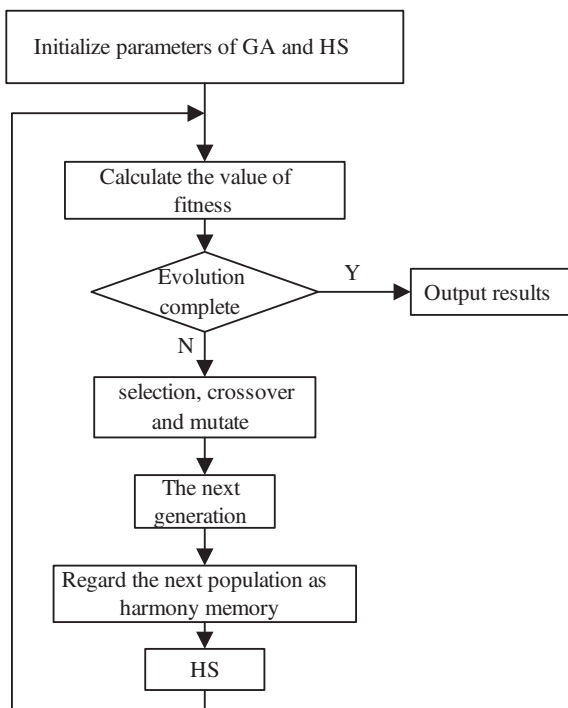
## 14.3 HSGA

HS is fast in convergent speed but low in precision. GA is easy to implement and can be used in many fields but has some shortages meanwhile.

Fig. 14.1 Flowchart of HS



**Fig. 14.2** Flowchart of HSGA



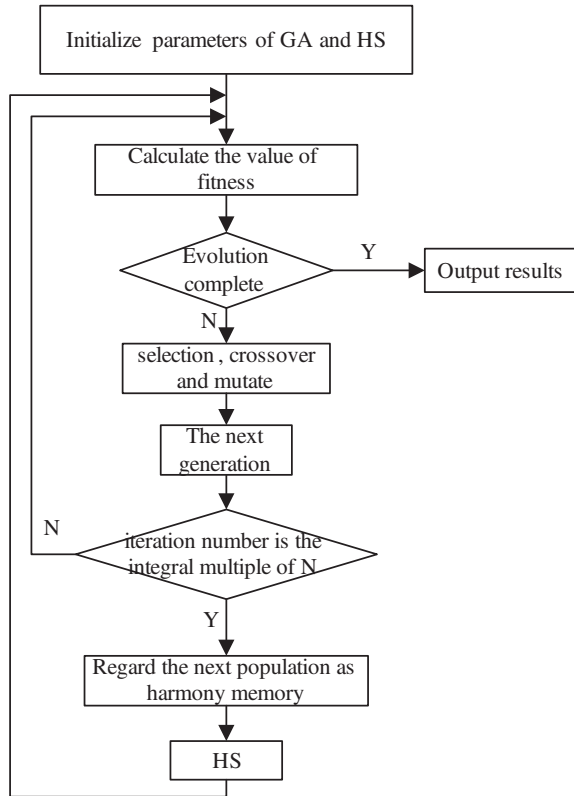
In fact the chromosome in GA and harmony in HS are the different expressions for feasible solution. What's more, populations in GA and harmony memory in HS are the different expressions for set of feasible solution. Based on them, HS is introduced into GA. Harmony and chromosomes are appropriately integrated as well as harmony memory and population. So a new hybrid algorithm HSGA is put forward.

The main process of the new algorithm is that firstly initiate parameters including the size of population, the generations, the probability of crossover, the probability of mutate HMS, HMCR, PAR, NI and BW. Calculate the fitness value of every individual in the population. Then Generate next population by selection, crossover and mutate operation. Regard the next population as harmony memory and regard chromosome as harmony. Generate New Harmony by HS. Calculate the fitness value of every individual in the population again. This process is repeated until satisfying results are obtained. Figure 14.2 is the flowchart of HSGA.

## 14.4 Two Improved Strategies for HSGA

Compared to GA, the new hybrid algorithm HSGA enhances convergent rate and ability of searching the optimal solution. In every circulation all chromosomes in population are operated by both GA and HS. So the operation time and complexity

**Fig. 14.3** Flowchart of HSGA1



of the new hybrid algorithm are more than GA. Considering the solution quality, convergent rate and complexity of new algorithm, two improved strategies are given in this paper.

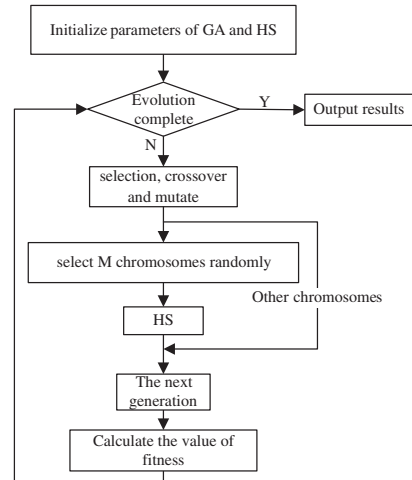
#### ***14.4.1 Improved Strategy One***

The main idea of this improved strategy is that GA is operated in every circulation as global searching. When the iteration number is the integral multiple of N, HS is operated in HSGA to enhance the ability of local searching. N is a fix value. This improved strategy reduces the operation numbers of HS to saving operation time. The new algorithm is named HSGA1. Figure 14.3 is the flowchart of HSGA1.

#### ***14.4.2 Improved Strategy Two***

The main idea of this improved strategy is that after getting the next generation through GA in every circulation, select only M chromosomes randomly to run HS.

**Fig. 14.4** Flowchart of HSGA2



M is a fix value. This improved strategy downsizes HS to reduce complexity of HSGA. The new algorithm is named HSGA2. Figure 14.4 is the flowchart of HSGA2.

### 14.5 Computational Experiments

For testing the performance of HSGA, HSGA1 and HSGA2, four typical testing functions listed in Table 14.1 are presented. The computer’s CPU is P4 2.5 GHz, and memory is 2 GHz.

**Table 14.1** Testing functions

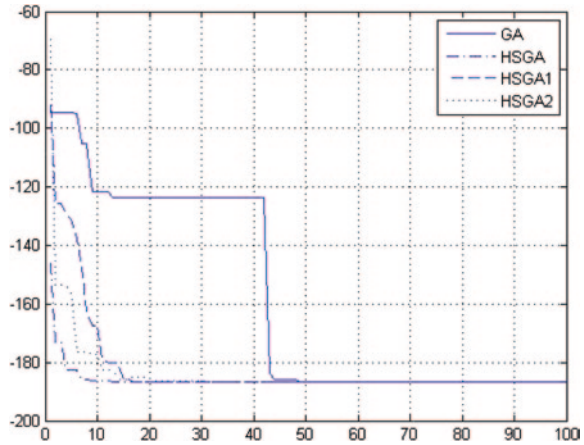
Function	Expression	Domain
$f_1$	$f_1(x_1, x_2) = \sum_{i=1}^5 i \cos[(i + 1) * x_1 + i] * \sum_{i=1}^5 i \cos[(i + 1) * x_2 + i]$	$[-10, 10]$
$f_2$	$f_2(x) = \sum_{i=1}^{20} x_i^2$	$[-512, 512]$
$f_3$	$f_3(x_1, x_2) = 0.5 + \frac{\sin \sqrt{x_1^2 + x_2^2} - 0.5}{[1 + 0.001(x_1^2 + x_2^2)]^2}$	$[-100, 100]$
$f_4$	$f_4(x) = \sum_{i=1}^{20} (x_i^2 - 10 \cos(2\pi x_i) + 10)$	$[-5.12, 5.12]$

**Table 14.2** Comparing results

Function	Indicator	GA	GAHS	GAHS1	GAHS2
$f_1$	Optimal solution	-186.730911	-186.730913	-186.730912	-186.730913
	Average value of solution	-186.635602	-186.720107	-186.714856	-186.719662
	Operation time	1.12	3.41	1.18	2.98
$f_2$	Optimal solution	0.079428	0.026199	0.057819	0.031236
	Average value of solution	1.580753	0.692412	1.149393	0.987524
	Operation time	3.25	10.13	4.53	8.64
$f_3$	Optimal solution	0.997186	0.997513	0.997209	0.997381
	Average value of solution	0.997102	0.997382	0.997113	0.997255
	Operation time	5.17	12.64	6.04	10.38
$f_4$	Optimal solution	9.4268e-04	4.3799e-04	7.3288e-04	5.2242e-04
	Average value of solution	25.1336e-04	9.8823e-04	15.0794e-04	11.3612e-04
	Operation time	115.28	423.78	202.15	387.75



**Fig. 14.5** Comparability test on convergence process



The parameters of algorithms used in the test are: the size of population is 40. The probability of crossover is 0.7. The probability of mutate is 0.1. HMCR is 0.95, PAR is 0.3, BW is 0.001, N is 10 and M is 20. Four typical testing functions are all operated by GA, HSGA, HSGA1 and HSGA2. Every algorithm operates every testing function 100 times separately. Table 14.2 shows the statistical results. Figure 14.5 compares the convergence process of different algorithms operated on testing function  $f_1$ .

According to Table 14.2 and Fig. 14.5, HSGA, HSGA1 and HSGA2 are better than GA in optimal solution quality, average value of solution and convergence speed. It shows three new algorithms are feasible and effective. Comparing with HSGA, HSGA1 reduces running time greatly but the distance between optimal solution quality and average value of solution is enlarged. It shows low stability of solution quality. HSGA2 is higher stability of solution quality but more operation time and complexity comparing with HSGA1.

## 14.6 Conclusion and Discussion

According to the shortages of GA such as low convergence speed and prematurity, HS is introduced into GA and a new hybrid algorithm HSGA is put forward. Considering the solution quality, convergent rate and complexity of HSGA, two improved strategies are given. The experimental results show the new algorithm and its improving are better than GA in solution quality, convergence speed and other indicators. It shows that three new hybrid algorithms are feasible and effective.

There are also many problems for HSGA, HSGA1 and HSGA2 which need to be improved. The further work will be that integrate GA and HS more effectively. At the same time design and select more appropriate parameters in order to improve algorithm efficiency.

**Acknowledgments** This work was supported by Nature Science Foundation of China (60902054), and China Postdoctoral Science Foundation (20090460114, 201003758).

## References

1. Zhang S-Y, Cai Z-H, Zhan Z-G (2011) Solving 0–1 Knapsack problem based on genetic algorithm with improved simulated annealing. *Microelectron Comput* 28(2):61–64
2. Ai Bao-Li, Wu Chang (2010) Genetic and simulated annealing algorithm and its application to equipment maintenace resource optimization. *Fire Control Command Control* 35(1):144–145
3. Mu Feng, Yuan Xiao-Hui, Wang Ci-Guang (2010) Ant-colony-genetic algorithm with adaptive parameters based on grey prediction and normal cloud. *Control Theory Appl* 27(6):701–707
4. Xue Feng, Wang Ci-Guang, Mu Feng (2011) Genetic and ant colony collaborative optimization algorithm based on information entropy and chaos theory. *Control Decis* 26(1):44–48
5. Yang Xiao-Ying, Peng Gangz, Wang Taoz (2010) Tracking algorithms based on quantum genetic particle filter for WSN. *Comput Eng Des* 31(23):4950–4952

# Chapter 15

## Analysis on Construction Project Safety Based on Fuzzy Evaluation Method

Minghua Wang and Jing Gao

**Abstract** Due to their unique properties, the construction industries become more dangerous. The paper is based on the fuzzy evaluation method to the evaluation of construction engineering safety. Exploration in the construction industry is prone to the risk factors. Training management personnel safety consciousness, improve the construction of protective equipment, for the construction industry to provide some improvement measures.

**Keywords** Construction engineering • Fuzzy evaluation • Safety consciousness

### 15.1 Introduction

At present, due to the unique nature of the construction industry makes it one of the most dangerous building industries, construction safety construction workers and researchers pay most attention to a problem [1–3]. Some of the factors that directly affect the construction engineering safety, for example, worker's attitudes, construction company scale, security policy, project coordination, economic pressure, management training and safety culture. At present, China's construction safety is not optimistic, according to the 2000 China construction industry statistics show that, in 1999, there were 923 cases of three above the level of the building construction safety accident (draw each accident basically has killed 2 people, injured direct loss of 3–19, 1–3 billion yuan), one of every 1,097 people lost their lives. In 1999 the construction total working population of 24,286,000 people. The cause of these injuries accident probability is 3.8 deaths per 100,000 workers per 100,000 workers, 4.5 workers belonging to the 1–3 level disability [4]. The article from the architectural engineering security to explore the construction industry to the risk events, determine the construction site safety influence factors, in order to improve the construction industry safety put forward reasonable suggestions. Construction of the building industry in

---

M. Wang (✉) · J. Gao  
Binzhou Polytechnic, Binzhou 256603, China  
e-mail: bz\_wmh@163.com

**Table 15.1** The architecture of construction safety evaluation system

Architectural design	Design of basic provisions Indoor environment design
Building fire protection	The construction of various types of specialized design Basic provisions Structure design
Construction equipment	Enclosure structure Water supply and drainage equipment Gas equipment, electrical and lightning protection equipment
Survey and foundation	Heating, ventilation and air conditioning equipment Foundation investigation, foundation design, foundation design
Structure design	Slope, foundation of roadway Foundation treatment Building fire resistance rating classification, and fire-resistant limits
Anti-seismic design of building	General layout and layout Fire safety evacuation, fire fighting, and structure of elevator, fire extinguishing facilities
	Seismic fortification basis and classification Basic provisions, seismic design of structures Housing isolation and mitigation

the status of supervisory body. Including the development plan, regulate the construction market and construction institutions, as well as on construction safety monitoring [5]. The great man once said: While person is creating environment, the environment also created a person. The harmonious campus environment can encourage the student's emotion and motive, equally for forming the university student's creative character talented person to provide may; It can also stir up the student's endless imagination and guide them to search and pursue and struggle at the same time, thus for formed the university student of innovation characteristic to create condition. Harmonious campus environment at with his/her strong influence and permeate a dint help student gradually establishment rise correct philosophy of life, value, and construct one actively upward of creative character [6].

Construction safety evaluation system mainly includes six parts: first, building design; building fire; second, third, fourth, reconnaissance and construction equipment; foundation; structure design; fifth, sixth, building aseismic design. As shown in Table 15.1.

## 15.2 The Establishment of Safety Evaluation System

The academic atmosphere that forms harmony in the high school can guide the research that the student emphasizes science, climb science high peak and cultivate good campus and campus style spirit. Under the new situation, the high

school should hard construct excellent academic atmosphere and hard develop dependably, diligence, careful, the talented person of innovation. Meanwhile, we should insist taking essential culture as predominance. Socialism advanced culture included essential culture in campus culture; it was the essence of our national time spirit and campus spirit. Is to can't get away from the essential and cultural in harmonious campus cultural construction process, because it is to construct harmonious campus cultural foundation and assurance. Because the world is already diversified, present coming trend of not-essential culture of in campus culture currently, and have a lot of university students to mean favor to it, not-essential culture has already blown to have a warning to essential culture.

A complete architectural engineering safety analysis should be used to design, procurement, construction mode.

1. The design stage effects of engineering factors are: first, the design plan of work; second, design qualification and experience; third, design standards and norms; fourth, design quality; fifth, design depth and procurement and construction of cross; sixth, drawing construction; seventh, can be the change processing. Engineering design of safety evaluation system as shown in Fig. 15.1.
2. The complete procurement phase safety assessment analysis system should include: first, purchase plan; second, supplier selection; third, equipment performance and productivity; fourth, spare parts and after sale service; fifth, equipment factory inspection; sixth, equipment process. As shown in Fig. 15.2.
3. The complete construction safety evaluation system including safety management, civilized construction, base of roadway and template engineering, electricity, construction material hoist and elevator, the tower crane and hoisting, construction machinery. As shown in Fig. 15.3.

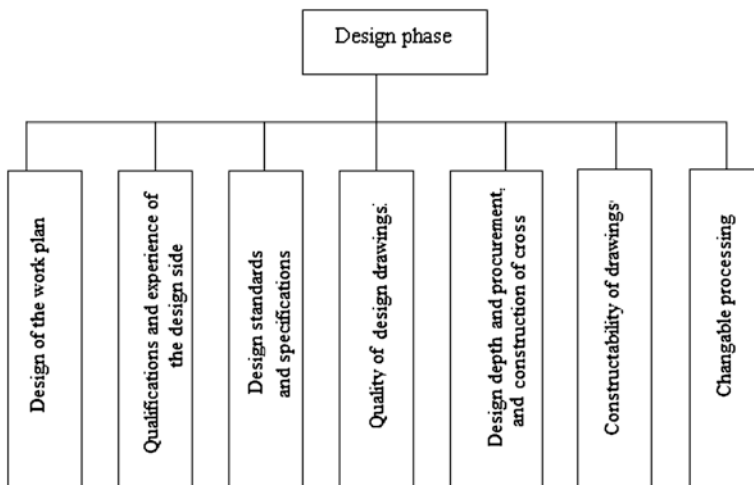


Fig. 15.1 The engineering design stage of safety evaluation system

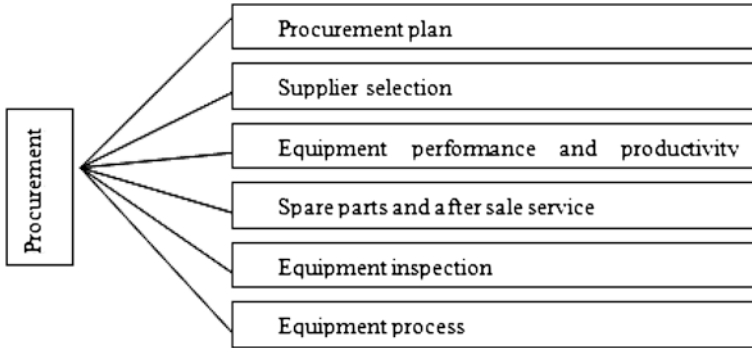


Fig. 15.2 The procurement phase of safety evaluation analysis system

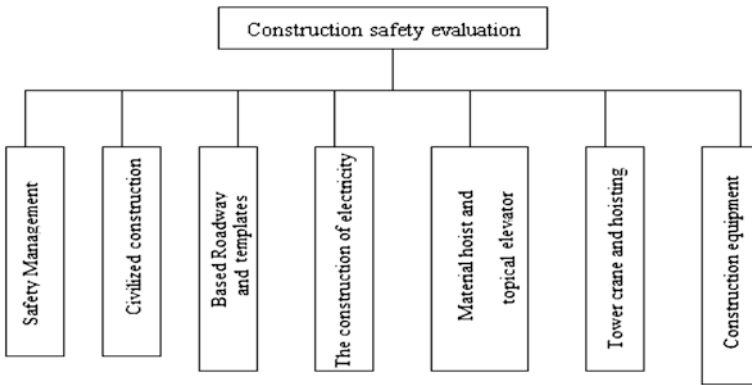


Fig. 15.3 The construction phase of the safety assessment analysis system

### 15.3 The Application of Fuzzy Evaluation Model

Use the method of fuzzy evaluation for construction engineering safety by fuzzy analysis. Fuzzy evaluation mainly involves three main factors [7–9]:

- The first, establish the factor set  $U = \{u_1, u_2, \dots, u_m\}$
- Second, establish the evaluation set  $V = \{v_1, v_2, \dots, v_n\}$
- In third, the single factor judgment matrix [10]:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} \tag{15.1}$$

Among them, judgment matrix R is single factor geometry U evaluation judgment, get V on the fuzzy set (2) the safety grade fuzzy evaluation analysis.

The domain for V, and the definition of  $V_i = (i = 1, 2, l, m)$  with the increasing of i, system risk is gradually increasing. Make  $W_i < W_{i+1}$  the domain of the V ranges for [11]:

$$\Omega = \{w_1 : w_2, w_1 : w_2, l, w_{m-1} : w_m\}$$

$$\bar{B} = \{u_{v1}, u_{v2}, \dots, u_{vm}\}, \text{ and the } \sum_{i=1}^m u_{vi} = 1 \quad (15.2)$$

Then, a security feature vector for grade [12]:

$$H_{uv} = [H_{uv}^+, H_{uv}^-] \quad (15.3)$$

$$\text{In which, } H_{uv}^- = \sum_{i=1}^m u_{vi} [w_i + u_{vi}(w_{i+1} - w_i) \div 2]$$

$$H_{uv}^+ = \sum_{i=1}^m u_{vi} [w_{i+1} - u_{vi}(w_{i+1} - w_i) \div 2] \quad (15.4)$$

Fuzzy characteristic quantity of safety grade median [13]:

$$H_{muv} = \sum_{i=1}^m 0.5u_{vi}(w_i + w_{i+1}) \quad (15.5)$$

When the  $[H_{uv}^+, H_{uv}^-] \subseteq [w_i, w_{i+1}]$  When the, Safety grade is a 100 % chance;

When the  $[H_{uv}^+, H_{uv}^-] \subseteq [w_i, w_{i+2}]$  When the, Security level as a possibility for [14]:

$$\pi_i = \frac{\int_{H_{uv}^-}^{w_{i+1}} u_{Fvi}(w)dw}{\int_{H_{uv}^-}^{w_{i+1}} u_{Fvi}(w)dw + \int_{w_{i+1}}^{H_{uv}^-} u_{Fvi}(w)dw} \quad (15.6)$$

## 15.4 Conclusion

Architectural engineering security related to the personal and property safety problems, but because of the current building design risk, uncertainty of many factors, the accurate and objective evaluation of construction engineering design safety is a difficult job. In this paper, based on the mathematical theory of fuzzy evaluation method for construction of the safety assessment and analysis, not only can understand and grasp the project design of the overall safety, but also can provide prevention and improvement measures.

## References

1. Liu B (1999) Engineering project management: a practical handbook. Chemical Industry Press, Beijing 22(2):190–199
2. Zhao T (2006) Equipment engineering supervision quality control. Tianjin University Press, Tianjin 21(23):123–128
3. Liu T, Zhang X, Liu G (2005) Safety evaluation methods guide. Chemical Industry Press, Beijing 23(31):398–403
4. Huang Jixin, Fang Dongping (2006) How to safety culture in the construction industry. China Saf Sci J 16(8):78–81
5. Su Y, Huang L (2006) Construction design of safety fuzzy evaluation. Coal eng 4(7):76–78
6. Li Lixin, Yu Yuanyuan (2006) Based on the fuzzy theory of subway foundation pit engineering safety evaluation method. J Shenyang Constr Univ 1(12):55–59
7. Fang Dongping, Huang Xinyu, Huang Zhiwei (2001) The construction safety management present situation and prospects of the research. J saf environ 21(2):25–32
8. Chen Minsheng (2006) On constructability study. Petrol Chem Inst Manage J 21(3):66–68
9. Li H (2007) Building construction safety evaluation. Building sci 11(28):77–78
10. Chen JJ (1998) 1997 China s construction industry and foreign investment. Building Res Inf 121(11):23–25
11. Hinze J (2006) Human aspects of construction safety. J Constr 11(12):212–214
12. Jannadi OA, Bu-Khamsin MS (2003) Factors considered by industrial 2002 Safety contractors in Saudi Arabia. Building Environ 12(5):539–547
13. Wang Jian, Xu Yabo (2005) The method of fuzzy mathematics application in safety assessment. Theory explor 2(2):31–35
14. Lian Fengmei (2006) Research on safety assessment of high-rise construction. Liaoning Tech Univ 12(2):20–29



# Chapter 16

## Analysis Based on Curve Fitting Analysis of Tai Chiquan Treatment of Spinal Diseases Feasibility

Wenhong Deng and Nan Jiang

**Abstract** With the changing of the form of people's lives (the mental-manual shift mainly on seat), complication rate of the related diseases caused as a result of spinal imbalance increases, and the spine-related diseases are getting more and more medical attention. Therefore, health care and rehabilitation of the spine has become a major topic of the contemporary medical profession in the health sector. In this paper, through literature, expert interviews and other methods, from the perspective of spine-related diseases incentives, the principle of treatment of spinal-related diseases, as well as tai chi theory and practice on the curvature of the spine to curve fitting, we explore Tai Chi Chuan movement on the spine positive impact, as well as tai chi exercise on the feasibility of the treatment of spine related diseases.

**Keywords** Psychological dynamics • Game • Quantitative analysis • Team spirit

### 16.1 Introduction

Through the direction of the line of spine four bending force, and in accordance with Newton's Third Law, the spine geometry of the outline can be drawn parallelogram. Lumbar curvature increases, the cervical curvature also increases; lumbar curvature straight, neck curve anti-bow; disorder of the lumbosacral angle, atlantoaxial joints staggered joint; and abdominal and intra-abdominal pressure on the lumbar spine from clinically confirmed playing a certain role in its stability, etc. Therefore, the four-dimensional structure of the spinal contour plays an important role in spine stability [1–3]. Spine abnormalities have human health effects, gradually causing the attention of the modern medical profession. Spinal and soft tissue injury not only can cause physical

---

W. Deng (✉)  
Anshun University, Anshun 561000, China  
e-mail: wenhong\_deng@163.com

N. Jiang  
Beijing Sport University, Beijing 100084, China

pain, numbness, or movement disorders, clinical practice by research confirmation, but also can cause respiratory, digestive, circulatory syndromes, nervous, endocrine, facial features which actually seem having nothing to do with the spine [4, 5].

Spine-related diseases are the cervical, thoracic and lumbar spine bone, joints, intervertebral discs and vertebral weeks of soft tissue that subjected to injury or degenerative changes in the small joints under certain incentive conditions. The occurrence of spinal dislocation, disc, ligament calcification or bone hyperplasia, para-spinal soft tissue swelling, spasm, or adhesions, directly or indirectly, irritation or compression of the nerve root, spinal canal inside and outside the blood vessels, spinal cord or sympathetic, etc., resulting in spinal injuries, illness and multi-system symptoms and signs of the disease. Spine-related diseases are common diseases, with its cervical spondylosis and lumbar high incidence, often influence people's study and work, and even cause serious harm to physical and mental health. The occurrence of spine-related diseases, and its development and change are extremely relevant with spinal intrinsic balance of features, the patient's constitution and the nature of the risk factors.

The spine is the backbone of the human body, and the spine and surrounding soft tissues are a body's balance system. The spine itself is supported by the vertebrae, articular processes, intervertebral discs, ligaments, joint capsule, and other organizations to maintain its stability. Muscles is one of maintaining spinal stability factor, is also a spine is the driving force behind the activities. The normal physiological activities of the spine down in the stabilizing effect of muscle contraction and relaxation to promote the disc, ligaments, facet joints, and various organizations of the above composition anomalies can balance the dysfunction of the spine, and the uncoordinated spine will disrupt normal spinal anatomy and physiology, thereby affecting the corresponding tissues and organs, then causing disease. Spine changes in the structure lead to changes in body functions, and visceral functional changes may also affect the structure of the spine. Because the body's various tissues and organs should be linked through the nerves and spinal lesions can be seen in the spine in the internal organs, adaptive reflex muscle contraction and relaxation function of the change, as well as around the spinal column ligaments, joint capsule adjustment caused by spinal function abnormalities [6–8]. Therefore, spine disease prevention, treatment and rehabilitation play an important role in health of the whole body system.

## **16.2 Theoretical Basis of Tai Chi Exercise on the Treatment of Spine Related Diseases**

Tai chiquan requires “Hanxiong loose waist and back”, “lumbar dominate” which mean Tai chiquan has good effect on the form and organizational structure of the spine. Tai chiquan requires action not only a move action in the line of the campaign which is not simply about flat spin, but can not be designed in the up and down, before and after doing the bending action, and must be lumbar unite the route of the movement to form both up and down, space before and after the curve, in order to establish the basis for a moving action. Only through the lumbar center can we

make the whole nine major movement joints (neck, spinal, waist, hip, knee, ankle, shoulder, elbow and wrist) in turn runs through smoothly. With this axis, both hands to use the centrifugal and centripetal forces of unity, achieving “moving divided, tranquility united” [9]. For many spine-related diseases, the Chinese and the western medical profession both want to promote effective sports therapy, such as “stretch back movement, spinal ring transfer movement” corrective movement. Tai chiuan requires the “loose, top, down” in the body from beginning to end so that the spine in flexion, extension, rotation and turn a comprehensive and overall movement, and the range of motion between two vertebrae is small. However, movement in the overall between the vertebrae and spinal range becomes larger, and slow natural and soft multi-dimensional movement have to maintain the normal curvature of the spine to correct bad state is playing a decisive role. It is worth emphasizing that this Tai chiuan “relax”, “natural”, and “connection” enable practitioners to relax physically and mentally, so that the muscle gets some relaxations. On the basis of relevant expertise the practice can achieve better results, which is consistent with the three principles of treatment of spine related diseases.

## **16.3 Research Objects and Methods**

### ***16.3.1 Objects of Study***

We selected 112 ordinary male and female students to get curvature of the spine before and after the test. We screened 40 students as object of study whose anterior song is greater than 5.0 cm, male 26, and female 14. Anterior song of the research objects value distribution is in the range of 5.1–7.4 cm, with the average of 6.35 cm.

### ***16.3.2 Testing Content***

Requirements subject the level of tension of the trunk muscles to maintain the natural state. Take the neck and lumbar lordosis maximum value. Lung capacity test uses the pontoon spirometer (Model F-III). Vital capacity determination is based on Sports Measurement and Evaluation rules of conduct prescribed in the textbooks.

### ***16.3.3 Testing Methods***

Practice Chen Tai chiuan 5–8 times each day, always in accordance with the basic rules of the tai chi practice [10]: (1) virtual collar top strength: line power walking frame or station line sit cheek emblem adduction, vertical neck along, not bow to his back. In Baihui is like there being a glimmer gently on to mention. The virtual collar top has some strength (or head-hanging, or hanging on roof, or mentioning top). The neck

can not be rigid. The collapse can not be soft or natural vertical. Hanxiang and back; (2) chest slightly closed chest inside, which can pull back on the thoracic Chiang Kai-shek, gas sticker's back. No chest or concave chest; (3) orange hips wrapped hip: hip of both sides of the nest to relax vital convex, hip muscles orange hanging down, and then gently forward, to where there is convergence, the coccyx micro-move forward, meaning that up to boosting the pubic region pubic region gas filling in the four tip.

Corrective rehabilitation gymnastic exercises, specific methods are [11]: (1) Hands clasped behind his cross as close as possible to the shoulder blade, and are forced to withstand the back, while the head is thrown to the back; (2) chest movement, arms held straight and level, in the chest former relative to Taiwan, and outreach to both sides, while rising the forward-looking eyes; (3) supine, hands remaining flat on the side, quite on the chest and abdomen, and the posture of the occipital and the arm thrust; (4) kneeling, both hands to grasp the heel, chest forward, and head holds very hard back; (5) push-ups, elbow flexion, the upper arm to shoulder level with nose-up; (6) sitting and relying, figures folded to hold in the occipital. Head pushing hard back and the back pad in the upper edge of the chair. Do the exercises twice daily, every 30 min or more.

### 16.3.4 Testing Equipment

This is used to test the Qualisys infrared point automatic identification system of Tai chiquan typical action shooting, with the shot frequency 50/s. The traditional high-speed photography (video), compared with the analytical method, infrared light point test system obviates the manual frame-by-point resolution heavy work, not only for rapid feedback of test results, but can avoid the manual interpretation of measurement points due to human error.

### 16.3.5 Testing Steps

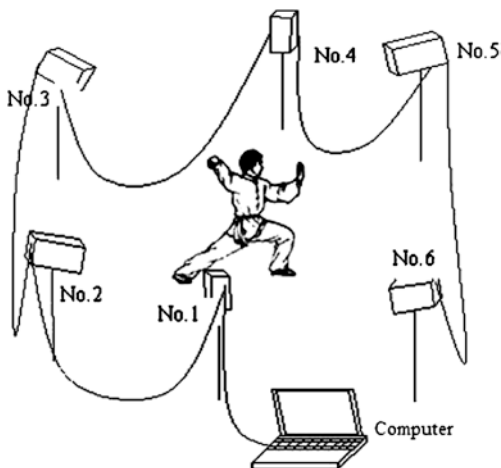
In this research, we use the the Qualisys infrared light point automatic identification system to test. First set the acquisition frequency selection 50/s, acquisition

**Table 16.1** Comparison before and after testing

	n	Anterior neck (cm)	Anterior waist (cm)	Lung capacity nom Hg
Before the experiment	40	6.35 ± 0.72	3.98 ± 0.97	–
After the experiment	40	5.26 ± 0.74	3.37 ± 0.18	–
Difference	40	−0.96 ± 0.83	−0.25 ± 0.48	75 ± 136.5

(Note Lung capacity has gender difference, and should not be mixed through statistics. We compared anterior neck and anterior waist before and after the experiments. ( $P < 0.05$ ))

**Fig. 16.1** Working principles of QUALISYS testing system and test-site scheme computer



time of 8 s. We use the height of 1.9–2.0 m infrared camera whose shooting range is of 5–6 m. Reflective signs point name and a fixed location are shown in Table 16.1, and the camera placement diagram is shown in Fig. 16.1.

### 16.4 Data Processing and Curve Fitting

Human basic axis and the basic section are calculated by setting coordinate system in the torso on the anthropometric point coordinates according to the film resolution through the establishment. Human forehead-like axis (X axis): right shoulder → left shoulder (calculation of the upper limb joint angles), or the right hip → left hip (calculation of the lower limb joint angles). Through the human plane equation of the basic axis we can determine the basic aspects of the human body.

Human horizontal plane: the normal vector of the plane is the body vertical axis (Z axis).

$$S_1 : x_2x + y_2y + z_2z + D = 0 \tag{16.1}$$

Human sagittal plane: body amount-like axis (X axis) is the vector plane.

$$S_2 : x_1x + y_1y + z_1z + D = 0 \tag{16.2}$$

The human frontal plane: the human body sagittal axis (Y axis) is the normal vector of the plane.

$$S_3 : x_3x + y_3y + z_3z + D = 0 \tag{16.3}$$

In the above equations, D is the coefficient to determine the plane position, without knowing its exact value in the later calculation.

For the thoracic and lumbar segments respectively we do the curve fitting. According to the thoracic anatomy, the hyperbolic function is the fitting function,

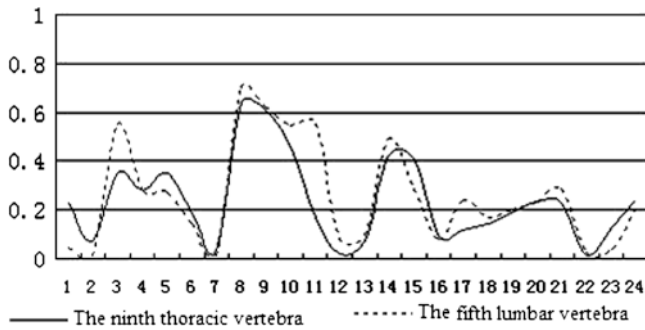


Fig. 16.2 Vertebral curvature comparisons of the objects before testing

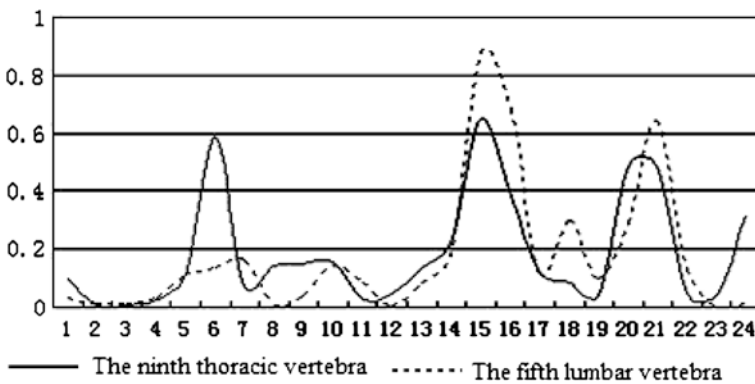


Fig. 16.3 Vertebral curvature comparisons of the objects after testing

according to the thoracic, lumbar spine to fit the projection of the human body sagittal plane coordinates. Application curvature formula can calculate the curvature of the fitted curve at various points, and is applied to calculate the radius of curvature.

Calculated through the data, we obtained before and after the fitting of experimental curves as is shown in Figs. 16.2 and 16.3.

## 16.5 Experimental Results

After the period of six months of the experiment, the data obtained before and after the experimental statistics are shown in Table 16.1.

In the field of rehabilitation research of the spine, chiropractic therapy is a feasible method of chiropractic practice, which is an integrated approach by adjusting the abnormal spine, reaching through channelling, and adjusting the purpose of the function of organs. Harmonization of spine morphology and function

determines the stability of the spine contours of stress on the spine. In the spinal contour outside the four-dimensional stress, muscle ligaments leverage the power and support force. Therefore, the chiropractic needs tendon. On the other hand, the secondary imbalance of the spine, except for injury foreign violence, and bone destruction outside the common disease of the strain are originated in the muscle and ligament damage may cause contour stress imbalance. Therefore, in the physical therapy spine strain disease, tendon is the primary treatment. Vertebral curvature determines the shape of the intervertebral foramen and spinal canal, and also determines the self-positioning of the spinal nerve and spinal cord. Therefore, spinal strain diseases' almost all pathological changes are the curvature changes. Therefore, chiropractic treatment is the conditioning and recovery of the curvature is our primary purpose [12]. The three treatment principles of chiropractic treatment are tendon, channelling and exercise. As for clinical treatment of spinal diseases, the most direct and effective method is to do massage, traction, and sports rehabilitation.

## 16.6 Conclusion

Through six-month Chen Tai chiquan combined with sports rehabilitation training to correct implementation on 40 university students, experimental results show that the cervical from an average of 6.35 cm before the experiment is reduced to 5.26 cm. Although the average after the experiment is still higher than the normal range, the curvature of the spine in a large range, in which 12 had returned to normal range, accounting for 30 % of the total sample. Experimental attacking midfielder before the average 3.98 cm, in the normal range 3.0–5.0 cm, which is the sample range of variation between 2.5–6.1 cm, and the waist is in more than 5.0 cm in the normal range of only four down, accounting for 10 % of the total sample, 90 % of the sample is simply the anterior waist is too large. After the experiment, the average of the waist before becomes 3.37 cm. ( $P < 0.05$ ), which is statistically significant before and after the experiment. Four cases of lordosis of the sample are completely adjusted within the normal range. Chen tai chi exercises combined with sports rehabilitation training can correct the lumbar spine and it has corrective effect.

In summary, using six month Chen Tai chiquan combined with sports rehabilitation training to correct is not only for better correction of the cervical spine, but also for the lumbar spine there was a marked improvement, and increases lung capacity. Six months of training process did not have any negative effect phenomenon. Sports rehabilitation training for the movement of the cervical and thoracic muscles and ligaments attached to the spine proves to be proper exercise, such as the traction of the anterior longitudinal ligament “J” so that it get stretched, which will help reduce the curvature of the chest; back muscle strength can improve the tension and allows the chest and cervical to reduce and ultimately achieve the goal of full recovery.

## References

1. Guikang W (2005) Spine-related diseases and their treatment. People's Health Publishing House, Beijing, 5(3):234–236
2. Zhang C (2008) Spine-related diseases. People's Health Publishing House, Beijing, 18(14):357–362
3. Yizong W (2006) Chinese chiropractics. People's Health Publishing House, Beijing, 2(01):345–347
4. Hai S, Cheng Z (2010) Chiropractic therapy-based treatment of internal diseases clinical reports. *Massage and guided* 10(3):34–36
5. Wang Yongqiang (2004) TCM holistic therapy in the treatment of cervical and lumbar World. *Tradit Chin Med Orthop* 12(2):3–5
6. Xu Yan, Wang Lijun, Yu Chunling (2001) Exercising therapy for treatment of cervical spondylosis. *Mod Rehabil* 5(10):13–15
7. Zhang S (2005) Tai chi book. People's Sports Publishing House, Beijing, 1(10):513–515
8. Li L (2009) Disease of the spine image diagnostics. People's Health Publishing House, Beijing, 11(3):433–439
9. Stefanyshyn DJ, Nigg BM (2007) Mechanical energy contribution of the metatarsophalangeal joint to running and sprinting. *J Biomechanics* 12(30):1081–1085
10. Liu Xuezheng, Liu Hui, Li Shiming, Meng Jie (2009) Different types of tai chi exercise on the human spine. *Beijing Sport Univ* 27(4):480–483
11. Tang H, Gu L (1964) Research on Tai chi. People's Sports Publishing House, Beijing, 4(16):317–320
12. Quan L (2002) Traditional Chen Style Tai Chi fitness value. Shanxi Normal University, Institute of Physical Education 7(1):65–66



# Chapter 17

## A Device Diagnosis Algorithm Based on Naive Bayesian

Xiaoqiang Jia and Nina Li

**Abstract** Make expert knowledge and experience to record a large number of diagnostic reports as research data, use Bayesian machine learning method to compute and find out the current status of mechanical device, which best matches the description of diagnostic suggestions and for experts to provide decision support. Exercise natural language processing methods to initialize the text, then Naive Bayesian methods is calculated the similarity with text of the device state description and diagnostic reports, thus draw the best device diagnostic suggestion to help expert decide. By using the Java language platform did simulation experiments of the algorithm, the final output fairly validate this approach based on similarity analysis, which can draw the best diagnostic recommendations.

**Keywords** Decision support • Naive bayes • Device diagnosis • Uncertain reasoning

### 17.1 Introduction

When to build devices diagnostic system based on device report, uncertainty problems is to be considered. The basic idea of Bayesian theory is given a priori probability of an object, use the Bayesian formula for the posterior probability of the object under the observation conditions, and find out the maximum probability that is output [1, 2]. Given a priori probability, combined with the way the formula to calculate in response to the problem of uncertainty reasoning can find the optimal solution; it has a strong reasoning ability.

---

X. Jia (✉)

School of Mathematics and Information Science, Wei Nan Teachers University,  
Weinan 714000, Shaanxi, China  
e-mail: 394892738@qq.com

N. Li

School of Foreign Language, Wei Nan Teachers University, Weinan 714000, Shaanxi, China  
e-mail: 86456620@qq.com

### 17.1.1 Device Diagnosis Algorithm Based on Naive Bayesian

The device diagnosis auxiliary system based on device diagnostic report [3], it requires the system to diagnose a large number of devices and find reference empirical knowledge in the reports of experts to assist in making decision. Taking into account the real circumstances of the data of device diagnostic reports must be relatively large scale, and the interaction between text data so far is still not a good solution, so here choose Bayesian learning model to solve uncertainty reasoning of device diagnostic report.

Naive Bayesian theory is the most simple and demanding independence in Bayesian learning system, but also the most efficient model. When the Bayesian learning model is applied in device diagnostic expert auxiliary system [4] to the development of device diagnostic report, it needs modification appropriate for the model changes. Throughout the development process, the application form of Naive Bayesian learning model is Bayesian classifier. Text to be classified in pretreatment process to be represented as a text vector is classified to the category the most similar is the task of Naive Bayesian text classification. In order to more clearly expressed Naive Bayesian classifier in the field of application of device diagnostic, whose formula is as follows:

$$P(f_i | d_0, d_1, \dots, d_{n-1}) = \frac{P(d_0, d_1, \dots, d_{n-1} | f_i) P(f_i)}{P(d_0, d_1, \dots, d_{n-1})} \quad (17.1)$$

The meaning of formula (17.1) is based on the device diagnostic report, in which, device status text is described as sample data, with a corresponding device status, diagnosis and treatment recommendations probability.

$$d_0, d_1, \dots, d_{n-1} \quad (17.2)$$

The formula (17.2) indicates vector after preprocessing in the device diagnostic report text, each  $d$  representing a word after preprocessing, which is the training sample data of conditional probability.

$$f_0, f_1, \dots, f_{n-1} \quad (17.3)$$

The formula (17.3) indicates the diagnosis treatment programs with different device status, these diagnostic programs has a direct correlation with the text description of the device status.

$$P(d_0, d_1, \dots, d_{n-1} | f_i) \quad (17.4)$$

The formula (17.4) assume the state for device solutions for the diagnosis is  $f_i$ , and the description of the device state probability vector is

$$P(d_0, d_1, \dots, d_{n-1}) \quad (17.5)$$

The formula (17.5) shows joint probability in the device described text of the state between each text vector, that is, the relationship probability between each vocabulary word.

The Naive Bayesian learning theory, as is given to classified training sample data set based on device diagnostic report, by learning this training text data set,

when meet with new machinery device status information description, it can be found out the most similar devices state diagnostic program. The most important hallmark is its independence assumption for the conditions with Bayesian theory, only on the premise of the assumption is valid, is the results the most accurate in the use of Bayesian theory. After the device diagnosis report preprocessing in the Japanese text, from which the vector is derived That is to say, the result of Japanese text segmentation is independent. It can be drawn the independence assumption and the independence assumption of the Bayesian theory is an exact match. So, we can derive the following formula.

$$f_{NB} = \arg \max \frac{P(d_0, d_1, \dots, d_{n-1} | f_i) P(f_i)}{P(d_0, d_1, \dots, d_{n-1})} = \operatorname{argmax} P(d_0, d_1, \dots, d_{n-1} | f_i) P(f_i) \quad (17.6)$$

Now, what to do is to calculate  $P$  value for each  $P(f_i)$ , which is based on training data derived formula (17.6) in the value of two data items. As long as the device calculates the frequency of each diagnostic report text appears in the text of the training data set, it is all right. However, to calculate  $P(d_0, d_1, \dots, d_{n-1} | f_i)$ , it is difficult to get an accurate result without a very large of training data set. Bayesian theory based on the conditional independence assumption, the joint probability of  $d_0, d_1, \dots, d_{n-1}$  is equal to the product of probability the properties of each individual text vector.

$$P(d_0, d_1, \dots | f_i) P(f_i) = \prod_i P(d_i | f_i) \quad (17.7)$$

And substituted it into the formula (17.4–17.7), the mathematical mode of Bayesian theory can be obtained in this study.

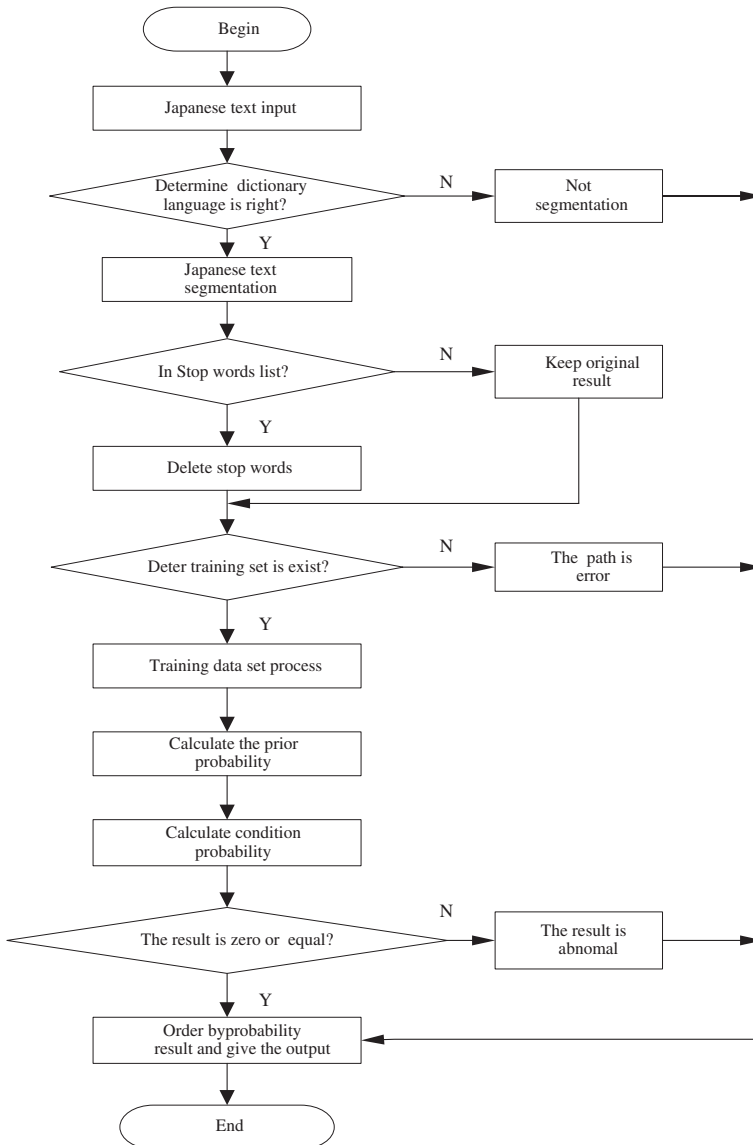
$$f_{NB} = \arg \max P(f) \prod_i P(d_i | f_i) \quad (17.8)$$

In which,  $f_{NB}$  means the best device state corresponding diagnostic recommendations can be obtained by calculating, and calculate different  $P(d_i | f_i)$  is more easier than do  $P(d_0, d_1, \dots, d_{n-1})$  from a large number of device diagnostic report text. After the above formula is derived, the formula (17.8) to be calculated is known. In order to achieve the purpose, and he text of preprocessing is added to. The program flow chart is shown in Fig. 17.1.

## 17.2 Experimental Results and Evaluation

### 17.2.1 Text Preprocessing of the Diagnosis Report Based on Bayesian Theory

As a probabilistic reasoning method, the use of Bayesian theory of uncertainty reasoning is bound to be involved in the calculation of the probability. Since it is a



**Fig. 17.1** Bayesian model based programming flow char

computational problem, it will involve the establishment of mathematical models, and in this study, it is a way to establish a device diagnostic report as data for the decision support method. Therefore, the mathematical model needs to associate text data into the calculation of the probability, that is, the text preprocessing.

First, Japanese word in the device diagnostic report text is processed. The so-called word making great length sentence as unit text is separated into string the

phrase as a unit individually. So far widely used a very high accuracy word segmentation method is based on a dictionary word. The segmentation method is to use a reverse approach to word dictionary.

Second, delete the stop words in device diagnostic report based on the Japanese text, stop words, refers to appear in the text and have no real sense of some modified and dotted words, such as the Chinese in the “a”, “yes”, “in”, the Japanese in the “の”, “は”, “です” and so on.

### 17.2.2 Initialize the Training Data Set

Next to the uncertainty in the process of reasoning, it is needed to initialize the device diagnostic reports and establish the training data set. And build a data training center based on Naive Bayesian methods, experimental data from a power company research project of the intelligent device diagnostics system, description information of the device status and the corresponding solutions are isolated and extracted. Combined with the same solution of the state description, the combined approach is to have the same information processing program put a folder; this folder will be named after the program’s name. The text information with the same folder is storage in Text format. The final structure is as shown in Fig. 17.2.

Figure 17.3 shows the monthly device diagnostic is not initialized with the form of tables. The state initialized the text in the monthly device diagnostic report as showing in Fig. 17.4. In accordance with an earlier diagnosis treatment programs tend to view the corresponding of multiple devices diagnosis, so make dealing with text as a the name of the folder, each folder stored inside is the corresponding views of device diagnosis, that is, the text description of device status information. As is shown below:

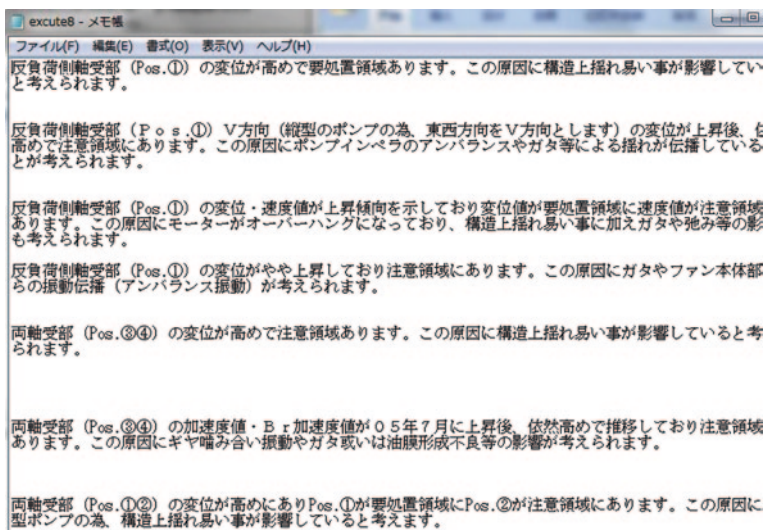


Fig. 17.2 The device status information in folder

部位	診断コメント	処置、対応	実施時期
モーター	モーター同軸受部(Por④)の方位・速度値が測定開始当初と比較すると僅やかに上昇しており注意又は異常領域にありますが、この原因に電磁駆動やガス等の影響が考えられます。	機会を見て異常診断を実施し原因を究明される事をお勧めします。	C
モーター	レベル的には変化しないものの、反直前軸受部(Por④)A方向の方位が依然高めで注意領域にあります。この原因にファンの磨きによるエアークリップやアンバランス等による影響が考えられます。	レベル的には変化しない事から、傾向管理を行えば良いと判断します。	-
本体	レベル的には変化しないものの、本体同軸受部(Por④)A方向の方位値が依然高めで注意領域にあります。この原因にファンの磨きによるエアークリップやアンバランス等による影響が考えられます。	レベル的には変化しない事から、傾向管理を行えば良いと判断します。	-

Fig. 17.3 The original state of the device diagnostic report

- 1 処置1(変位については、上昇・下降を繰り返しているもののレベル的には変化しない事から)
- 2 処置2(上昇・下降を繰り返しているもののレベル的には変化しない事から今後傾向管理)
- 3 処置3(レベル的には変化しない事から、傾向管理を行えば良いと判断します。)
- 4 処置4(今後の傾向管理に於いて振動値が上昇する様であれば御報告致しますので、その)
- 5 処置5(当該軸受はシールタイプでありグリスアップ出来ない事から、今後の傾向管理に)
- 6 処置6(早急な対策が必要なレベルではない事から、傾向管理を行えば良いと判断します)
- 7 処置7(振動については現状では早急な対策が必要なレベルではない事から、傾向管理を)
- 8 処置8(今後の傾向管理に於いて振動値が上昇する様であれば御報告致しますので、その)
- 9 処置9(今後の傾向管理に於いて振動値が更に上昇する様であれば御報告致しますので、)
- 10 処置10(変位については、C重油洗浄機の点検整備を早めに、ご計画される事をお勧め)
- 11 処置11(変位については、本体の点検整備を早めに、ご計画される事をお勧めします。)
- 12 処置12(変位・速度値については、本体の点検整備を早めに、ご計画される事をお勧め)
- 13 処置13(変位・速度値については、レベル的に変化しない事から、傾向管理を行えば良い)
- 14 処置14(変位・速度値については、レベル的に変化しない事から、傾向管理を行えば良い)
- 15 処置15(変位については、上昇・下降を繰り返しているもののレベル的には変化しない事)
- 16 処置16(変位については、上昇・下降を繰り返しているもののレベル的には変化しない事)
- 17 処置17(今後、異音が発生し振動値が上昇する様であれば御報告致しますので、その際)
- 18 処置18(加速度レベルが高めにあるのは流体振動の影響で生来のものと考えますが、今)
- 19 処置19(変位については、レベル的には変化しない事から今後傾向管理を行えば良いと)
- 20 処置20(変位については、レベル的には変化しない事から今後傾向管理を行えば良いと)
- 21 処置21(変位については、レベル的には変化しない事から今後傾向管理を行えば良いと)
- 22 処置22(速度についてはレベル的に変化しないことから、傾向管理を行えば良いと判断し)
- 23 処置23(変位・速度値については、レベル的に変化しないことから傾向管理を行えば良い)
- 24 処置24(レベル的には変化しない事から、傾向管理を行えば良いと判断します。尚、今)
- 25 処置25(変位・速度値については、レベル的には変化しない事から今後傾向管理を行え

Fig. 17.4 The center of training data after training set initialization

### 17.2.3 Experimental Model Based on Naive Bayesian

The training set for the system to establish data center is structured for the text knowledge of device diagnostic report. In order to ensure the integrity of knowledge as much as possible, all the text in a form where the smallest unit is the

sentence, thus making the probability of the process also involves the problem of natural language processing [5].

Learning model based on Naive Bayesian classifier built in the field of device diagnostic applications, regardless of the calculation is the prior probability or the probability of the other conditions, are required prior corresponding processing for the text. To calculate the probability of the text is actually calculated the frequency of key words [6]. Through a variety of segmentation methods, which are now widely used to understand the Chinese language is the word most used language specific word components, these components is actually a word or several language dictionary with a set of rules constituting a word. Therefore, the adaptability to change its practice is to use the dictionary of different language versions to replace in order to achieve the purpose of multi-language processing.

When done from the Knowledge base to the correct identification of the text, the probability calculation, Decision algorithm based on device Diagnostic report has been achieved. Then on the adoption of practical examples to evaluate the test the practical effects.

First, enter a standard device state description of expert:

“No change in the level of two-axis motor displacement and velocity value is still high, and the reason should be considered due to the imbalance caused by the blade and less rigid and other affecting factors.”

Then, it can be seen results from Fig. 17.5 program word for this sentence. From the effect of word, the point of view is still very good, basically to get manual segmentation results. Finally, the probability the results sequenced and the final output:

Figure 17.6 is the probability that the results described in the text input device state corresponding diagnostic treatment programs and device in order to report the similarity of text processing program. Observing the results from the final output, the algorithm can very accurately find the experience of the expert diagnostic knowledge to find the best match proposal [7] for new diagnosis. The final result is shown in Fig. 17.7.

## 17.3 Summary

The use of Naive Bayesian theory, expert decision support system based on the device diagnostic report has improved, the above experimental results proved expert decision support system based on the device diagnostic report had been

```

In process...
知度25(実位 速度値については、レベル的には変化しない事から今後も傾向管理を行えば良いと判断します。):4.421639E20
In process...
知度27(これは予め変動範囲内である事や、負荷変動等一過性の上昇であると考えられる事から、傾向管理を行えば良いと判断します。):4.1179722E11
In process...
知度29(グリスアップを実施し振動値の変化をご確認下さい。尚、当該軸系には自動給油装置(電池式)が設置されていますが、装置作動有無(電池残量)の確認及びグリス変化の確認をされる事をお勧めします。):2.51E
In process...
知度34(運賃値については、振動測定周期を早めた傾向管理の実施、及びオイルポンプの更新準備(予備機の購入等)が必要です。):2.573732E10
In process...
知度36(グリスアップを実施し、振動値の変化をご確認して下さい。):4.9671671E11
In process...
知度39(傾向管理をすれば良いと判断します。):7.738666E8

```

Fig. 17.5 The results of probability sort



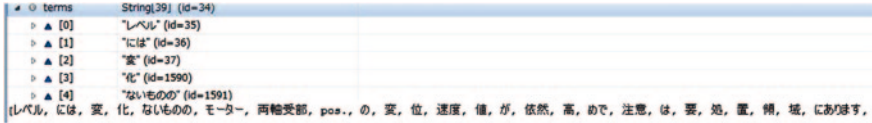


Fig. 17.6 Segmentation of the program



Fig. 17.7 The final output

found the most match diagnostic reference experience with the help of Naive Bayesian model.

## References

1. Gao JJ (2003) Device diagnostic engineering. College and University Admission 6:1–2
2. Langley P, Iba W, Thompson K (1992) An analysis of Bayesian classifiers. In: Proceedings of the tenth national conference on artificial intelligence, vol 88, pp 223–228
3. Huang Q, Li M (2001) A fault diagnosis expert system based on fault tree analysis for lubricating de-waxing process. Comput Appl Chem 18:129–133
4. Patel SA, Kamrani AK (1996) Intelligent decision support system for diagnosis and maintenance of automated systems. Comput Ind Eng 30(2):297–319
5. Zhang H, Ling CX (2001) Learn ability of augmented Naive Bayes in nominal domains. In: Proceedings of the eighteenth international conference on machine learning, Morgan Kaufmann, Los Altos, vol 76, pp 276–300
6. Ohsawa Y, Nara Y (2003) Decision process modeling across internet and real world by double helical model of chance discovery. New Gener Comput (Springer and Ohmsha, Ltd.) 21(2): 109–122
7. Roth D (1999) Learning in natural language. In Proceedings of IJCAI'99. Morgan Kaufmann, Los Altos, vol 55, pp 898–904



# Chapter 18

## A NN-Based Control Method of Uncertain System with Large Time Delay

Li-Xin Wei, Liang Cheng and Ying Li

**Abstract** Aimed at the uncertain models in time-delay systems, a Smith prediction control scheme based on neural network was presented in this paper to overcome the drawback that traditional Smith predictor must depend on the mathematical model of the controlled plant. The scheme can make up for the poor robustness caused by the traditional Smith predictor when the parameters are changed. The simulation results show that this method could be applied in the case of unknown mathematical model of the system, and it had good adaptability when the system parameters were altered.

**Keywords** Large time delay • Smith predictor • Neural networks • Uncertain system

### 18.1 Introduction

To settle the time lag existed in the industrial production system, Smith predictor is commonly used. It can eliminate the time lag theoretically and improve the stability and response characteristic of the system. Considering the shortcomings that Smith predictor not only relies on the mathematical model of the system, but it is very sensitive to the errors of the model parameters.

In Refs. [1–4], the structure of Smith predictor has been improved, it raised the anti-interference performance of the control scheme; Literature [5] combined internal model control and fuzzy control on the basis of Smith predictor, which increased the robustness of Smith predictor; Literature [6, 7] used the way of putting the fuzzy control and adaptive control combined to add on Smith predictor to reduce the dependence on mathematical models; Ref. [8] combined the controller of Smith predictor with the neural network partly. When the object model is completely unknown in the actual production, all of the methods are applied inefficiently.

---

L.-X. Wei · L. Cheng (✉) · Y. Li  
Institute of Electrical Engineering, Yanshan University, Qinhuangdao 066004, Hebei, China  
e-mail: liamcheng901ysu@gmail.com

In this paper, a neural network-Smith (NN-Smith) predictive control scheme was proposed, which could make the controlled plant and its mathematical model matched real-timely through using the neural network to complete the identification and the tracking to the system parameters. As the simulation results showed, NN-Smith predictor is better than the common one both in the application and control effect.

### 18.2 Smith Predictor Control

Smith predictive compensator control scheme can be described as follows: the dynamic characteristics of the process are pre-estimated under the basic disturbance, and then in order to make the hysteretic regulated variable reflected on the regulator in advance and take action at the same time, compensation control is put to use by Smith predictor, which can reduce the overshoot and accelerate the adjustment process.

Suppose  $G_0(s)e^{-\tau s}$  is the controlled plant,  $e^{-\tau s}$  is pure time-delay link, the transfer function of the predictive compensator is  $G_s(s)$ , and the controller is  $G_c(s)$ , the principle of Smith predictor can be shown as Fig. 18.1, and its characteristic equation can be described as in Eq. (18.1).

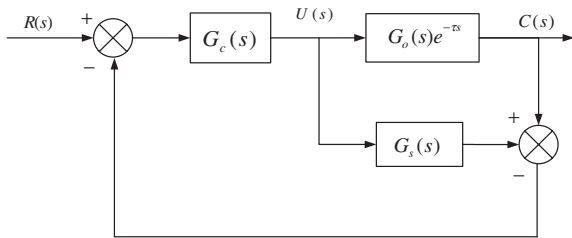
$$\frac{C(s)}{R(s)} = \frac{G_c(s) [G_0(s)e^{-\tau s} + G_s(s)]}{1 + G_c(s) [G_0(s)e^{-\tau s} + G_s(s)]} \tag{18.1}$$

As shown in Eq. (18.1), the lag is contained in the characteristic equation. If the predictive compensator is given by  $G_s(s) = G_0(s)(1 - e^{-\tau s})$ . The transfer function will be given by

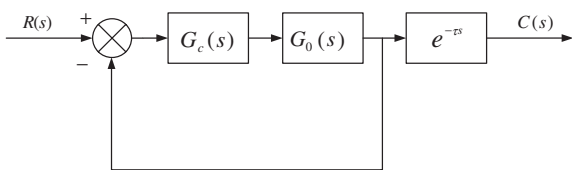
$$\frac{C(s)}{R(s)} = \frac{G_c(s)G_0(s)}{1 + G_c(s)G_0(s)}e^{-\tau s} \tag{18.2}$$

As shown in Eq. (18.2), the delay component can be eliminated from the characteristic equation for the closed-loop system. The equivalent figure of the Smith predictor is shown in Fig. 18.2.

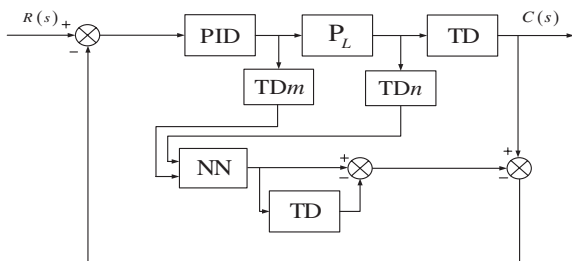
**Fig. 18.1** Block diagram of Smith predictor control



**Fig. 18.2** Block diagram of equivalent Smith predictor control



**Fig. 18.3** Block diagram of the NN-Smith predictor control scheme



### 18.3 NN-Based Smith Prediction Control

Figure 18.3 shows a block diagram of the NN-Smith predictor control scheme, in which  $P_L$  is for the plant, and TD is the dead time of the plant. NN is the Neural network module. Both  $TD_m$  and  $TD_n$  are time-delay which is artificially imposed to the signal.

#### 18.3.1 Learning Steps and Formula Derivation of Offline Training

Off-line identification of the neural network is based on the fact that BP neural network can approach nonlinear function in any accuracy, and the input and output samples of the system are collected to train the network. The system plant is assumed to be:

$$T = f [u(1), \dots, u(k), \dots, u(M); y(1), \dots, y(k), \dots, y(N)] \quad (18.3)$$

where  $u(k)$  and  $y(k)$  are corresponding to the input and output of the system,  $M$  and  $N$  are the order of system's input and output.  $f[*]$  can be linear or nonlinear function. The Neural network structure can be the three-layer BP network structure. Use both the input and output samples as the input of neural network input layer, which is  $x(k)$ .  $x(k)$  is given as:

$$x(k) = \begin{cases} u(k) & .k \geq 1; k \leq M, k \leq N \\ y(k) & \end{cases} \quad (18.4)$$

Assuming the number of hidden layer neurons is  $p$ ,  $s_j(k)$  is the output of the hidden layer, which can be given as:

$$s_j(k) = f_1 \left[ \sum_{i=1}^2 \sum_{j=1}^p w_{ji} x_i(k) - \theta_1 \right] \quad (18.5)$$

As shown in Eq. (18.5),  $\{w_{ji}\}$  is the weight from input layer to hidden layer,  $\{\theta_1\}$  is the threshold of hidden layer,  $f_1[*]$  is the function of hidden layer node. Here choose the Hyperbolic tangent function. The output of output layer is given by

$$y^*(k) = f_2 \left[ \sum_{j=1}^p v_j s_j(k) - \theta_2 \right] \quad (18.6)$$

Here  $\{v_j\}$  is the weight from hidden layer to output layer.  $\{\theta_2\}$  is the threshold of output layer,  $f_2[*]$  is the function of output layer node. Here choose the linear function. The Error indicators of Off-line training can be given as

$$E = \sum_{k=1}^{num} E(k) = \sum_{k=1}^{num} \frac{1}{2} e^2(k) = \frac{1}{2} \sum_{k=1}^{num} [y(k) - y^*(k)] \quad (18.7)$$

As shown in Eq. (18.7),  $num$  is the number of samples.  $E(k)$  is the local error.  $y(k)$  is the output of the plant,  $y^*(k)$  is the output of the Neural network module. When the Neural network is training, the weights are adjusted according to the principle of minimum the local error. The weight adjustment formula is given as

$$\Delta w(t+1) = -(1 - \mu) \alpha(t+1) \frac{\partial E}{\partial w(t+1)} + \mu \Delta w(t) \quad (18.8)$$

As shown in Eq. (18.8),  $\Delta w(t+1)$  is the adjusted weight of hidden layer or output layer.  $\alpha(t+1)$  is the current learning rate.  $\mu$  is the Inertial coefficient.  $\frac{\partial E}{\partial w(t+1)}$  is the Gradient from the error to the weight.

The convergence speed of BP network is greatly improved through increasing inertia element and introducing the learning rules of adaptive learning rate.

### 18.3.2 Neural Network Online Learning

When the system parameters are changed, the fixed weights and thresholds cannot adapt to the new sample of input, which can result in the bigger error. To solve the problem, a judgment link is added to the output of the neural network to determine the error after introducing the comparison between the actual output of the plant and neural network. If the comparison is greater than the error indicator of off-line training, both the weight and the threshold are needed to be re-adjusted.

## 18.4 Simulation

### 18.4.1 Application and Simulation in the AGC System

In the Mill automatic gauge control system (AGC), this is a typical system with large time delay. The AGC transfer function model usually has a very high order and Complex structures. Through the model reduction process, AGC system can be simplified to a second-order system, which can be written as  $G(s)e^{-\tau s} = \frac{2}{3s^2+2s+1}e^{-5s}$  [9]. After discretize the system, both input and output samples are collected as the training samples of the neural network. In order to get a better comparison, the controller of both schemes are using PID controller, with the same parameters. When the mathematical model is accurately matched, the two step response curves almost superposition. As is shown in Fig. 18.4: The smith predictor's step response is rapid, while the NN-Smith scheme has the same response without the accurate mathematical model.

Figure 18.5 shows a different result when the mathematics model is mismatch. By changing the system plant  $G(s)e^{-\tau s}$  from  $\frac{2}{3s^2+2s+1}e^{-5s}$  to  $\frac{5}{3s^2+2s+1}e^{-5s}$ . The overshoot of Smith-predictor is more than 30 %, while the overshoot of NN-Smith predictor is 10 % or less, besides, the adjustment time is only half of Smith predictor. It shows that the stability of NN-Smith scheme is better than Smith predictor.

### 18.4.2 Comparison with Improved Smith Predictive Scheme

Reference [4] proposed a control program with dual-controller, which had good anti-jamming feature. But a precise mathematical model was still

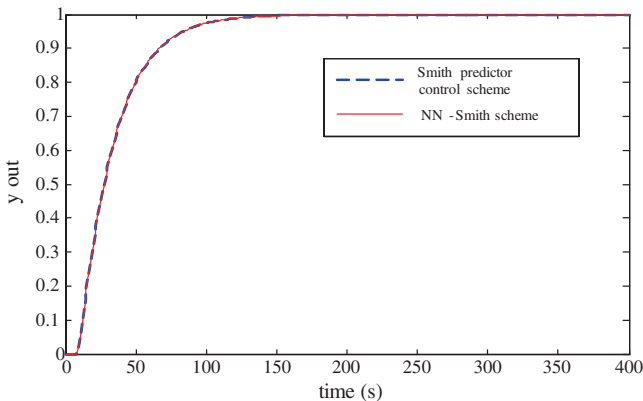


Fig. 18.4 Step response of two schemes when the mathematical model accurately match

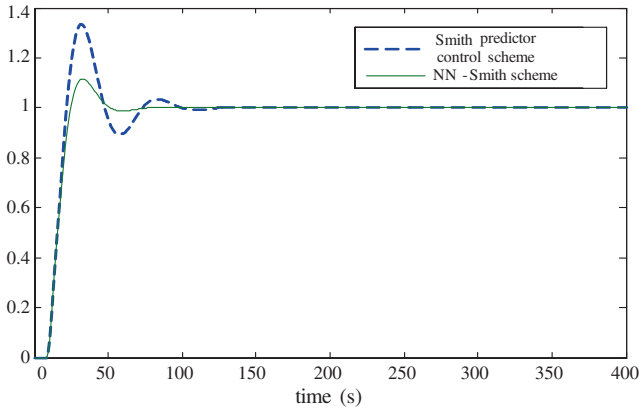


Fig. 18.5 Step response of two schemes when the mathematical model mismatch

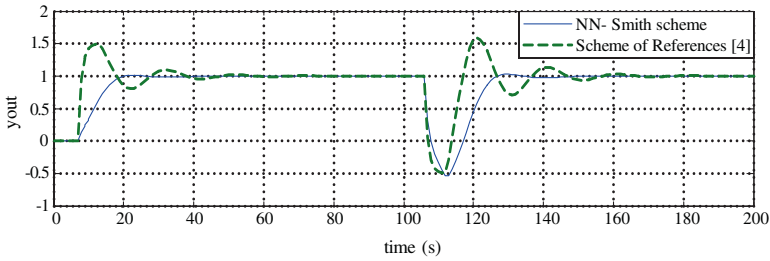


Fig. 18.6 Step response of two schemes when the mathematical model mismatch

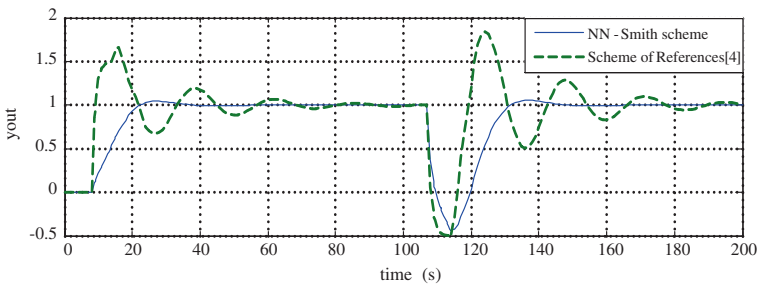


Fig. 18.7 Step response of two schemes when the mathematical model and the lag time both mismatch

selected as its basis in the design and operation. In this paper, the controlled plant of literature [5] is chose; a simulation of comparative study is made between NN-Smith predictive scheme and the one proposed in literature [6]. The comparison of the two schemes is as shown in Figs. 18.6 and 18.7.

As can be seen from Fig. 18.6, when the model is mismatched, the overshoot of scheme in Ref. [7, 8, 10] can reach 50 %, and the adjustment period is longer. When the disturbance signal appeared, the overshoot nearly reaching 70 %. The respond of NN-Smith predictive program proposed in this paper is slower, but the control effect is still better after mismatching, and the overshoot can be limited within 5 %. When the model and the lag time are mismatched at one time as we can see in Fig. 18.7, the program with dual-controller is difficult to achieve stable. But the proposed NN-Smith predictor control scheme is still stable; the overshoot is always controlled within 5 %.

## 18.5 Conclusion

In this paper a NN-Smith scheme is described. The scheme can control the time-delay systems even if the mathematical model is completely unknown, which not only can improve the application of Smith predictor, but also can take advantage of the superiority in controlling the time-lag systems by Smith predictor. When the parameters of the controlled plant are change, NN-Smith predictive controller has better stability.

## References

1. Padhan DG, Majhi S (2012) Modified Smith predictor based cascade control of unstable time delay processes. *ISA Trans* 55:95–104
2. Chen YD, Tung PC, Fuh CC (2007) Modified Smith predictor scheme for periodic disturbance reduction in linear delay systems. *J Process Control* 18:799–804
3. Uma S, Chidambaram M, Seshagiri AR, Chang KY (2010) Enhanced control of integrating cascade processes with time delays using modified Smith predictor. *Chem Eng Sci* 10:1065–1075
4. Tian YH (1999) A double controller scheme for industrial processes with dominant delay. *Acta Automatica Sinica* 77:824–827
5. Yao RH, Xie YF, Jiang ZH (2010) Design of fuzzy two-degree-of-freedom controller for time delay system. *Control Eng China* 54:24–26
6. Wang X, Chen J, Zhu XF (2010) Modification and research of identification adaptive predictive control for variable time delay system. *Control Instrum Chem Ind* 9:25–27
7. Zhang B, Meng XR, Li H, Ma HY (2010) Research on fuzzy PID active queue management based on smith prediction. *Comput Eng Des* 67:986–989
8. Zhang XY, Gao PJ, Liu Y (2010) The researching and simulation of BP neural network PID controller in industry's control system. *Tech Autom Appl* 37:9–12
9. Han LQ (2000) Application of robust control in the automatic gauge control system for the rolling mill. Master degree thesis of Yanshan University, vol 25, pp 234–278
10. Cui DG, Zhang YB, Su YM (2005) On control algorithm for process with pure time delay. *Control Eng China* 33:368–388

# Chapter 19

## Sampling System Based on DSP I/O Space and Resolver

Lin He, Jie Bai, Hexu Sun and Jie Gao

**Abstract** This article describes an implementation of position control system in the shaft—the design of digital conversion. It can be applied to the system that need for accurate position. The core technology is the use of rich I/O space of DSP and the rotary transformer and the high-precision converter. Compared to the conventional position control system, the program simplifies the complexity of the system, reduces costs and increases the processing speed of the system. It is suitable for real-time signal processing; what's more, its reliability and versatility have been greatly improved.

**Keywords** Position control • Digital signal processor (DSP) • Resolver-digital converter (RDC)

### 19.1 Introduction

With the development of industrial technology and control technology, good control effects are required [1–3]. For example, in military applications, radar tracking, and gun positioning etc. needed precise position control. But when the inertia of machinery is large or driving a large load, will cause the system with a lag, seriously affect the rapid and accuracy of system's positioning [4]. So, in some cases precise positioning becomes a difficult point in motion control area [5, 6]. However, precise detection of the position is the premise of precise positioning. In this paper we proposed a position detection scheme, solved the problem, and achieved high-precision detection of position, so provided a guarantee to achieve accurate positioning.

---

L. He (✉) · H. Sun · J. Gao

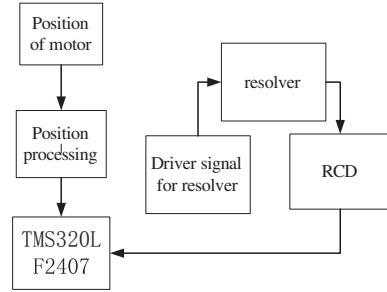
School of Control Science and Engineering, Hebei University of Technology, Tianjin, China  
e-mail: hxsun@hebut.edu.cn

J. Bai

Hebei Professional College of Political Science and Law Shijiazhuang, Shijiazhuang, China



**Fig. 19.1** Block diagram of position detection system



## 19.2 Block Diagram of Position Detection System

With the development of science and technology, CNC machine tools, radar tracking, robotics and etc. need high performance of driver system in accuracy, speed, reliability and miniaturization [7, 8]. It is need to install the sensor to detect the motor's position and speed in real-time in motor speed control and positioning process. The commonly used rotor position sensors are grating encoders, Hall sensors and revolver. The output of grating encoder is digital signal and the processing circuit is simple but it requires harsh environmental and the reliability is poor, cannot use in the field of military and space. Hall sensor detection accuracy is not high enough. Rotary transformer is widely available because thermos table, resistance to humidity, impact resistant, resistance to interference. But the output signal of the resolver is analog; we need the resolver-digital converter (RCD) to converter the signal to a digital for digital signal processors. In this paper we used a dual-channel rotary transformer to detect the rotor's position and the velocity, converted the output analog signal to accuracy digital signal by MTS19R (produced by China Electronics Technology Group Corporation) for the motor controller. Block diagram of position detection system is shown in Fig. 19.1.

## 19.3 Hardware Circuit

### 1. TMS320LF2407 and the I/O space

The system used TMS320LF2407 as the core controller produced by TI (Texas Instruments). This family of DSP chips designed for high accuracy and high performance single-chip motor control system or motion control system. This chip uses a modified Harvard architecture, with separate program and data buses, makes the processing instructions and data can be run simultaneously, greatly improves the efficiency of the processor; uses four pipelining, each instruction processing can be completed in a single instruction cycle, processing speed is greatly increased.

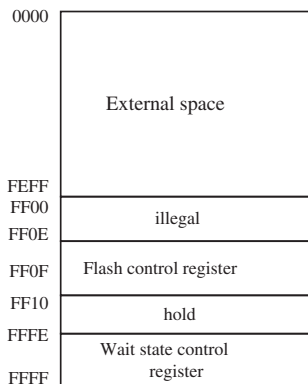


Fig. 19.2 The I/O space address mapping of TMS320LF2407

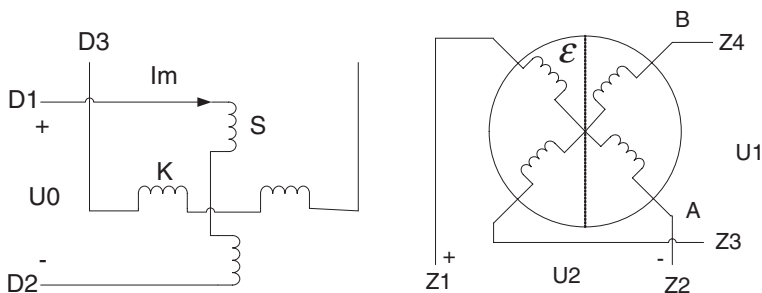


Fig. 19.3 Schematic of rotary transformer

Taking into account the limited number of input and output interfaces in DSP, we used the extensive I/O space resources of DSP. The chip’s I/O space is 64 K words; users can access the I/O space via the external bus. Figure 19.2 shows the I/O space address mapping of TMS320LF2407.

In the C language, to access the I/O space address in the program, you must first use the keyword “import” to define the address which needed to access. We can access the I/O port which is defined by the keyword “import” as a general variable in the program.

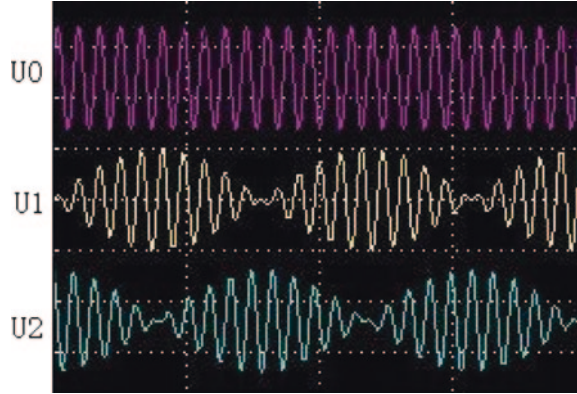
## 2. Rotary transformer and converter

Multi-pole dual-channel rotary transformer is a high-precision angle sensor. Its main features are as follows: 1, high precision, high sensitivity, simple structure; 2, instead of using electrical variable speed mechanical transmission, improve system accuracy and simplify the system structure. The principle of rotary transformer circuit is shown in Fig. 19.3.

Add an AC voltage  $U_0$  with constant amplitude and frequency on winding S.

$$U_0(t) = A \sin \omega_{ref} t \tag{19.1}$$

**Fig. 19.4** Input and output waveforms of rotary transformer



Then output of winding A and B are:

$$U_1(\varepsilon, t) = A \sin \omega_{ref} t \cdot k \cdot \sin \varepsilon \quad (19.2)$$

$$U_2(\varepsilon, t) = A \sin \omega_{ref} t \cdot k \cdot \cos \varepsilon \quad (19.3)$$

where  $k$  is the effective ratio between the two winding turns. From the above expression we can get the rotor's absolute position  $\varepsilon$  by decoding  $U_1(\varepsilon, t)$  and  $U_2(\varepsilon, t)$ . When the rotor rotates uniform the input and output waveforms of rotary transformer are shown in Fig. 19.4.

In this paper we used MTS19R to convert the analog signal of the rotary transformer to digital signal. There are two signal processing circuit in the MTS19R, one is fine circuit and another one is coarse circuit shown in Fig. 19.5. The two circuits are controlled by one reversible counter, the cross detector process the two signals from fine and coarse circuit, and the result output by the latch.

The timing diagram of MTS19R is shown in Fig. 19.6. The output of MTS19R is 19 bit, the controller can control the output latch by the three pin  $\overline{Enable}_{LO}$ ,  $\overline{Enable}_{Mi}$  and  $\overline{Enable}_{Hi}$ , to connect to the data bus.

$\overline{Inhibit}$  is the prohibition signal which is connected to the 5 V power supply by the internal pull-up resistor. When  $\overline{Inhibit}$  at logic "0" the converter is prohibited and the output is enabled, then the controller can read the data after 490 ns. When  $\overline{Inhibit}$  at a logic "1" the internal converter is enabled to work and the output data is invalid.

### 3. Interface circuit

Figure 19.7 shows the interface circuit connection diagram of resolver position detection system. DSP2407 is the core controller, has high cost-effective, and widely used in motor control, digital signal processing and many other areas. MDAC25S20 W is the excitation power which needed dual power supply, and the output frequency is 400 Hz. Sinusoidal signal is connected to the R1 and R4 of resolver and  $R_{L0}$   $R_{Hi}$  of MTS19R, generated by MDAC25S20 W.

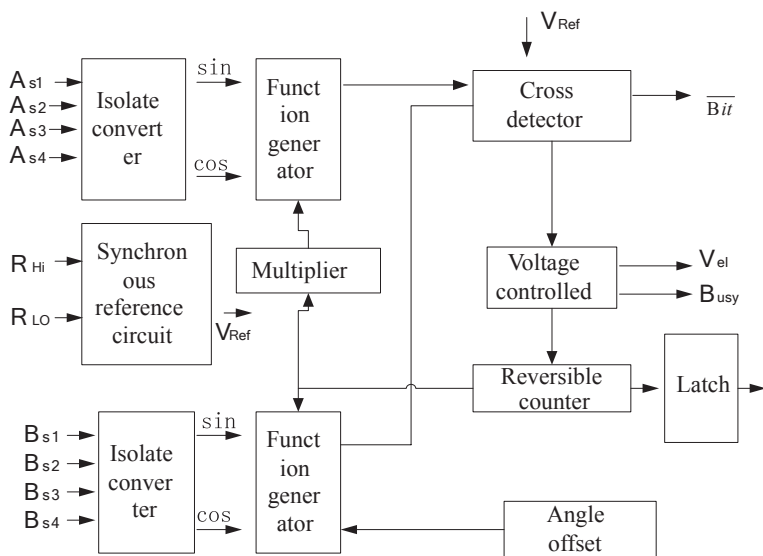
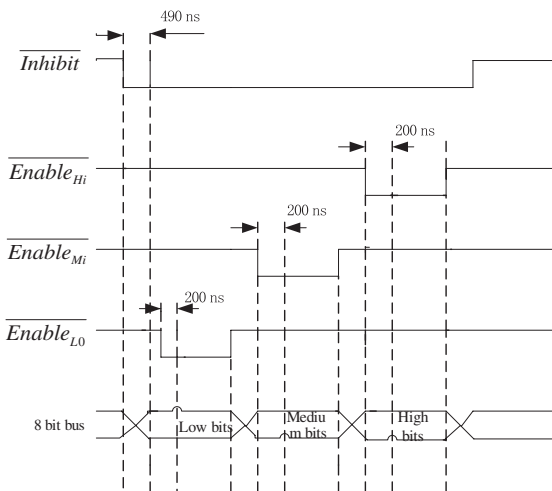


Fig. 19.5 Sample schematic of two-speed converter

Fig. 19.6 8 bit bus transfer timing diagram



Port S1 ~ S4 of rotary transformer connected to the port Bs1 ~ Bs4 of MTS19R, port S5 ~ S8 connected to the port As1 ~ As4 to achieve information transmission. As1 ~ As4 are the fine channel input ports, Bs1 ~ Bs4 are the coarse channel input ports. XTMS0 ~ XTMS7 are the data output ports, XTMCs is the CS port, XTMSenH, XTMSenM, XTMSenL are the high, medium, low data bit enable ports.

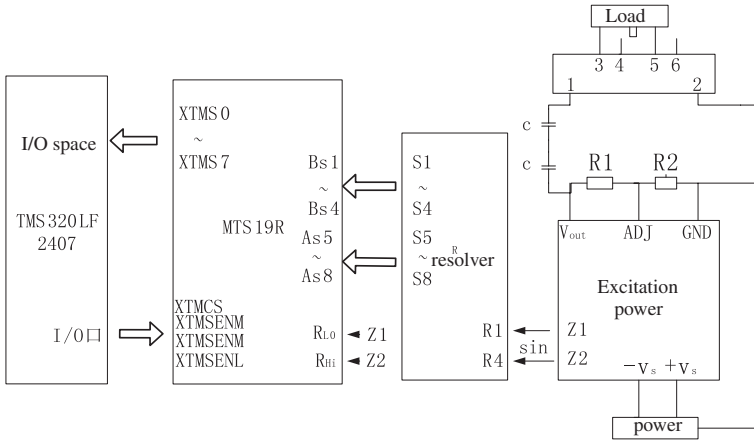


Fig. 19.7 Circuit of hard ware interface

## 19.4 Advantages of this Scheme

### 19.4.1 Improve the Real-Time of Control System

TMS320LF2407 greatly enhanced the data processing speed and capacity. Harvard architecture make it is possible that instruction and data can be handled in parallel and this improved the operation speed.

### 19.4.2 Improve the Accuracy of the Control System

There are two-speed converter and three-state digital output in MTS19R, the resolution up to 20 bits. These features made the decoding of data more accurate.

### 19.4.3 Improve the System Wide Application

As a common element of angle detection, resolver has simple structure, reliable sensitive, no special requirements on the environment, easy maintenance, the output signal amplitude, anti-interference ability, and its detection accuracy to meet the general requirements; it makes the scheme applied more widely.

## 19.5 Conclusion

The combination of DSP, multi-pole dual-channel resolver and MTS19R, makes the angle conversion more accurate. Because of its high precision, small size, high reliability, making this combination has been successfully applied to a positioning system, the accuracy is 0.2 mil.

## References

1. Wu HX, Hong JJ (2008) Study on rotor position detection of motor based on resolver. *Micromotors* 41(4):1–4
2. Sun HX, Meng XC (2010) Simplification of motion controller based on DSP IO space and CPLD artificial intelligence and computational intelligence, (AICI). *Imag Commun* 15(5):265–268
3. Zou X (2008) Resolver signal processing and design. *Huazhong Univ Sci Technol* 7(4):4–6
4. Zhao L, Shu Z (2007) Forty-three institute data sheet. China Electronics Technology Group Corporation 21(34):45–46
5. Liu YD, Zhu HY (2011) Design and implementation of full automaticity parameter tester for resolver. *Micromotors* 41(7):9–12
6. Wen LS, Shuang W (2011) New speed determination method based on resolver. *Electric Drive* 41(15):61–64
7. Shang J, Xu Q (2011) Analysis of the principle of one pair pole axial-flux resistance resolver. *J Harbin Inst Technol* 43(14):70–74
8. Song XL, Wang YX (2011) Analysis on impedance matching of signal windings of variable-reluctance resolver. *Micromotors* 44(13):9–12

# Chapter 20

## Antispam Topic Crawler Algorithm Based on Anti Spoofing

**Xiaoqiang Jia**

**Abstract** The main target for the current crawler system lack the ability of detecting (Web Spam Detection) capacity, which is the primary limitation for further improvement of their performance. In order to supply a want, the topic crawler algorithm based on anti Spoofing is proposed. The design goal of topic crawler is to gather more relevant to subject pages with limited resources, and minimize the likelihood of the irrelevant page. And the algorithm enables the topic crawlers to the function of the ant spam, improves the correlation of the pages downloaded by the topic crawlers, and enhances the adaptability of the crawlers. And the algorithm's effectiveness has been verified by experiments.

**Keywords** Topic crawler • Web spam • Slack variable • Linear and nonlinear

### 20.1 Introduction

Topic crawler [1] traverses on the Web by analyzing hyperlink on the page to achieve the theme of searching. In addition, a variety of labels on Web pages, hereby can afford analytical data for topic crawler to determine whether the page comply to retrieving theme of users. Although the current topic crawler performance has greatly improved by using various machine learning methods, such as neural networks, incremental learning, and the relevant degree in the subject etc., but for the search engines recently, hackers have developed a lot of Web Spam and SEO tools to obtain a higher relevant degree to the subject by cheating crawler. In fact, this page is not much value. Web Spam mainly webmasters to improve their rankings in search engines by some cheating, deception reptiles, and the reptiles page evaluation module gives high priority to obtain economic benefits. To overcome these problems, the subject of anti-fraud web crawler algorithms has made.

---

X. Jia (✉)

School of Mathematics and Information Science, Wei Nan Teachers University,  
Weinan, Shaanxi 714000, China  
e-mail: 394892738@qq.com

## 20.2 Antispam Topic Crawler Algorithm Based on Anti Spoofing

AntiSpam topic crawler is mainly through the analysis of page content and hyperlinks to distinguish whether the page is cheating, in this algorithm, definitions are as follows:

1.  $L$  is the sample number of the marked sites, as  $(X_1, Y_1), (X_2, Y_2), \dots, (X_i, Y_i)$ , where  $X_i$  represents the feature vector of  $i$ -th site, and  $Y_i$  means the label whether site cheats.  $+1$  on behalf of cheating,  $-1$  means no cheating.
2.  $U$  is the sample number of unlabeled sites,  $X_{L+1}, \dots, X_n, n = L + U$ .
3. A weighted directed graph, nodes are the  $X_1 \dots X_n$ , and the edge set is  $E$ , if there is a directed edge from the node  $i$  to node  $j$ , then  $(i, j) \in E$ ,  $W_{ij}$  is the side of weight.

### 20.2.1 Oriented Graph Rules

First trained a linear classifier  $g(x) = v \cdot x + b$ , classifier is train by support vector machine,  $V$  is defined as follow:

$$P(v) = \frac{1}{l} \sum_1^l H(v \cdot x + b, y_i) \quad (20.1)$$

among which,  $\lambda$  is the parameter,  $P(v)$  is used to balance the adaptive and complexity of the algorithm. And  $H(u, y)$  to denote the loss of sample classification, in which,  $H(u, v) = \max(0, 1 - uv)$ ,  $v \cdot v$  is as a parameter adjustments to add classification samples.

Hyperlinks can be denoted as Oriented graph that the edge set is  $E$ . Hyperlinks are not random, it can be found through the analysis, the hyperlink points to the source node and destination node is generally similar to subject [2]. Based on these findings, the above formula (20.1) is to expand, adding new sections:

$$P(v) = \frac{1}{l} \sum_1^l H(v \cdot x + b, y_i) + \lambda \cdot v + \gamma \sum w_{ij} \tau(v \cdot x_i + b, v \cdot x_j + b) \quad (20.2)$$

In which,  $W_{ij}$  is the weight of a directed edge  $(i, j)$ , among which, the first two is linear description of SVM, and the third part is the hyperlink feature representation, the matrix  $(x, y)$  is used to express a structure of the oriented graph. Equation 20.1, 20.2 has been realized by Belkin et al. [3] and Zhang et al. [4] the value of  $\tau$  is the use of  $(u, v) = (u - v)^2$ , which shows that the source and destination addresses have similar predictive value. On the contrary to Belkin and Zhang, the graph structure is designed for Web Spam classification. And using a directed graph to classify, due to a page with Spam will produce a lot of links pointing to the real page, but not the reverse link. So the formula (20.2) is replaced by  $r(u, v) = \max(0, u - v)^2, v \cdot v$ .



For non-linear classification, the use of appropriate inner product function  $K(x_i, x_j)$  can be achieved linear classification after a nonlinear transformation, then the optimization objective function is change into the formula (20.3), in which,  $\alpha_i, \alpha_j$  is the Lagrange coefficient and corresponding Lagrang function is formula (20.4)

$$Q(\alpha) = \sum_{i=1}^l \alpha_i - \frac{1}{2} \sum_{i,j=1}^l \alpha_i \alpha_j y_i y_j K(x_i, x_j) \quad (20.3)$$

$$L = \frac{1}{2} \|w\|^2 - \sum_{i=1}^l \alpha_i y_i (w \cdot x_i + b) + \sum_{i=1}^l \alpha_i \quad (20.4)$$

The problem converted into the dual problem is equivalent to seeking the following inequality:

$$W(\alpha) = \sum_{i=1}^l \alpha_i - \frac{1}{2} \sum_{i,j=1}^l \alpha_i \alpha_j y_i y_j (x_i \cdot x_j) \quad (20.5)$$

$$y_i [(w \cdot x_i) + b] - 1 \geq 0 \quad \sum_{i=1}^n y_i \alpha_i = 0, \alpha_i \geq 0, i = 1, \dots, l \quad (20.6)$$

$$\sum_{i=1}^n y_i \alpha_i = 0, \alpha_i \geq 0, i = 1, \dots, l \quad (20.7)$$

It is also equivalent to find a quadratic function extremal problem under the constraint of the inequality. According to Karush–Kuhn–Tucker (KKT) conditions, the solution of the problem must be met:

$$\alpha_i \{y_i [(w \cdot x_i) + b] - 1\} = 0, i = 1, \dots, l$$

After the above steps, then the classification function can be expressed as (20.8), for which,  $b^*$  is the classification threshold. Characteristics of hyperlinks is added forward and backward,  $P(v)$  is into the Eqs. (20.9), (20.10).

$$f(x) = \text{sgn} \left( \sum_{i=1}^l a_i^* y_i (x_i \cdot x) + b^* \right) \quad (20.8)$$

$$p(v) = \frac{1}{l} \sum_1^l H \left( \text{sgn} \left( \sum_{i=1}^n a_i^* y_i (x_i \cdot x) + b^* \right) \right) + \lambda v \cdot v \quad (20.9)$$

$$\begin{aligned} P(v) &= \frac{1}{l} \sum_1^l H \left( \text{sgn} \sum_{i=1}^l a_i^* y_i (x_i \cdot x) + b^* \right) + \lambda v \cdot v \\ &+ \gamma \sum_{(i,j) \in E} W_{ij} \tau \left( \left( \text{sgn} \sum_{i=1}^l a_i^* y_i (x_i \cdot x) + b^* \right), \left( \text{sgn} \sum_{j=1}^l a_j^* y_j (x_j \cdot x) + b^* \right) \right) \end{aligned} \quad (20.10)$$

**Parameters:**  $\lambda_1, \lambda_2, \gamma, w_{i,j}, \tau(x, y)$   
**Input:** the training set marked  $(x_1, y_1), (x_2, y_2), \dots, (x_i, y_i), \dots, (x_l, y_l)$   
**Unlabeled training set**  $x_{i+1}, \dots, x_n$   
**The directed graph E and edge weights to the hyperlink structure**  $w_{i,j(i,j \in E)}$   
**Compute:** for linear classifier  $v, a \rightarrow \operatorname{argmin}_{v,a} P(v, a)$ ,  $P(v, a)$  is given by (2-11),  
 For non- linear classifier,  $v, a \rightarrow \operatorname{sgn} \min_{v,a} P(v, a, b^*)$ ,  $P(v, a, b^*)$  is given by (2-12).

Fig. 20.1 Improved antisпам algorithm

### 20.2.2 Adding Slack Variables for the Algorithm

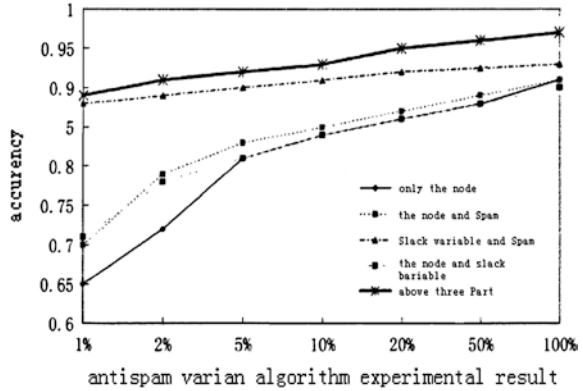
Through analysis, the distance between the feature vectors of the above formula may not be relaxed, at the same time, the linear classifier such as  $g(x) = v \cdot x + b$  is not flexible enough. According to [4] in the discussion, It can be introduced parameters  $a_i$  ( $a_i \geq 0$ ) for each node  $i$ ,  $a_i$  can be seen as slack variables and used to improve the adaptability of the classifier, each node  $i$  for the introduction of parameters  $a_i$ ,  $a_i$  can be seen as slack variables, and used to improve the adaptability of the classifier, then, the formula becomes  $g(x) = v \cdot x + a_i + b$ . Finally, the model can be expressed as follows:

$$\begin{aligned}
 p(v) = & \frac{1}{l} \sum_1^l H(v \cdot x + a_i + b, y_i) + \lambda_1 v \cdot v + \lambda_2 a \cdot a \\
 & + \gamma \sum_{(i,j) \in E} W_{ij} \tau(v \cdot x_i + a_i + b, v \cdot x_j + a_j + b)
 \end{aligned}
 \tag{20.11}$$

If it is nonlinear, the introduction of non-negative slack variables  $\xi_i, i = 1, 2, \dots, l$ , the final model can be expressed as (20.12), C is a constant. Of course, non-linear can be converted to linear. The improved antisпам algorithm is shown in Fig. 20.1.

$$\begin{aligned}
 P(v) = & \frac{1}{l} \sum_1^l H \left( \operatorname{sgn} \sum_{i=1}^l a_i^* y_i (x_i \cdot x) + b^* + C \sum_{i=1}^l \xi_i \right) + \lambda v \cdot v \\
 & + \gamma \sum_{(i,j) \in E} W_{ij} \tau \left( \left( \operatorname{sgn} \sum_{i=1}^l a_i^* y_i (x_i \cdot x) + b^* + C \sum_{i=1}^l \xi_i \right), \right. \\
 & \left. \left( \operatorname{sgn} \sum_{j=1}^l a_j^* y_j (x_j \cdot x) + b^* + C \sum_{i=1}^l \xi_i \right) \right)
 \end{aligned}
 \tag{20.12}$$

**Fig. 20.2** Five kinds anti spam variant of the algorithm results



### 20.2.3 The Experimental Results to Selecting Different Features for Antispam Algorithm

All the experimental data of this experiment come from Web Sparm Challenge 2010 project collating data set WEBSpAM.

1. The weight  $W_{ij}$  selecting: the final selection  $W_{ij} = \log^{(1+n_{ij})}$
2. The expression to matrix  $(x, y)$

If node  $i$  and node  $j$  exists the hypertext link,  $\tau(S_i, S_j)$  can be measured hyperlinks value between Spam score  $S_i$  of the nodes  $i$  and score  $S_j$  of node  $j$ .

$\tau(S_i, S_j)$  is defined as follows:

$$\tau(S_i, S_j) = \alpha(S_i - S_j)^2 + (1 - \alpha)\max(0, S_j - S_i)^2 \tag{20.13}$$

In general, when a cheat site link to a site that is not cheating, and the contrary link is not existence, and we assume that the link is very little in the Spam. Three parts in Eq. (20.13) respectively repret node characteristics, slack variables, and Spam-way. The three-part in the distinction role between Spam page is different, so we choose a different combination to verify the importance of each part.

Results to five kinds of antiSpam variant algorithm is shown in Fig. 20.2 (NB classifier): As can be seen from Fig. 20.1, ignoring Spam one-way hyperlink, and selecting only the features of the site classification items are generally the same. On the face of it, continuing to tap the Spam features for improving classification accuracy, better filtering Spam page, are of great significance.

## 20.3 Summary

Mainly analysed the problems of current topic crawler, and proposed anti-cheating and its variants algorithms, antiSpam algorithm and its variants use SVM to train classifiers. As can be seen from the experiment, determine the key attributes

of classification is to map the hyperlink itself and the characteristics of the site itself is relatively small. Algorithm improvements in the future, research should focus on the hyperlinks between Web site and themes drift problems. Of course, by the proportion of the sample cluster analysis, although the classification accuracy improved better, while filter Spam page fairly better, it need to the help of text filtering technology.

## References

1. Zhu L (2008) Research and design about Topic crawler on Web. *Nanjing Univ Sci* 7(3):11–13
2. Zhou X, Zhang HX (2008) An algorithm of text categorization based on similar rough set and fuzzy cognitive map. In: *Proceedings of the 5th international conference on fuzzy systems and knowledge discovery*, Jinan, China, vol 40(4), pp 34–36
3. Belkin M, Niyogi P, Sindhvani V (2005) On manifold regularization. In: *Proceedings of the 10th international workshop on artificial intelligence and statistics (AISTATS)*, vol 22(18), pp 6–7
4. Zhang T, Popescul A, Dom B (2006) Linear prediction models with graph regularization for web-page categorization. In: *KDD 06: Proceedings of the 12th ACM SIGKDD international conference on knowledge discovery and data mining*, vol 34(5), pp 821–826

# Chapter 21

## Solution of Fuzzy Pattern Recognition Inverse Problem

Cuilan Mi, Xinchun Wang and Jianming Liu

**Abstract** The fuzzy pattern recognition is a kind of popular pattern recognition presently. This paper studies the fuzzy pattern recognition two basic model of inverse problem. (1) The standard model of fuzzy vector set race, and to identify the sample for the single point vector, (2) The standard model and to identify samples are fuzzy vector set clan. Put forward the weight calculation method and an example are presented.

**Keywords** The fuzzy pattern recognition • Fuzzy vector set family • The inverse problem • Weight

### 21.1 Introduction

Pattern recognition is compared and matching the identification of the object to be characteristic information and mode library characteristic information, and give target belong to the judgment of the model. In the usual pattern recognition, the model is clear, clear, for sure. But there are a lot of problems, the model itself is not very clear, has some fuzzy. And the fuzzy pattern recognition is refers to in pattern recognition, model is fuzzy, namely standard mode library provided in the fuzzy model test. The fuzzy pattern recognition in the engineering problems to a wide range of applications. These applications to more positive, negative meaning application is rare. In this paper, the fuzzy pattern recognition two basic models of the inverse problem is presented, and the solving methods.

---

C. Mi (✉) · X. Wang  
College of Science, Hebei United University, Hebei,  
e-mail: micuilan@163.com

X. Wang  
e-mail: wxc@heuu.edu.cn

J. Liu  
Mathematics and Information Science Department, Tangshan Normal College,  
Tangshan, Hebei, China  
e-mail: liujianmingtssx@yahoo.cn

## 21.2 The Fuzzy Pattern Recognition Basic Model

From the Recognition model of recognition process, fuzzy pattern recognition method can be divided into two types: direct method and indirect method, the direct method according to maximum subjection principle of classification, and indirect method according to choose nearly principle classified [1].

Maximum subjection principle: A domain is on the U a fuzzy subsets of m (m model), and compose a standard model base is U x0 fixed element, if

$$\tilde{A}_{i0}(x_0) = \bigvee_{k=1}^m \tilde{A}_k(x_0) \tag{21.1}$$

then think the relative membership  $x_0$  in  $A_{i0}$  fuzzy subsets nearly principle:

Set  $\tilde{A}_1, \tilde{A}_2, \dots, \tilde{A}_m$  is domain of m a U fuzzy subset (m model), and compose a standard model base, Stay recognition model is fuzzy subsets, if

$$\sigma_0(\tilde{A}_{i0}, \tilde{B}) = \bigvee_{k=1}^m \sigma(\tilde{A}_k, \tilde{B}) \tag{21.2}$$

Argue that  $\tilde{B}$  is closest to  $\tilde{A}_{i0}$ ,  $\sigma$  is the close degree. About the definition of close degree, a lot of literature are discussed, Among them the literature [2] discusses more in detail, the commonly used close degree have case close degree, distance of press close At present, the common problem of the fuzzy pattern recognition according to different purpose is divided into different types, the literature [3] is according to the domain of the dimension characteristic elements which is divided into “a d fuzzy pattern recognition method” and “more features the fuzzy pattern recognition,” [4] according to identify objects (standard model) and be identified objects (to identify sample) and its view of relation between the divided into four types will be. This paper discusses two classical fuzzy pattern recognition type.

Type 1: the standard model is fuzzy vector set family, to identify object is clear single point set.

Set  $\tilde{A}_1, \tilde{A}_2, \dots, \tilde{A}_m$  is domain of m a U fuzzy subsets of [5], constitute the standard model library,  $\{\tilde{A}_1, \tilde{A}_2, \dots, \tilde{A}_m\}$ , each standard model  $\tilde{A}_{ii}$  have n characteristics score, also is the fuzzy subsets, namely

$$\tilde{A}_i = (\tilde{A}_{i1}, \tilde{A}_{i2}, \dots, \tilde{A}_{im}) \quad (i = 1, 2, \dots, m) \tag{21.3}$$

Called fuzzy vector set race [6]. Usually, to particular problems, this n characteristics in pattern recognition of the role is different, so the membership degree respectively with appropriate weight To identify object  $X = (x_1, x_2, \dots, x_n)$ ,

$$\tilde{A}_i(x) = \sum_{j=1}^n \omega_j \tilde{A}_{ij}(x_j) \quad (i = 1, 2, \dots, m) \tag{21.4}$$

Among them,  $\omega_j \in [0, 1]$  is ( $i = 1, 2, \dots, m, j = 1, 2, \dots, n$ ), weight coefficients, meet  $\sum_{j=1}^n \omega_j = 1$   $\tilde{A}_{ij}(x_j)$ . As a fuzzy subsets of membership functions,  $\tilde{A}_i(X)$  as  $X$  to comprehensive fuzzy set membership. According to the maximum subsection principle can get  $X$  subordinate type.

Type 2: standard mode and to identify object is a fuzzy vector set clan

A domain of fuzzy vector set on  $U$  family  $\{\tilde{A}_1, \tilde{A}_2, \dots, \tilde{A}_m\}$ , each standard model  $\tilde{A}_i$  have  $n$  characteristics score:

$$\tilde{A}_i = (\tilde{A}_{i1}, \tilde{A}_{i2}, \dots, \tilde{A}_{im}) \quad (i = 1, 2, \dots, m) \tag{21.5}$$

Fuzzy vector set clan  $\tilde{B} = (\tilde{B}_1, \tilde{B}_2, \dots, \tilde{B}_m)$  as identify object. Seeking first two fuzzy vector set the family comprehensive close to the degree, the weighted close to degrees

$$\sigma(\tilde{A}_i, \tilde{B}) = \sum_{j=1}^n \omega_j \sigma(\tilde{A}_{ij}, \tilde{B}_j) \quad (i = 1, 2, \dots, m) \tag{21.6}$$

Among them,  $\omega_j \in [0, 1]$  is Weight coefficient, meet:  $\sum_{j=1}^n \omega_j = 1$

According to choose nearly principle, can get subordinate type.

From the above two kinds of fuzzy pattern recognition method of the traditional view, its essence is still linear weighted model. Weighted close to the degree is widely application is more close to the degree, the fuzzy pattern recognition is a classic example of fuzzy mode identification of wheat parents [6], use is the kind of form of comprehensive weighted close to degrees.

### 21.3 The Fuzzy Pattern Recognition the Problem and Its Solution

In the above two types of fuzzy pattern recognition, generally every index discuss problems in the role of is different, so the weights of the rational selection is very important. The fuzzy pattern recognition has two aspects of the problem, namely, positive and the question of problems. The question of Fuzzy pattern recognition is: given the weight of each index vector  $W = (\omega_1, \omega_2, \dots, \omega_n)^T$ . According to the index weigh  $W$ , judge to what kind of identify object belong to? The inverse problem of the fuzzy pattern recognition is that if the known to identify target belong to type, how to determine the weight vectors, so that more in line with the intention of the decision maker. The fuzzy pattern recognition problem, especially the problem, there is a general practical significance. Experience and technology, often comes down to people in mind to the factors of a kind of weight distribution, it is often difficult to talk, the inverse problem of discussion, will help these experience summary. For this we study the above the fuzzy pattern recognition two basic model of inverse problem, and give the solution.

### 21.3.1 The Inverse Problem of Type 1

In  $\tilde{A}_i(x) = \sum_{j=1}^n \omega_j \tilde{A}_{ij}(x_j)$  ( $i = 1, 2, \dots, m$ ), If the known membership functions  $\tilde{A}_{ij}(x_j)$ , ( $i = 1, 2, \dots, m, j = 1, 2, \dots, n$ ) and  $\tilde{A}_i(X)$ , and the known to identify object  $X = (x_1, x_2, \dots, x_n)$  Subordinate type, In turn for weight vectors, Therefore, in order to calculate the convenient, might as well hypothesis  $\tilde{A}_i(x) = b_i, \tilde{A}_{ij}(x_j) = \gamma_{ij}$  ( $i = 1, 2, \dots, m, j = 1, 2, \dots, n$ ), solution model is:

$$b_i = \sum_{j=1}^n \omega_j \gamma_{ij} \tag{21.7}$$

Set weight vectors  $W = (\omega_1, \omega_2, \dots, \omega_n)^T, b = (b_1, b_2, \dots, b_m)^T, R = (\gamma_{ij})_{mn}$ , then the model (21.7) available vector type, use

$$RW = b \tag{21.8}$$

This is use  $W = (\omega_1, \omega_2, \dots, \omega_n)^T$  as an unknown variables linear equations.

#### 21.3.1.1 Linear Equations Solution

For the linear Eq. (21.8), when  $\text{rank}(R) = \text{rank}(R, b)$ , equations have the solution, can press in linear algebra method to solve.

When  $\text{rank}(R)$  indicates  $\text{rank}(R, b)$ , is no solution equations, the linear algebra, it is known that no matter whether equations solution, least squares solution (i.e. Eq. (21.8) of the solution of the) must exist [11], so can beg least squares solution of sense, that is under the solving equations

$$R^T R W = R^T b \tag{21.9}$$

And then the calculated results for the normalized, namely get right vector W.

#### 21.3.1.2 Goal Programming Method

Because we are required by the weight coefficient, so in addition to meet relationship Eq. (21.7) should also meet the  $\sum_{j=1}^n \omega_j = 1, 0 \leq \omega_j \leq 1$ . This shows (21.7) weight coefficient of the exact solution might often don't exist, so the right solution for approximate coefficient has certain practical righteousness vigilant. Below we tried to target planning solution Eq. (21.7) the approximation of the weight coefficient solution.

Solution:

establishing the basic model

$$b_i = \sum_{j=1}^n \omega_j \gamma_{ij}, \text{ s.t } \sum_{j=1}^n \omega_j = 1, 0 \leq \omega_j \leq 1 \tag{21.10}$$



Basic model into the goal programming model:

In (21.7) will be a realistic goal each with a negative deviation variables  $\xi_i \geq 0$ , minus a positive deviation variables  $\eta_i \geq 0$ , become a target constraint

$$\sum_{j=1}^n \omega_j \gamma_{ij} + \xi_i - \eta_i = b_i \quad (i = 1, 2, \dots, m) \quad (21.11)$$

set  $s_i = \sum_{j=1}^n \omega_j \gamma_{ij} - b_i$ , then  $|s_i| = \xi_i + \eta_i$ , ( $i = 1, 2, \dots, m$ ), because the solution to make all kinds of established approximation, to make  $|s_i|$  minimum, so target for

$$\min P(\xi_1 + \eta_1, \xi_2 + \eta_2, \dots, \xi_n + \eta_n) \quad (21.12)$$

P shows the goal of the constraint conditions are negative deviation, the variables of the priority.

$$\min P(\xi_1 + \eta_1, \xi_2 + \eta_2, \dots, \xi_n + \eta_n) \quad (21.13)$$

$$\sum_{j=1}^n \omega_j \gamma_{ij} + \xi_i - \eta_i = b_i, \text{ s. t. } \sum_{j=1}^n \omega_j = 1, 0 \leq \omega_j \leq 1 \quad (21.14)$$

Among them,  $\xi_i \geq 0, \eta_i \geq 0$ , mean positive and negative deviation variables respectively.

Fuzzy relations equation and the relationship between the goal programming equation.

If  $\omega_j$  ( $j = 1, 2, \dots, n$ ) is the goal programming of the solution of the model, is also for relations Eq. (21.7) weight coefficient of approximate solution. The approximation of the relationship equation weight coefficient of the corresponding solution can goal programming model work out, it is worth noting that, in the deviation of the variable goal priority according to the evaluation results  $\tilde{B}$  can be known of the reasonable determination and adjustment. For example, if the evaluation result is more reasonable satisfied, it require to (21.14) the  $\xi_i, \eta_i$  equally and reached the minimum, then, make them in the same priority, the goal (21.12) can be set to

$$\min(\xi_1 + \eta_1 + \xi_2 + \eta_2 + \dots + \xi_n + \eta_n) \quad (21.15)$$

If you think the  $i_0$  the results  $b_{i_0}$  can be appropriately more, so, can relax  $\eta_{i_0}$  requirements, put  $\eta_{i_0}$  on a low priority, and even can move it from the goals of take down. This time can be set to target

$$\begin{aligned} \min & (\xi_1 + \eta_1 + \xi_2 + \eta_2 + \dots + \xi_{i_0-1} + \eta_{i_0-1} + \xi_{i_0} \\ & + \xi_{i_0+1} + \eta_{i_0+1} + \dots + \xi_n + \eta_n) \end{aligned} \quad (21.16)$$

As in the specific application of the evaluation results will be affected by various factors influence, not entirely accurate and reliable data, according to the target can attune, we can adjust the appropriate for all kinds of possible solution of the comparative analysis, commissioning a more reasonable solution.

### 21.3.2 Type 2 Inverse Problem

In  $\sigma(\tilde{A}_i, \tilde{B}) = \sum_{j=1}^n \omega_j \sigma(\tilde{A}_{ij}, \tilde{B}_j)$  ( $i = 1, 2, \dots, m$ ), If know the close degree  $\sigma(\tilde{A}_{ij}, \tilde{B}_j)$ , ( $i = 1, 2, \dots, m, j = 1, 2, \dots, n$ ) and  $\sigma(\tilde{A}_i, \tilde{B})$ , And the known to identify object

$\tilde{B} = (\tilde{B}_1, \tilde{B}_2, \dots, \tilde{B}_m)$  belong to which kind, In turn for weight vectors  $W = (\omega_1, \omega_2, \dots, \omega_n)^T$  therefore, in order to calculate the convenient, might as well hypothesis  $\sigma(\tilde{A}_i, \tilde{B}) = b_i, \sigma(\tilde{A}_{ij}, \tilde{B}_j) = \gamma_{ij}$  ( $i = 1, 2, \dots, m, j = 1, 2, \dots, n$ ), the solution model is  $b_i = \sum_{j=1}^n \omega_j \gamma_{ij}$  According to the solution method of type 1 to solve the linear equations.

#### 21.3.2.1 Application Examples

In order to facilitate comparison in literature [6] parents of wheat in pattern recognition for example. Five kinds of wheat parents model,  $\tilde{A}_i$ , ( $i = 1, 2, \dots, 5$ ), Bunches of wheat 5 kinds of shape features:  $x = (x_1, x_2, \dots, x_5)$ , for five the standard model, there were 25 a fuzzy subsets  $\tilde{A}_{ij}$  ( $i = 1, 2, \dots, 5, j = 1, 2, \dots, 5$ ), identify parents  $\tilde{B} = (\tilde{B}_1, \tilde{B}_2, \dots, \tilde{B}_5)$ , if use  $\tilde{A}_{ij}(x)$  means  $\tilde{A}_{ij}$  Membership functions,  $\tilde{B}_j(x)$  means  $\tilde{B}_j$  Membership functions, between Fuzzy subsets  $\tilde{A}_{ij}$  and  $\tilde{B}_j$  close degree  $\sigma(\tilde{A}_{ij}, \tilde{B}_j)$  ( $i = 1, 2, \dots, 5, j = 1, 2, \dots, 5$ ), means matrix  $R = \sigma(\tilde{A}_{ij}, \tilde{B}_j)_{5 \times 5}$ , namely

$$R = \begin{pmatrix} 0.8096 & 1 & 0.9896 & 0.9997 & 1 \\ 1 & 0.9796 & 0.9865 & 0.9999 & 0.9987 \\ 1 & 1 & 0.9836 & 0.9991 & 0.6903 \\ 1 & 0.9940 & 0.9642 & 0.9996 & 0.9588 \\ 1 & 0.9998 & 0.9916 & 0.9999 & 1 \end{pmatrix} \quad (21.17)$$

According to literature [6] method, two fuzzy vector set between family closer degrees  $\sigma(\tilde{A}_i, \tilde{B})$  vector ( $i = 1, 2, \dots, 5$ ) for

$$\vec{b} = (0.9492, 0.9945, 0.9175, 0.9786, 0.9975)^T \quad (21.18)$$

Using the above data, calculating weight vector  $W = (\omega_1, \omega_2, \dots, \omega_n)^T$

Method: solving linear equations

$$\begin{pmatrix} 0.8096 & 1 & 0.9896 & 0.9997 & 1 \\ 1 & 0.9796 & 0.9865 & 0.9999 & 0.9987 \\ 1 & 1 & 0.9836 & 0.9991 & 0.6903 \\ 1 & 0.9940 & 0.9642 & 0.9996 & 0.9588 \\ 1 & 0.9998 & 0.9916 & 0.9999 & 1 \end{pmatrix} \begin{pmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \\ \omega_5 \end{pmatrix} = \begin{pmatrix} 0.9492 \\ 0.9945 \\ 0.9175 \\ 0.9786 \\ 0.9975 \end{pmatrix} \quad (21.19)$$

get  $W = (0.25, 0.05, 0.30, 0.15, 0.25)$ , Visible, the results and literature [6] is consistent.

## References

1. Yumei S, Han X (1998) Research on method of fuzzy pattern recognition. *J Yunnan Inst Nationalities* 2(4):14–20
2. Hongxing L (1993) Engineering fuzzy mathematics methods and application, vol 1(3). Tianjin Science and Technology Press, pp 252–256
3. Yang S, Chen Y (1998) Classification of disaster loss based on the fuzzy pattern, recognition theory. *J Nat Disas* 202:56–60
4. Chen Z, Yu Y et al (2010) Research on several models of fuzzy pattern recognition problems. *Comput Technol Dev* 21:32–35
5. Wenxin J, Yuge Z (1993) Explained on the least squares solution and its geometric. *Jiaozuo Mining Inst* 2(2):92–95
6. Zodeh LA (1965) Fuzzy Sets. *Inf Control* 2(4):338–353

# Chapter 22

## Research on Combination Mode of College Art Education and Computer Art

Wei Shan

**Abstract** The Computer art as the representative of the technology for the development of traditional art education development offers a wide range of technical means and methods of performance, and is the key to promote the art of teaching to the high level of development. This paper mainly discusses that the three-dimensional virtual interactive technologies in computer art is how to be used in the art education and the final results. In the end it points out prospectively the future innovation mode of Innovative art education.

**Keywords** Computer art • Combination mode • Innovative art education

### 22.1 Introduction

With the rapid development of science and technology, the Information technology's generally infiltration into the art education information technology has become the new-century art-education's most distinctive scenery line. The Computer art as the representative of the technology for the development of traditional art education development offers a wide range of technical means and methods of performance, and is the key to promote the art of teaching to the high level of development [1]. Due to the computer art's truly multi-angle performance for art's image, intuitive and plasticity, it can cultivate the students' interest and a sense of achievement, and in-spire students' creative enthusiasm, and explore the potential of creative thinking. As a result it can turn art teaching from the traditional painting techniques into the all-round development of intelligence, and play a unique role in the cultivation of students' creative ability [2]. So how to realize

---

W. Shan (✉)

Xin Xiang University, Xin Xiang, People's Republic of China  
e-mail: danweipaper@163.com

the effective use of computer art will have a positive influence and the impetus function on the higher art education's reform and development of modernization.

## 22.2 The Present Situation of Today's University Art Education

In the market-oriented and globalization, situation, the diversified development of the college art education has reached a consensus. As a result of various countries and regions of different social status and the needs of the market each has emphasize particularly on different aspect. To meet the social demand of diversity talent in this diversified artistic environment, the curriculum of arts education should be based on their different advantages and conditions of development of teaching objectives [3]. The curriculum of the art education generally focus on the technique and despise the social practice, so the social practice related to the curriculum is insufficient and the lo-cal traditional culture curriculum is lack too. The talents cultivation model of "professional as the center and industry as the goal" leads to single disciplines, differentiated meticulous profession and the thin structure of talents. On the other fact, with the development of market economy the setting of some universities subject and the teaching contents focus on practicality, showing a one-sided utilitarian orientation and short-term behavior [4].

In addition, The present colleges' teachers on art design partly comes from trained graduates of themselves or others. Although they have the higher education but generally lack the experience on teaching and social practice, so the teaching level discounts. The other part is come from the arts design turned form the design career. This part of the teacher mostly enter art design by short-term education, training or self study and professional art design education. So they also haven't art design practice experience, and are incompetent for art design teaching. Now the university teaching modes have three basic patterns: class A: the knowledge provided by textbooks and teaching reference book; class B: Teachers' personal knowledge; class C: new knowledge produced by interaction of teachers and students. In most traditional mode, curriculum and teaching separates. The teaching plan and syllabus are prescribed by the state, and textbooks and teaching reference book are written by specialists, and teachers teach by reference book information, stressing on students' educational content of memory and internalization. Thus the A class knowledge takes absolutely advantage, and there are few class B knowledge, and almost no C class knowledge.

It's without doubt that the college art education for college students to improve overall quality plays a very important role. Therefore we should advance with the times, continuing to re-form the university's arts education, introducing the modern technology and educational media and personalized education concept. We should combined the art education with social history, local customs and practices together, and guide the students outside of the classroom, and walk into art club, Art Association, Museum of fine arts to experience the charm of art.

### **22.3 Unique Computer Art**

Computer art design is a comprehensive discipline of creating the modern art products, fusing science, art, and technology as one. It is a design art form through the computer to express language of art. Computer art design covers all information technology related to graphics, display and storage. As a new visual style, with the aid of computer the art teaching can activate students' design thinking, and enhance the study efficiency, and attract students to think more deeply, thus enhancing students' learning initiative of professional foundation courses.

Some statistics from the United States of America show that students can learn three times of knowledge with the help of the multimedia teaching by computer art. Some statistics from Russian show that the teaching can be speeded up to approximately 36 %.

Modern information technology and its products, especially multimedia teaching resources, make the college art teachers no longer hold the brush palette and plan around, only need to use the modern multimedia products. Modern information technology is one of the achievements of the Internet. By its global characteristics we can see the global art master works with the help of computer art, unfolding in our classroom, and greatly expand our teaching resources. The change bring our college art education great convenience, for example: when we teach the related works of art of European and American Impressionist, we can search the painting of all known works through the Internet, and discuss in the classroom with outside the world of China, and learn together so as to enhance the impression of the learned content, and enlighten the mind by communicating, and improve sentiment. The development of college art teaching resources in digital era are also reflected the understanding to the timely information about the art. Now many of the world's Museum of art has its own network platform, through the network platform, college art teachers can easily understand the world art trends which has the extremely vital role for improving students' learning effectiveness and pertinence, and improving students' grasp on the contemporary art. The abundant teaching resources turn the modern fine arts education from the past teaching way of behind closed doors type, the fundamental solution to the content of education behind the times.

Since the computer art application in teaching has so many advantages, so its application to art education has its irreplaceable role.

### **22.4 The Innovational Application of Computer Art in Higher Art Education**

The application of computer art in the art teaching in universities has its superiority and necessity, but how to do to realize the innovative applications making full use of the advantage of computer art and modern information technology and network in art education?

The web3D technology is a technical scheme combined with network technology and three-dimensional technology. The Web3D technology used in the teaching system expands in time and space, and realizes a breakthrough in time and space constraints.

At present, the application of the virtual reality technology in the aerospace field develops fastest, in which the most extensive and most successful application includes the paperless design in transportation 777 and the repair of Harbert space telescope before Yu Crew's training and flight simulation, using the 3D modeling to reduce cost, virtual manufacturing to provide virtual reality testing environment, and computer analysis of data to reduce waste. In many foreign auctions, the museum makes use of three-dimensional simulation of three-dimensional virtual reproduces antique or treasure in order to preserve the authentic. In addition, the interaction technology is more and more mature from the network interaction to now real virtual interaction, and it can realize human-machine interaction to the projected three or two dimensional scene using photosensitive optical instrument through three-dimensional photographic projector, photographic camera in Guangzhou animation star city, such as people will be in the LCD screen to see for 2 dimensional hair himself through photographic camera, and three dimensional photographic projector, from the ceiling project in the football field, and using photographic equipment, two people can be in a virtual football playing virtual soccer. After changing the scene, the projection area will open a virtual flowers or fireworks. But the projection techniques are also required for transmission medium, such as white walls, or curtain, or water curtain, believing in the future ten years there will be through the medium of air transmitted to the projector.

Compared with the traditional art education, interactive 3D virtual class has a stronger interaction, the study object of study for 3D interaction, for the production of interactive function of network interactive courseware.

The main purpose of the interactive 3D virtual technology is to study the users' visual and tactile. The virtual real or illusory people or things by the use of high-tech make users feeling be personally on the scene.

For art education divided the theory and the practice course, combined with 3D virtual interaction technology, the application of innovation mainly as follows:

#### ***22.4.1 The Appreciation of the Innovative Theory Model***

With the help of interactive 3D virtual technology, the teacher took the 3D remote control in room of one computer, four stereo projectors, and in 2–3 sets of data glove for teaching. This is the appreciation course innovative teaching mode, such as MTV, director, music appreciation, prints appreciation etc. Through three-dimensional photographic projection equipment, coupled with a gate glasses and data glove, the students will feel the virtual real scene, including the war scenes, and scenes from Dunhuang grottoes, and the Western Palace interior scene, and each world historic scenes and so on. Using the data glove, the students will feel

simulation antique, and ancient weapons, and the weight of the laundry, texture etc. The wireless Bluetooth data glove with a sensor based on computer data, automatically adjust the gloves on students' hand pressure and weight so that the touch of virtual goods will feel more real; With the photographic projector, students' move can be perceived, and nearby item can be explained.

#### ***22.4.2 Innovative Mode of the Computer Practice Curriculum***

Joining the three-dimensional photographic projector, computer is put into a circle, and the four stereo projections are in the middle. Respectively playing teacher's four models, appearing a three-dimensional shape to the projection stage, students can directly see stereo, and teacher in the table also can directly switch students' computer interface. The projection in the middle of the stereo picture may be corrected and adjusted for the teacher.

#### ***22.4.3 Innovative Model of Professional Practice Curriculum***

In professional practice courses, such as models sketch, model by 3D projection, by computer virtual projection, you can adjust the model's body, appearance, gender, and clothing, and can also zoom in the local models, such as muscle or clothes, thus it can make the model sketch in a unified curriculum, such as the human body sketch and character sketches, when students will no longer use traditional sketchpad, and the replacement is digital board to simulate various pen effect. On the digital plate, the teacher can switch picture, and switch to the students' painting pictures, immediately changing, and also can make the picture into half sketch, half model for comparison. In the color class, different models of the digital pen replace different types of gouache painting or pen. In ceramics, print-making or sculpture class, students can use the computer virtual out the final effect in the practice stage, thereby saving the material.

#### ***22.4.4 Innovative Pattern of the Lesson Plans and Teaching***

With the help of interactive 3D virtual technology teacher will classified the course, and arrange inside the course scene and teacher-student interaction factors of the very next day, raising the interest of the students. Using 3 dimensional projections we can realize synchronization, and experience according to the needs of different professional, or interact with another class of students, learning from each other. For some courses, or a simple sketch, color class we need not real teacher, but use pre-made virtual teacher education curriculum, so the virtual



teacher can answer some question often asked, and can modify mistakes made by students, such as shading problems, structure problems.

Although many content are through fantasy. But Einstein said: imagination is more important than knowledge. By contrast to the traditional mode and innovation pattern, we may find the advantages of the innovation patterns. Students understand the domestic education level is insufficient, and also see the teachers' sweaty for teaching. Contemporary educational pattern often can make the students and teachers in a locked state, students not interested in, teachers' no passion to teach. Innovation pattern will appear, in addition to the advanced technical support, but also the use of advanced technology in art education. How to use, how to use, what effect these three questions is what I should be discussed, but also the future development course and prospect of innovation mode.

The reform and changes brought to the modern fine arts education by the networking and the normalization will be enormous. Although the application with the help of three-dimensional virtual interactive teaching of the computer art in universities in China fine arts are not specialized, but the perspective of the combination with the computer arts and higher art education will be very wide.

## References

1. Rawsthorn A (2006) Celebrating the beauty of 'super normal' little objects of daily life. IHT (International Herald Tribune) 3:9-19
2. Ito F, Picchi F (2006) Naoto + jasper = super normal. Domus (894)
3. Raw thorn A, Naoto Fukasawa (2007) Intuiting function from form. IHT (International Herald Tribune) 12(4):6-10
4. Ashcraft B (2007) Without thought. Metropolis 3(5):47-54

# Chapter 23

## A Survey of Software Reliability Qualitative Evaluation

Qiuying Li and Lixin Liu

**Abstract** Software reliability evaluation plays an important role in the software reliability engineering. Software reliability qualitative evaluation technology can be an effective way to make up for the deficiency of the software reliability quantitative evaluation method. It can put forward the level of the software reliability before testing and suggest some improvement measures for software design, development and other activities. This article mainly sums up the research results of qualitative assessment of software reliability from the following three aspects: based on the theory used to deal with the uncertainty problems in mathematics; software development process and other methods used to evaluate software reliability. So it provides a reference to select qualitative evaluation method and lays the foundation for further study.

**Keywords** Software reliability • Qualitative assessment • Review of assessment

### 23.1 Introduction

Software reliability evaluation is one of the important contents of software reliability engineering. It can determine reliability level of the existing system or system components, which always provides reference for improving software reliability level during the development process.

Software reliability evaluation mainly includes the quantitative evaluation and qualitative evaluation. The quantitative evaluation refers to deal with the collected failure data produced during the software running or software reliability testing process and gives the estimated value or predicted value of software reliability parameters; There is no clear definition for the qualitative evaluation, thus we give the following definition: it refers that decision makers use experience and

---

Q. Li (✉) · L. Liu

School of Reliability and Systems Engineering, Beihang University, Beijing, China  
e-mail: li\_qiuying@buaa.edu.cn

L. Liu

e-mail: liulixin@dse.buaa.edu.cn

knowledge to analyze the state, the behavior, and related information of the evaluated object; According to the analyzed results, the software reliability level can be put forward. On the other hand, it points that we employ the model or other methods to provide the value of software reliability assessment before software testing. Although the second method given above is also a quantitative value, it still has certain deviation comparing with the results based on the failure data. So we put the second type as the software reliability qualitative evaluation.

The traditional software reliability evaluation methods are more focused on software reliability quantitative assessment. So far, hundreds of software reliability models have been published [1].

Although the software reliability assessment methods based on the models can accurately obtain the value of software reliability, there are many problems to solve, such as the highly dependent on failure data, idealized model assumption, and so on. These shortcomings and insufficiency have serious impact on the application and development of software reliability quantitative evaluation method [2].

Software reliability qualitative evaluation technology can be an effective way to make up for the deficiency of the quantitative evaluation method. It can put forward the level of software reliability before testing and suggests some improvement measures for software design, development and other activities. So it is necessary to do further research on software reliability qualitative evaluation technology.

## **23.2 The Summary of Research Results of Software Reliability Qualitative Evaluation**

### ***23.2.1 The Method of Software Reliability Qualitative Evaluation Based on the Theory Used to Deal with the Uncertainty Problems in Mathematics***

Software system's reliability evaluation is based on the analysis and synthesis of the affecting factors in the process of development. There are a lot of influence factors, which include software complexity, software operation, the team scale and so on. To do software reliability qualitative evaluation, the influence factors contain both behavioral factors and state factors, but the information exist some uncertainty. So many experts try to solve these problems with the theory used to deal with the uncertainty problems in mathematics.

#### **23.2.1.1 The Method of Software Reliability Qualitative Evaluation Based on the Fuzzy Comprehensive Evaluation**

Reference [3] once made a questionnaire survey which included 32 uncertain factors affecting software reliability on the entire software development process, and sorted the uncertain factors according to the severity of their effect on software

reliability. These works play a good guidance on how to improve the software reliability. Ref. [4] had analyzed the close relationship between the severity of uncertain factors on the software reliability and the software reliability level, which used the 32 uncertain factors put forward in [3] as reference and made an appropriate amendment and analysis. Applying the AHP method to determine weights, the article drew on the fuzzy thinking and proposed a two-stage fuzzy comprehensive evaluation method. As a result, the level of software reliability was given, which achieved qualitative assessment. In [5] the unascertained theory was introduced into research on software reliability. But its idea was also to establish the evaluation system of influencing factors, using the method of comprehensive evaluation to set up model. What was worth noting was that the comprehensive measure did not apply the maximum subordination principle, but it raised the credible degree criteria reaching more reliable results.

### **23.2.1.2 The Method of Software Reliability Qualitative Evaluation Based on Neural Network**

Back Propagation (BP) neural network is a kind of forward without feedback neural network. It can establish the global nonlinear mapping between input variables and output variables by learning some samples. Due to the particularity of the neural network technology it has broad prospects in the field of software reliability application. Since the early 90s, there are lots of documents discussed this [6]. Ref. [7] pointed out that neural network had advantages in expressing complex data pattern or data relationship between the input and output variables. If it was used in conjunction with fuzzy logic, fuzzy rules could be extracted from large amounts of data and used for intelligent computing system developed for industrial control, which thereby improved system security and performance. For that reason Ref. [8] proposed fuzzy neural network model combining fuzzy logic and neural networks. The fuzzy rules contained in expert advice were extracted by using the model. According to these rules the software reliability assessment was achieved. This approach is better than simply using fuzzy method for it can get more accurate result, but having enough and good sample data is vital for training neural networks, so we should do further research in this field.

### **23.2.1.3 The Method of Software Reliability Qualitative Evaluation Based on Clustering**

Reference [9] put forward a method of clustering thought using support vector machine (SVM) to do cluster research. Its idea is that software reliability is determined by many factors and to evaluate them is a much more complex decision problem. If factors affecting software reliability are similar, software reliability should be roughly the same. According to this idea, different software reliability factors are put into classification for clustering. The software divided into the same

type can be considered the results of software reliability assessment are consistent. This approach is an attempt to comprehensively utilize expert knowledge and support vector machine for software reliability assessment.

#### **23.2.1.4 The Method of Software Reliability Qualitative Assessment Based on Grey System Theory**

Comprehensive evaluation method of grey system can extract valuable information from known information, enabling the correct description of the systems' behavior. Compared to other evaluation methods, it has the advantages of dealing with poverty information systems, making full use of known information [10]. On the basis of the idea that the traditional comprehensive evaluation system for reliability is under the help of experts, Ref. [11] made a complete framework for software reliability comprehensive evaluation based on grey system theory from the point of system engineering. First of all, it established a comprehensive evaluation system of software reliability on the basis of ISO/IEC 9,126 [12]. It calculated the relevant degree between each measure and software reliability with the grey correlation analysis method. According to this, it determined the metrics' weight in the evaluation system. At last, it concluded the software reliability evaluation method based on grey system theory.

#### **23.2.1.5 The Method of Software Reliability Qualitative Assessment Based on Rough Set Theory**

Reference [13] pointed out that rough set theory could effectively deal with inaccurate, inconsistent and incomplete information, finding the hidden knowledge. Ref. [14] proposed the method of software quality evaluation based on rough set theory. Its core thought is to find the dependency degree of each attribute according to the relational data model established based on the attributes, calculating the important degree and weight of the attribute. In the end, it did comprehensive evaluation based on the characteristic value of attributes. Advantage of this method was that it could explore implicit knowledge and reveal the underlying rules only with the classification of the measured data during the development. It did not need any prior information.

### ***23.2.2 The Methods of Software Reliability Qualitative Evaluation Based on Software Development Process***

Doing reliability assessment throughout the software development process has caused widespread concern in the scholars, because the IEEE 982.1 standard [15] states that the whole software life cycle will have affect on software reliability [16]. Related research achievements are showed as follows.

### **23.2.2.1 The Method of Software Reliability Qualitative Evaluation Based on Requirements Stage**

Reference [17] pointed out that eighty percent defects in the software were introduced in the requirements phase of the software development process and modifications of requirements phase could cause the 95 % modifications of late-stage. So reliability assessment in the requirements phase is essential. But in fact very few people do research in the requirements phase. Gaffney and Davis [18], put forward the method of using the number of error code in one thousand lines found before testing to assess software reliability. RADC [19] made use of software development metrics standard affecting software reliability to get the initial fault density and did evaluation with other reliability measure methods. Ref. [20] showed that in order to do assessment in early phase, we need to regulate system and study on its probability of failure using formal method. According to this thought, Ref. [21] came up with a kind of formal methods, called VIEWCHARTS, to describe the behavior of a software system, applying Markov chain to implement accelerated states transformation of the system. Under the combination of these two methods, if you could calculate the probability of failure state, reliability of the final system would be able to find.

### **23.2.2.2 The Method of Software Reliability Qualitative Evaluation Based on Design Stage**

Reliability assessment in the design phase of the software development has a certain amount of research. Their idea is to do comprehensive calculation of reliability of the individual components according to the architecture of software system. Ref. [8] proposed to describe the system architecture by state diagram. But this method can only apply to some predefined classical structure style. Ref. [22] noted that the path-based method was to calculate the reliability of all possible execution paths, and integrated them to get the whole software reliability. But this method was not suitable for system with infinite paths. So there were certain limitations, although Dolbec and Shepard attempted to use the rate of component usage to calculate the reliability to solve the problem, which would bring loss of precision [23]. The state-based method used control flow chart to represent the system's internal structure and calculated the entire system's reliability with analysis method [24]. However, these two methods have a limitation on the scope because of their difficulty to meet the assumptions in most instances. Ref. [25] proposed to make use of Petri net as a tool for software architecture description, and eventually got the evaluation method of dealing with different kind of control structure by improving traditional reliability assessment state-based method. It could not only get results quickly and accurately, but also had a measure of the importance of components, which provided more references to analysis the system. We know that the function execution probability and failure severity levels have influence on the software reliability, which was ignored by the existing software reliability evaluation method. So

Ref. [26] proposed to analyze software architecture described by UML with statistical method, which calculated the perform probability of all function and defined the reliability of components at first. It achieved the final reliability of software system by constructing the conversion model of Markov multi-component system.

### **23.2.2.3 The Method of Software Reliability Qualitative Evaluation Based on Environmental Factors**

Reference [2] defined environmental factors as follows: They existed in the software development, testing and maintenance process; They were the set of various characteristics and behavior, which had an impact on software defects and failure behavior. A method of software reliability assessment based on environmental factors was presented in the article. Its view is to classify the environmental factors at first, then with the expert evaluation method to do audit and qualitative evaluation about the environmental factors. According to the values, the result was concluded by comprehensive computing.

### **23.2.3 Other Methods of Software Reliability Qualitative Evaluation**

#### **23.2.3.1 The Method of Software Reliability Qualitative Evaluation Based on Bayesian Theory**

Bayesian method has broad application. Software reliability assessment based on Bayesian theory has been proposed by many scholars. Oikonomou and Pham put forward a Bayesian approach to software reliability estimation based on software failure time [27, 28], which took software failure time as general information to describe the behavior of software testing. But it is difficult to effectively collect and express the data of software failure time, which limits the application of this method in reliability evaluation. On the basis of the previous work, Ref. [29] established the testing procedure's formal description based on input field, and determined the general information of testing distribution. According to Bayesian theory, it got the posterior distribution with prior distribution and general distribution. In the end, did software reliability evaluation based on testing data.

#### **23.2.3.2 The Method of Software Reliability Assessment Based on Early Prediction Model**

Although early prediction models are expected to be quantitative values, the values have a gap with the result obtained by failure data on the basis of system testing. Therefore this method is also one of software reliability qualitative assessment. So

far the classic early predictive models about the reliability include the following four [30, 31]: Phase-based model of Gaffney and Davis; Defects model of Agresti and Evanco; Software reliability prediction and assessment model put forward by air Rome laboratory; Process adaptability reliability model proposed by Yin and Lawrence James. All of the models' basic idea is to obtain information about software defects or software failure as far as possible and to make full use of the information on software reliability assessment. These models can make assessment and forecasting in the early stage of software development, and in the later stage it can verify and adjust such estimates on the basis of the failure data obtained by testing.

### 23.3 Summary

This article mainly introduces the research results of qualitative assessment of software reliability from the following three aspects: based on the theory used to deal with the uncertainty problems in mathematics; software development process and other methods used to evaluate software reliability. It has summarized the primary methods of software reliability assessment, the latest progress, academic insights and recommendations, which offers a variety of references to the investigators. Also combining the characteristics of software testing with the provided methods they can get the optimal solution. At the same time the article lays the foundation for further study, as a result, researchers will soon capture the results of historical research which can widen their train of thought.

From the given methods of assessment, suggestions for improvement and research direction, we can conclude that qualitative assessment of software reliability has made a great progress. It has established a number of reliability models and methods for reliability analysis, but there are also weak points. Our future research directions are combining various ways to get more exact results. Optimization and application of software reliability models are future research directions too.

### References

1. RenZuo X, Min X, RenJie Z (1994) Software reliability model and its application. Tsinghua University Publishing House, Beijing
2. QiuYing L, MinYan L, HaiFeng L (2007) The research for software reliability qualitative evaluation based on environmental factors. Reliability, safety, maintenance and airworthiness topics 01:08–13
3. Zhang X, Pham H (2000) An analysis of factors affecting software reliability. J Syst Softw 50:43–56
4. Tiejiang W, Meng L (2002) A fuzzy comprehensive evaluation model for software reliability. Comput Eng Appl 20:23–26
5. Yu-mei W, Min-yan L, Yong-qi Z (2007) Software reliability qualitative evaluation based on unascertained measurement. Comput Eng 10:380–386



6. Karuanithi N (1993) A neural network approach for software reliability growth modeling in the presence of code churn. In: *Proceeding of the fourth international symposium on software reliability engineering* 21(3):18–24
7. Du YG, Tyagi RD, Bhamidimarri R (1999) Use of fuzzy-net model for rule generation of activated sludge process. *Process Biochem* 35:77–83
8. Wang W-L, Wu Y, Mei—Hwa C (1999) An architecture-based software reliability model. In: *Proceedings of the 1999 Pacific rim international symposium on dependable computing*. Hong Kong, China 12(3):143–150
9. WuQin HC, Jumei Y (2006) Software reliability evaluation based on support vector machine. *Micro-computer information*. Chin core J 22:3
10. SiFeng L (2004) *Grey system theory and its application*. Beijing: Sciences Publishing House 12:82–88
11. Li Haifeng L, Minyan WZ, Zhen L (2008) Framework for software reliability comprehensive evaluation based on grey system theory. *J Beijing Univ Aeronaut and Astronaut* 12(32):380–388
12. ISO/IEC 9126-1 2001 (2001) *Software quality characteristics and metrics-part 1: quality model*
13. Wang G (2001) *Rough set theory and knowledge acquisition*. Xi'an Jiao tong University Press, Xi'an 20(9):277-283
14. Zhang Y, Hua Y (2011) *method of software quality evaluation based on rough set theory*. 2011 Academic and teaching seminar on electronic information sciences of higher vocational education
15. IEEE Std 982.1-1988 (1998), “IEEE Standard Dictionary of Measures to Produce Reliable Software”, IEEE
16. Pham H (2000) *Software reliability*. Springer, Singapore 12(20):70–74
17. Isazadeh A, Lamb DA, Shepard T (1999) Behavioral views for software requirements engineering. *Requirements Eng J* 4(1):19–37
18. Gaffney JE Jr, Davis CF (1988) An approach to estimating software errors and availability. In: *Proceedings of the 11th minnowbrook workshop on software reliability SPC-TR-88-007*, version 1.0
19. McCall J (1992) *Methodology for software reliability prediction and assessment*. Technical report RL-TR 1(02):92–52
20. Yin M-L, Hyde CL, James LE (2000) A petri-net approach for early-stage system-level software reliability estimation. In: *Proceedings annual reliability and maintainability symposium* 127(9):01–04
21. Alipour H, Isazadeh A (2008) Software reliability assessment based on a formal requirements specification. *Human Syst Interact* 10(1):11–17
22. Goseva—Popstojanova K, Mathur AP, Trivedi KS (2001) Comparison of architecture-based software reliability models. In: *Proceedings of the 12th IEEE international symposium on software reliability engineering (ISSRE-2001)*, Hong Kong, China, 22–31
23. Jean D, Terry S (1995) A component based software reliability model. In: *Proceedings of the 1995 conference of the centre for advanced studies on collaborative research Toronto*. Ontario, Canada 9(12):388–392
24. Gokhale Swapna S, Trivedi Kishor S, W Eric Wong, Horgan JR (1998) An analytical approach to architecture-based software reliability prediction. In: *Proceedings of the IEEE international computer performance and dependability symposium* 12(2):13–22
25. Wen L, Feng X, Jian L (2010) An approach of software reliability evaluation in the open environment. *Chin J Comput* 1(32):380–385
26. Jun-tao L, Xiao-yuan J, Hai Z(2009) Software reliability evaluation based on software architecture. *J Appl Sci—Electron Information Eng*, May 122(09):678–683
27. Oikonomou KN (1997) Predictive with the dynamic bayesian gamma mixture Model. *IEEE Trans Syst Man Cybern. PartA* 27:5262–5295
28. Pham L, Pham H (2000) Software reliability models with time dependent hazard function based on bayesian approach. *IEEE Trans Syst, Man Cybern, PartA* 30:25–35

29. Bo-ping Z, Ju-ming C (2007) Research of software reliability estimation method based on bayes theory. *Electron Qual* 11:209–214
30. Lyu MR (1996) *Handbook of software reliability engineering*. McGrawHill and IEEE, New York 12:924–930
31. Carol S, Martin S (1998) Software reliability modeling: an approach to early reliability prediction. *IEEE Trans Reliab* 47(3):268–278

# Chapter 24

## Identification Method of Streaming Media Based on Queuing Theory

Shuliang Pan, Ye Liang, Jingzhang Liang and Cui Teng

**Abstract** In the network supervision management, identification of streaming media is an important technology for the online linkage and real-time application. In this paper, we analyze the behaviour characteristics of some real-time protocols and find out a novel identification method through extracting the streaming media attribute within P2P working mechanism. Using the queuing theory, the identification method of streaming media in this paper can reduce the complexity of algorithm on timing, insure high identification accuracy rate and fulfil the real-time quality. Experiment shows that this method has good performance.

**Keywords** Identification • Streaming media • P2P • Queuing theory

### 24.1 Introduction

In recent years, P2P applications, for instance, PPstream, PPlive, QQlive and so on, is more and more popular. They adopt a gossip-based mechanism which transmits streaming media based on the overlay multicast technology. One of the attractive advantages of P2P streaming media is multicast stream, which offers on-demand services and contributes to the total transportation of large data section [1].

However, P2P media application, which usually holds the 70 % [2] of networking capacity, even 90 % [3] on some extreme conditions, takes up tremendous resource of network bandwidth. Additionally, Some reports reveal that the subscribers of Internet Protocol Television (IPTV), which is one of the streaming media, have got up to 4.3 million in 2005 and are estimated to reach to nearly

---

S. Pan (✉)

School of Computer, Electronics and Information, Guangxi University, Nanning, China  
e-mail: liangye@gxu.edu.cn

Y. Liang · J. Liang

Information Network Center, Guangxi University, Nanning, China

C. Teng

Department of Math, Computer and Electronics Information, Baise University, Baise, China

60 million by 2011 [4]. Obviously, P2P streaming media would occupy massive the network bandwidth with its subscribers increasing rapidly. Therefore, it is important to identify P2P streaming media and then take some control strategies on them for improving network performance. In this paper, we make effort to the identification of P2P streaming media.

At present, there are many researches focusing on the identification of streaming media. In [5], the authors adopt random port for the identification of streaming media. In [6], channel port is used. But these two methods are lack of accuracy. In [7], a method based on payload features is recommended to detect P2P streaming media. Because of mass calculation capacity and the variation of payload features, this method hasn't high real-time identification accuracy. In [8–10], since the behavior traits of streaming media are related to the protocol kernel and shifted scarcely, the action traits are used to detect P2P streaming media.

In order to overcome the defects mentioned above, we use the queuing model and the behavior traits of streaming media to identify P2P streaming media. There are several typical behavior traits extracted from the media packets, such as types transport orientation, way of control, up and down load tactics. The media stream traits can be obtained easily through the queuing model.

This paper has five sections. The next section describes the reasons of identifying streaming media by QT. The method of using queuing theory (QT) for media stream identification is depicted in Sect. 24.3. In Sect. 24.4, a case study is presented. Conclusions are provided in last section.

## 24.2 The Reasons of Identifying Streaming Media by QT

Queuing theory studies service objects and the statistics of service period, from which we can obtain the statistic number of their performance indexes, such as waiting time and interval times, and service time. There are some parameters to describe queue characters including: the quantity of service case, the distribution of interval times of the service calling, service time distribution [11]. These parameters have Poisson distribution. According to the statistics, service system can improve service structure and reconstruct service objects. In this way, service system not only satisfies object requests, but also has the minimum consumption and optimizes some performance indexes.

Generally speaking, introducing QT to identify streaming media is based on the following considerations:

1. In network applications, the service time and the quantity of service calling also have Poisson or exponential distribution, just like waiting time and interval times, and service time in QT.
2. The major features in the process of streaming media identification, as the analysis in [12], have shown that the model of streaming media identification is a typical queuing model. These major features in the process of streaming media identification include the following aspects:

- (a) The inter arrival times between any two successive identification requests are independent each other and have a common distribution.
- (b) The service time needed for every request is not only dependent on the status of services, but also has identical distribution. Furthermore, they are independent with inter arrival times.
- (c) The first come first served is still the predominant order in streaming media identification.
- (d) In streaming media identification, there may be a single service case or a group of service case to process the requests.
- (e) Since the capacity of cache or buffer of streaming media identification is finite, the number of waiting requests is limited. It means that extra requests would be lost if the waiting room of a service hosting environment is fully occupied when extra requests arrive at service detection pool. The service detection pool is used to store the packages waiting for being detected.

According to the descriptions above, we can resort to QT to establish our streaming media identification mechanism.

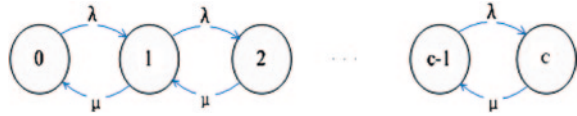
### 24.3 The Realization of Streaming Media Identification by QT

Combining the formulas of queuing theory with the main parameters of streaming media identification, we carry out two patterns of streaming media identification: individual identification and group identification.

Let us first define the variables used for P2P media identification based on queuing theory:

- M: denote the service time and the quantity of service calling in queuing theory
- S: denote the quantity of service case
- k: denote the service capability
- $\lambda$ : denote arrival rate of request, which signifies the rate at which requests arrive at the server detection pool
- $\mu$ : denotes service completion rate
- $\rho$ : denotes the occupation rate, which indicates the time of server processing
- $P_j$ : denotes the possibility of j requires in a queue when the queue attains its stationary state. In specialty,  $P_0$  indicates there is no requires in the queue and new requires could be served at once when they attain to the queue and need not to wait
- L: denotes the expectancy of queue length, which is equal to the average number of requires in the queue
- $L_q$ : denotes the expectancy of waiting queue length
- W: denotes the expectancy of linger time
- W': denotes the actual value of linger time
- $W_q$ : denotes the expectancy of waiting time

**Fig. 24.1** Flow diagram for M/M/C/C model



$W_q'$ : denotes the actual value of waiting time  
 $E$ : denote the acceptable identification error  
 $n$ : denote acceptable number of successive failed request periods (Fig. 24.1).

### 24.3.1 Individual Identification

We use the  $S = 6$  queue model M/M/6/K to analyze the individual services. The steps of individual identification are as following:

1. We set the unit time as 1 s. In every second, we denote  $\lambda_i$  that the number of requests arriving at the service detection pool, the number of requests departing from service detection pool which is  $\mu_{i,j}$ . For every period, such as every 100 s, we calculate the  $\lambda$  and  $\mu$  by the following formula:

$$\lambda = \frac{1}{n} \sum_{i=1}^n \lambda_i \tag{24.1}$$

$$\mu = \frac{1}{Sn} \sum_{i=1}^n \sum_{j=1}^S \mu_{i,j} \tag{24.2}$$

2. Calculate  $\rho$  by the following formula:

$$\rho = \frac{\lambda}{S\mu} \tag{24.3}$$

3. Calculate  $P_n$  by the following formula:

$$P_n = \frac{\left(\frac{\lambda}{\mu}\right)^n}{\sum_{n=0}^c \frac{\left(\frac{\lambda}{\mu}\right)^n}{n!}} = \frac{\frac{\rho^n}{n!}}{\sum_{n=0}^c \frac{\rho^n}{n!}} \tag{24.4}$$

4. Hence, the so-called blocking probability  $B(c, \rho)$

$$B(c, \rho) = P_k = \frac{\frac{\rho^k}{k!}}{\sum_{n=0}^c \frac{\rho^n}{n!}} \tag{24.5}$$

5. Calculate  $L$  by the following formula:

$$L = \sum_{j=0}^k jP_j \tag{24.6}$$

6. Calculate  $L_q$  by the following formula:

$$L_q = \sum_{j=0}^{k-s} jP_{s+j} \quad (24.7)$$

7. Calculate effective arrival rate by the following formula:

$$\lambda_e = \lambda(1 - P_k) \quad (24.8)$$

8. Calculate  $W$  by the following formula:

$$W = \frac{1}{\lambda_e} L \quad (24.9)$$

9. Calculate  $W_q$  by the following formula:

$$W_q = \frac{1}{\lambda_e} L_q \quad (24.10)$$

10. Compare  $W$  with  $W'$  or  $W_q$  with  $W'_q$  stored in service detection pool.

$$W - W' \leq e \quad (24.11)$$

or

$$W_q - W'_q \leq e \quad (24.12)$$

11. If the in equation in step 10 is true, it means we haven't identified the streaming media. Then clear the counter  $C$ , which counts the number of successive failed periods and repeat to step 1.

12. If the in equation in step 10 is false, increase  $C$  by 1, and then compare  $C$  with  $n$ . if  $C$  is not larger than  $n$ , it means we haven't identify the streaming media. Then repeat to step 1; otherwise, we successfully identify the streaming media through this approach.

### 24.3.2 Group Identification

In group identification, we refer to the performance model in [13, 14], which adopts the mean value analysis algorithm for multicast closed system.

Now we assume  $R$  job and  $K = (K_1, K_2, \dots, K_R)$ . The steps of group identification are as following:

1.  $\pi_i(k)$  is the marginal probability that there are  $k$  jobs at node  $i$

$$\pi_i(k) = \frac{F_i(k)}{G(k)} G(i) (K - k) \quad (24.13)$$

where

$$F_i(k) = \begin{cases} k_i! \frac{1}{\beta_i(k_i)} \left(\frac{1}{\mu_i}\right)^{k_i} \prod_{r=1}^R \frac{1}{k_{ir}!} e_{ir}^{k_{ir}}, \text{Type} - 1 \\ k_i! \prod_{r=1}^R \frac{1}{k_{ir}!} \left(\frac{e_{ir}}{\mu_{ir}}\right)^{k_{ir}}, \text{Type} - 2, 4 \\ \prod_{r=1}^R \frac{1}{k_{ir}!} \left(\frac{e_{ir}}{\mu_{ir}}\right)^{k_{ir}}, \text{Type} - 5 \end{cases} \quad (24.14)$$

$G(i)$  is the normalization constant of the network with  $k$  jobs and node  $i$  removed from the network.

2. Calculate the throughputs of node  $i$  load-dependent

$$\lambda(k) = \frac{G(K-1)}{G(K)} \quad (24.15)$$

and calculate the throughputs of node  $i$  load-independent

$$\lambda_i(k) = e_i \frac{G(K-1)}{G(K)} \quad (24.16)$$

3. Calculate the workload of the node  $i$

$$\rho_i = \frac{\lambda_i}{m_i \mu_i} = \frac{e_i}{m_i \mu_i} \frac{G(K-1)}{G(K)} \quad (24.17)$$

4. Calculate the mean number of jobs

$$\bar{K}_i = \sum_{k=1}^K \left(\frac{e_i}{\mu_i}\right)^k \frac{G(K-1)}{e_i G(K)} \quad (24.18)$$

5. Calculate the mean response time of node  $i$  using Little's theorem

$$\bar{W}_i = \frac{\bar{K}_i}{\lambda_i} = \sum_{k=1}^K \left(\frac{e_i}{\mu_i}\right) \frac{G(K-1)}{e_i G(K)} \quad (24.19)$$

6. Compare  $\bar{W}_i$  with the actual mean response time  $\bar{W}'_i$  stored in service detection pool

$$\bar{W}_i - \bar{W}'_i \leq e \quad (24.20)$$

7. If the in equation in step 6 is true, it means we haven't identified the streaming media. Then clear the counter  $C$  and repeat step 1.

8. If the in equation in step 6 is false, increase  $C$  by 1, and then compare  $C$  with  $n$ . if  $C$  is not greater than  $n$ , it means we haven't identified the streaming media. Then repeat step 1; otherwise, we successfully identify a streaming media through this approach.

## 24.4 Case Study

For brevity, we assume this service model is M/M/6/6 and identification frequency is 100 times every second. As customary, let  $\lambda_i$  denote the number of service calling arriving at the server detection pool and  $\mu_{i,j}$  denote the number of



**Table 24.1** The numbers of various values of  $\lambda_i$  and  $\mu_{i,j}$

Values	0	1	2	3	4	5	6
Numbers of $\lambda_i$	17	25	25	16	11	5	1
Numbers of $\mu_{i,j}$	180	164	137	38	8	2	0

service calling without entering the server detection pool. Usually, the values of  $\lambda_i$  and  $\mu_{i,j}$  range from 0 to 6. Under this condition, the statistic data is listed in Table 24.1:

We calculate  $\lambda$

$$\lambda = \frac{1}{n} \sum_{i=1}^n \lambda_i = 1.98 \tag{24.21}$$

Then calculate  $\mu$ :

$$\mu = \frac{1}{Sn} \sum_{i=1}^n \sum_{j=1}^S \mu_{i,j} = 0.99 \tag{24.22}$$

Then occupation rate  $\rho$  is:

$$\rho = \frac{\lambda}{S\mu} = 1/3 \tag{24.23}$$

$$B(c, \rho) = p_6 = 0.011 \tag{24.24}$$

Then  $\lambda_e$  is

$$\lambda_e = \lambda(1 - p_k) = 1.76 \tag{24.25}$$

Then  $L$  is

$$L = \sum_{j=0}^k jp_j = 0.231 \tag{24.26}$$

Since  $S$  and  $k$  are all 6, so  $L_q = 0$ , the  $W$  is

$$W = \frac{1}{\lambda_e} L = 0.13 \tag{24.27}$$

Now, we can compare  $W$  with  $W'$  stored in service detection pool, and establish whether the service is the media streaming from other streaming applications. Because of the superiority of queuing theory in stream media identification and the advantage of our algorithm, this case study shows that our method has good accuracy, high effective and less consumption.

## 24.5 Conclusion

In this paper, we put forward a mechanism for streaming media detection based on queuing theory. We also describe how the streaming media detection mechanism works with a study case. At next research stage, a control module which runs on

a P2P platform should be developed for processing the identified streaming media and then improving the network performance.

## References

1. Moulynox C (2008) Iptv bandwidth growth <http://www.webtvwire.com/iptv—bandwidth—growth-60-of-all-consumer-ip-traffic-in/>
2. Azzouna NB, Guillemin F (2004) Impact of peer-to-peer applications on wide area network traffic. *Exp Approach Globecom Dallas*: IEEE 232(4):1544–1548
3. Kamei S, Kimura T (2003) Practicable network design for handling growth in the volume of peer-to-peer traffic. In: *IEEE Pacific rim conference on communications, computers and signal processing*, vol 31, pp 597–600
4. Scherf K, Wang H, Jiang Y (2007) Iptv: from quadruple play to multiplay. *Ind Rep Parks Associates* 8(2):293–299
5. Sen S, Wang J (2004) Analyzing peer-to-peer traffic across large networks. *IEEE/ACM Trans Networking*. IEEE Press, NJ, 12:219–232
6. Gerber A, Houle J, Nguyen H, et al (2003) P2P the gorilla in the cable. *Nat Cable Telecomm Assoc (NCTA) Nat Show*. IL, Chicago 14(3):45–51
7. Sen S, Spatscheck O, Wang DM (2004) Accurate, scalable in-network identification of P2P traffic using application signatures. *New York, USA* 32(4):290–298
8. Gong J, Sun Z, Qiang G (2007) Research of identification method based on P2P flow behavior characterization. *J Chin Comput Syst* 28(1):23–29
9. Chen-Chi W, Kuan-Ta C, Yu-Chun C, Chin-Lauang L (2008) Detecting Peer-to-Peer activity by signaling packet counting. *sigcomm'08*, Washington, USA 32(5):398–403
10. Liu H, Feng W, Huang Y, Li X (2007) A Peer-To-Peer traffic identification method using machine learning. In: *International conference on networking, architecture, and storage (NAS)* 22(5):9–16
11. Willig A (1999) A short introduction to queueing theory. Available at: [www.tkn.tu-berlin.de/curricula/ws0203/ue-kn/qt.pdf](http://www.tkn.tu-berlin.de/curricula/ws0203/ue-kn/qt.pdf)
12. Chen H-P, Zhang C (2007) A fault detection mechanism for service-oriented architecture based on queueing theory. In: *7th IEEE international conference on computer and information technology (CIT)* 29(3):47–54
13. Willig A (1999) A short introduction to queueing theory, technical University Berlin, telecommunication networks group Sekr. FT5-2, Einsteinufer 25, 10587 Berlin
14. Alanyali M (2011) Occupancy distributions of homogeneous queueing systems under opportunistic scheduling. *Inf Theor* 57:256–266

**Part II**  
**Engineering Management and**  
**Applications I**

# Chapter 25

## Research of Smoke Denitration Technology in Denitrating Process in Coal-Fired Power Plants

Yuanshang Zhang, Tianrong Zhang, Xiaoman Zhang, Xiaochun Lin and Xiaoming Weng

**Abstract** This thesis gives a brief introduction to the necessity of the smoke Denitration in China's Power Plants; analyzes several main popular smoke denitration technologies; and aiming at the low denitration efficiency, excessive consumption of reducing agents, and heavy pollution in China's Power Plants, it makes a comparative research into the latest smoke denitration technologies, and reaches the conclusion that the SCR method (selective catalytic reduction of the denitration process) can meet the latest national standard of NO<sub>x</sub> emission and it has the advantages of low total oxynitride discharge, strong responding capability with the boiler-loads, low escaping rate of NH<sub>3</sub> and high denitration efficiency, etc.

**Keywords** Selective catalytic reduction • Selective non-catalytic reduction • Coal power plant • Denitration engineering

### 25.1 Introduction

In recent years, the oxynitride emission from China's coal power plants accounts for half of its total oxynitride emission amount. With the increase of the number of coal power plants, the percentage of oxynitride emission will keep on rising [1–4]. Thus, the control of NO<sub>x</sub> will be the focus of our environment-cleaning campaign after the movement of harnessing industrial dust and SO<sub>2</sub>. In 2009, Ministry of Environmental Protection issued a bulletin entitled 'about the printing and issuing of the notice: 2009–2011 Key points for the National Pollution Control'

---

Y. Zhang (✉)

Zhejiang Tiandi Environmental Protection Engineering Limited Company, Hangzhou, Zhejiang, China  
e-mail: zhangtr@zafu.edu.cn

T. Zhang · X. Zhang · X. Lin · X. Weng  
Zhejiang A&F University, Lin'an, Hangzhou, Zhejiang, China

(Environment Protection Office [2009] No. 247). This bulletin demanded that all the factories take measures to control the pollution of the industrial oxynitrides, especially in the coal power plants. In the areas of Jingjinji (Beijing, Tianjin, Hebei), Yantze River Delta and Pearl River Delta, the newly-built plants must have the denitrating equipment at the same time; and by the end of the year 2015, all the current machine sets will have to be reformed completely. In May 11th, 2010, General Office of the State Council forwarded “the Guidelines for Boosting the Work of Joint-prevention and Joint-control of the Air Pollution to Improve local Air Quality” (issued by State Council Office [2010]No.33), jointly made by nine Ministries and Commissions, including Department of Environmental Protection, National Development and Reform Commission, Ministry of Science and Technology, Ministry of Industry and Information, Ministry of Finance, Ministry of Housing, Ministry of Transportation, Department of Commerce and the National Energy Bureau. It stipulates that “the main areas of the air pollution joint-prevention and joint-control are Jingjinji, Yantze River Delta and Pearl River Delta” and that “the main contaminants of the air pollution joint-prevention and joint-control are sulfur dioxides, oxynitrides, PM (particulate matters), volatile organic matters, the main industries are coal power plants, iron and steel, non-ferrous metal, petroleum, cement and chemical, etc. and the main businesses are those which have the heaviest pollution on the local air quality”. This bulletin also stress that “strengthen the rules of reducing the oxynitride pollution and establish the total oxynitride emission amount control system”, and it requires that during the 12th Five-year Plan, all the coal power plants in the main areas must install denitrating facilities, even the present non-important areas should reserve a place for installing the denitrating devices. These documents not only in policy put forward the guidelines for the direction of the work in controlling and reducing  $\text{NO}_x$ , but also shows the central government’s strong urge to reduce and control  $\text{NO}_x$  with a high sense of responsibility for the benefits of all Chinese people.

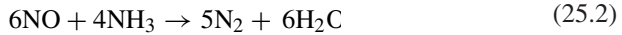
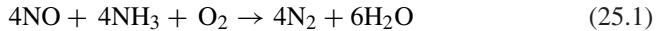
## **25.2 A Brief Introduction to the Denitrating History**

At present, the mature smoke denitrating techniques used in coal power plants are mainly Selective Catalytic Reduction, which is shortened to SCR, Selective Non-Catalytic Reduction, with shortened form SNCR and SNCR/SCR (mixed smoke denigrating method).

### ***25.2.1 SCR Smoke Denitrating Technique***

The theory of SCR technique is to spray the reductants like  $\text{NH}_3$  into the smoke of the furnace, within the temperature range 300 ~ 400 °C, and under the action of catalytics, combine with the  $\text{NO}_x$  from the smoke to produce the harmless  $\text{N}_2$  and

H<sub>2</sub>O [5]. Within the same temperature range and with the presence of O<sub>2</sub>, its main reaction mechanism is as in the following:

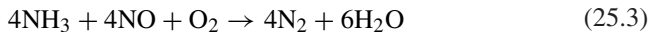


The technology core of SCR is to spurt the mixed gas of ammonia (sprayed from the ammonia-spraying gratings, with the volume density  $\leq 5\%$ ) and the air into the SCR reactor. In the reactor, the oxynitrides and the ammonia in the original fume will have oxidation reduction reaction under the influence of catalytics, producing nitrogen and water, thus completing the denitration process. The denitrated clean fume is flowed out from the bottom of the reactor, and is forced into the downstream air preheater through the fume exits.

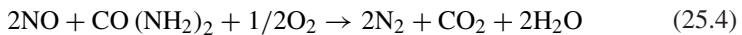
### 25.2.2 The Denitrating Method of SNCR

This technique operates by ejecting the reductants like NH<sub>3</sub> and ammonia into the furnace and let them do the selective reaction by the reductants and the NO<sub>x</sub>. Within the narrow temperature scope between 850 and 1,100 °C and without any catalytics, these ammonia-based reductants like NH<sub>3</sub> and urea reduce the NO<sub>x</sub> in the fume selectively. SNCR denitration method uses the hearth cavity as the reactor. The main NO<sub>x</sub> reduction action of NH<sub>3</sub> and urea is:

With NH<sub>3</sub> as the reductant



With ammonia as the reductant



### 25.2.3 The Mixed Denitrating Technology of SNCR/SCR

The mixed SNCR/SCR Denitrating method is to combine the technology of spraying reductants into the furnace cavity in SNCR technique with the technology of using the escaped ammonia to perform the catalytic reaction in the SCR technique. This method has a better denitration of NO<sub>x</sub>. This technique has two reacting areas. At first, spray the reductants into the first reacting area—the furnace cavity, via the spraying system built in the boiler walls, and it will carry out the initial denitrating stage under the high temperature by the reduction reaction of the reductants and NO<sub>x</sub> in the fume without any catalytics. Then spray the remaining reductants into the second reacting area—SCR reactor to perform the further denitration with the catalytics. The biggest improvement of SNCR/SCR technology is to omit the system of ammonia injecting grates (AIG), which

further reduces the dosage of catalytics. But at the same time, it installs an additional mixer at the entrance of the smoke channel and consequently increases the resistance-reduction.

The traditional SNCR/SCR mixed technique is simple combination of SNCR method and SCR method. It is feasible in theory, but in practice, it has the following defects:

1. Difficult Control for the Ammonia Generating Amount

There is a complex reciprocal influence between all the factors in this method, such as the location of SNCR spraying gun, the spurting amount, denitrating rate, ammonia generating amount, the furnace load(temperature field), etc. It's very difficult to control accurately the denitrating rate with a watchful eyes on the great ammonia generating amount. The difficulty of the control for the ammonia generating amount will lead to the overall difficulty for controlling the whole denitrating system.

2. The Limitation of the Ammonia Generating Amount Leads to the Limitation of the Total Denitrating Rate

Under the condition of the fixed spraying gun, the spraying gun will generate a certain amount of ammonia besides the effect of denitration. But this generated ammonia amount is not in linear relation with its spraying amount (or density). Generally speaking, when the generated ammonia amount is over 20 ppm, it has the exponent relation with its spraying amount, and 30 ~ 40 ppm is almost its limits. Therefore, the ammonia generating amount at the later stage of SCR process will be limited, and its total denitrating rate of this mixed technique will also be limited.

3. Excessive Consumption of the Reductants

This mixed method needs to consume several-folds of reductants because this method requires SNCR to produce a large amount of ammonia. Sometimes the NSR in the SNCR needs to reach 1.8–2.5 to meet the needs of its ammonia demand.

4. Difficulty for Mixing the Generated Ammonia before it Leaves the Coal Economizer

It is very difficult to control the ammonia generating spots and its flowing direction. When it flows clockwise in the boiler, it will not be able to mix fully the fume, ammonia and oxynitrides, which will lead to the incomplete mixing of the entrance fume when adopting the smoke-piped reactor, of course, influencing the denitrating rate and the ammonia escaping rate in SCR.

The main differences between the improved technique and its traditional method are:

1. Put an additional spraying set in the steering chamber and it will let the small amount of urea decompose at the steering chamber for the sake of complementing the shortage of ammonia requirement in the later stage of SCR method.

**Table 25.1** The overall comparison between the different fume denitrating techniques

Item	SNCR technology	SCR technology	SNCR/SCR mixed method
Reductants	Generally use urea	Liquid ammonia or urea pyrogenic decomposition 300 ~ 400 °C	Generally use urea
Reacting temperature	850–1100 °C		Inside the furnace (the same with that of SNCR technology); outside the furnace(the same with SCR technology)
Catalytics	Non-catalytics	Honey-comb type, plate-type, corrugated type	Inside the furnace (the same with that of SNCR technology); outside the furnace(the same with SCR technology)
Economic denitrating rate	25–40 %	70–90 %	50–70 %
SO <sub>2</sub> /SO <sub>3</sub> Oxidization	No	Usually less than 1 %	Usually less than 1 %
NH <sub>3</sub> escaping rate	10–15 ppm	Usually less than 3 ppm	5–10 ppm
The influence on the boiler	With bad control, it will generate greenhouse gas N <sub>2</sub> O, and the excessive CO, causing flying dust, incomplete-burnt ashes and the corrosion of the water-cooled walls	No influence on the operation of the boiler	The same with SNCR
The expected influence on the downstream air	The escaped NH <sub>3</sub> and SO <sub>3</sub> will produce NH <sub>4</sub> H <sub>2</sub> SO <sub>4</sub> , causing blockage or corrosion, and the escaping rate of NH <sub>3</sub> is the highest and has the worst influence on the air predictor.	The escaped NH <sub>3</sub> and SO <sub>3</sub> will produce NH <sub>4</sub> H <sub>2</sub> SO <sub>4</sub> , causing blockage or corrosion, and the escaping rate of NH <sub>3</sub> is the smallest and has the least influence on the air predictor.	The escaped NH <sub>3</sub> and SO <sub>3</sub> will produce NH <sub>4</sub> H <sub>2</sub> SO <sub>4</sub> , causing blockage or corrosion, and its influence on the air predictor is between the SNCR and SCR.
The loss of the system pressure	No loss of pressure	Causing the loss of pressure in catalytics and fume channel	The loss of pressure is about 150 Pa lower than that in SCR

(continued)



Table 25.1 (continued)

Item	SNCR technology	SCR technology	SNCR/SCR mixed method
The factors influencing the denitrating ability	SNCR technology Temperature, fume atmosphere, the molar ratio of ammonia and nitrogen, retention period, reducing agents, reductants	SCR technology Temperature, flow field distribution, flying dust	SNCR/SCR mixed method Sum of the influencing factors in SNCR and SCR
The responding ability of the boiler load	Must install multi-layer spraying guns to adjust to the denitrating window's position changing with the shift of the furnace loads	The quick reaction within the scope of the normal temperature range	Bad responding ability
The influence of the fuel changing	Small influence of the coal variety	Be greatly influenced by the density of the flying dust and its composition	Be slightly influenced by the density of the flying dust and its composition

2. Use the special flow field mixer and the technique of flow-guiding plate design to mix the fume and ammonia in the relatively short fume channel (Table 25.1).

### 25.3 The Choice for the Denitrating Operational Path

Through the overall analysis and comparison for the SNCR, SCR and SNCR/SCR, it can be seen that SCR has the advantages of high denitrating rate, strong responding ability to the boiler workloads, no influence on the operation of the boiler, easy control and low escaping rate of  $\text{NH}_3$ .

### 25.4 The Contrast Choice for the Fume Denitration Technology in the Coal Power Plant Denitrating Process

The former State Environmental Protection Administration investigated the oxynitride emission in coal power plants in 2007 and drew up “the technical proposal research for the oxynitride emission in China’s power plants”. The newly-made “The Emission Standard for the Atmospheric Pollutants in Power Plants” (GB13223-2011) will soon put into effect on Jan.1st, 2012, which will impose much higher restrictions on the oxynitride emission (Table 25.2).

The following power plants must adopt this limit value standard: W-type flame hearth in the coal-fired boiler; the existing circular thermal power boilers; as well as those that will be built and put into operation before Dec. 31st, 2013 or the environment impact report of the construction project has been approved.

The recent put-into-operation large-type unit, especially the super-critical or over-super-critical machine set nearly all adopted the low-nitrogen burning technology to control the  $\text{NO}_x$  emission density with good effect. But the  $\text{NO}_x$  emission of the earlier-built machine sets is relatively high. With some improvements (low-nitrogen burning technology) for the boilers, the  $\text{NO}_x$  emission density is usually between 300 and 400  $\text{mg}/\text{Nm}^3$ . If they want to meet the above new standard with the denitrating rate of about 50 ~ 80 %, they will have to choose the technique of SCR or SNCR/SCR.

**Table 25.2** Impose much higher restrictions on the oxidative emission

Area	Requirements	Emission limit
General area	All the coal-fired boilers	100, 200 [1]
Main area	All the coal-fired boilers	100

SNCR technology has the advantage of low investment cost compared with SCR technology, but it has lower denitrating rate, unstable performance, higher NH<sub>3</sub> escaping rate, being easily influenced by the boiler workloads, high operational costs and having a bad influence on the boiler-efficiency. Thus, SNCR is better to be used in those which have lower demands for denitrating rate. SNCR/SCR mixed technology makes up for the defect of low denitrating rate in SNCR, but compared with SCR, the initial investment of this mixed technology is higher than that of SCR. From the point of operational cost, the mixed technology of SNCR/SCR also has higher operational cost considering its high reductant consumption. Furthermore, this technology is complex in its large system. It neither solves the problems of unstable performance, being easily influenced by the boiler workloads and bad influence on the operational boilers in SNCR, nor solves the problem of being unable to function in low fume temperature in SCR. For the boilers with tight heat-receiving areas, it is not suitable to adopt the spraying guns of SNCR or SNCR/SCR, and therefore it is not advisable to adopt SNCR technology or SNCR/SCR mixed technology.

## 25.5 Conclusion

In order for the denitrating process of coal power plants to meet the NO<sub>x</sub> emission demands required by “The Atmospheric Pollutant Emission Standard for the Coal-fired Power Plants” (GB13223-2011) and the NH<sub>3</sub> escaping rate being under 3 ppm, it is advisable to adopt the selective catalytic reduction method, that is, SCR technology. This method has the advantages of high denitrating rate, mature technique and therefore is in the world leading position in the methods of denitration.

## References

1. Chen J (2008) The fume denitrating technology in the coal-fired power plants-selective catalytic reduction method. China Electric Power Publishing House 28:381–384
2. Johnson TV (2007) Diesel emission control in review. SAE Paper 01:0233
3. Johnson TV (2010) Review of diesel emissions and control. SAE Paper 01:0301
4. Dong H (2008) Diesel engine NO<sub>x</sub> selective catalytic reduction technology test study and numerical simulation, vol 31. Tsinghua University, Beijing, pp 63–67
5. Forzatti P (2001) Present status and perspectives in de-NO<sub>x</sub> SCR catalysis. Appl Catal A, Gen 222(1/2):2212236

# Chapter 26

## Research on SNCR Technology in the Denitration Engineering

Xiaoman Zhang, Rongtian Zhang and Xiaochun Lin

**Abstract** SNCR technology is a low-cost smoke denitration method. In order to increase the denitration rate in the smoke denitrating process, this article designed a typical SNCR processing chart, mixed the reduced urea fertilizer liquid with the output water from the dilution water modules and sprayed them into the hearth to be denitrated after accurate measurement by the metering dispensing equipment. The theoretical data are then used in the process of NO<sub>x</sub> Selective Non-catalytic Reduction on four utility-type Units, with the practical results of over 35 % denitration rate and less than 5 ppm ammonia-escaping rate.

**Keywords** SNCR technology • Denitration engineering • Ejector

### 26.1 Forewords

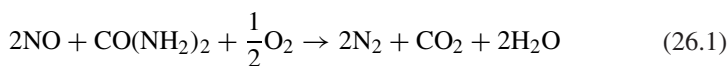
SNCR is a relatively low-cost smoke denitration technology, which operates by ejecting the reductants like NH<sub>3</sub> into the space with a given temperature in the hearth and let them do the selective reaction by the reductants and the NO<sub>x</sub> in the burnt materials to get N<sub>2</sub> from NO<sub>x</sub>. SNCR denitration method uses the hearth cavity as the reactor, and so the premise of this technology is to get the temperature of the inner hearth and the smoke distributing rules [1]. This research uses the simulated smoke or the standardized gas and the different reductants to perform the research of NO<sub>x</sub> Selective Non-catalytic Reduction [2, 3]. Put the SNCR system in the furnace into practice and test its effect by the productivity, and we get the results of over 35 % denitration rate and less than 5 ppm ammonia-escaping rate.

---

X. Zhang (✉) · R. Zhang · X. Lin  
Zhejiang A&F University, Zhejiang 311300, People's Republic of China  
e-mail: go\_zxm@zjfc.edu.cn

## 26.2 The Theoretical Basis for the SNCR Reaction

The SNCR technique is to use the hearth cavity as the reactor, and spray the reducing agents like urea fertilizer (without any catalytic agents) into the hearth area with the temperature between 850 and 1100 °C. In this process, the reductants were soon decomposed into NH<sub>3</sub> thermally and reacted with the NO<sub>x</sub> selectively in the smoke to become N<sub>2</sub>. The main reducing reaction of urea fertilizer into NO<sub>x</sub> is shown as Eq. 26.1.



In this method, we arranged multi-layer reductant-spraying nozzles at the different heights in the hearth cavity. We then sprayed the reductants to the areas with the proper temperature zones according to the different furnace loads. The simple diagram is as Fig. 26.1.

During the process of research, in order to get the proper control of the NO<sub>x</sub> emission, we will use the computational fluid dynamics (CFD) and chemical kinetics model (CKM) to imitate its flowing and combustion processes for the determination of its spraying points.

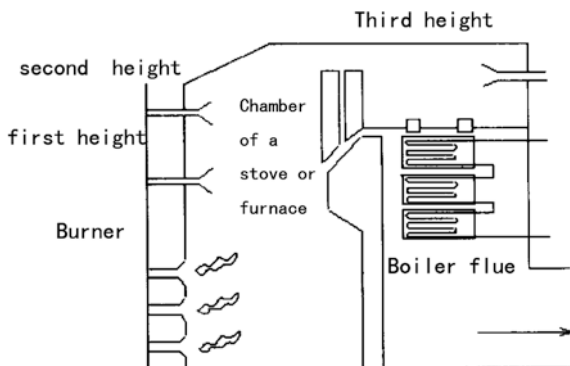
The SNCR technology is made up of reductants storing tanks, multi-layer reductants-spraying devices and their matching control instruments, etc. The process flow chart of SNCR is shown in the Fig. 26.2.

## 26.3 The Main Influencing Factors in the SNCR Denitrating Process

### 26.3.1 Temperature

The biggest influencing factor is the temperature. With the furnace cavity temperatures between 850–1,100 °C, the reductants will selectively reduce the NO<sub>x</sub> in the smoke without any reaction with O<sub>2</sub>. When the temperature is higher than

Fig. 26.1 SNCR schematic



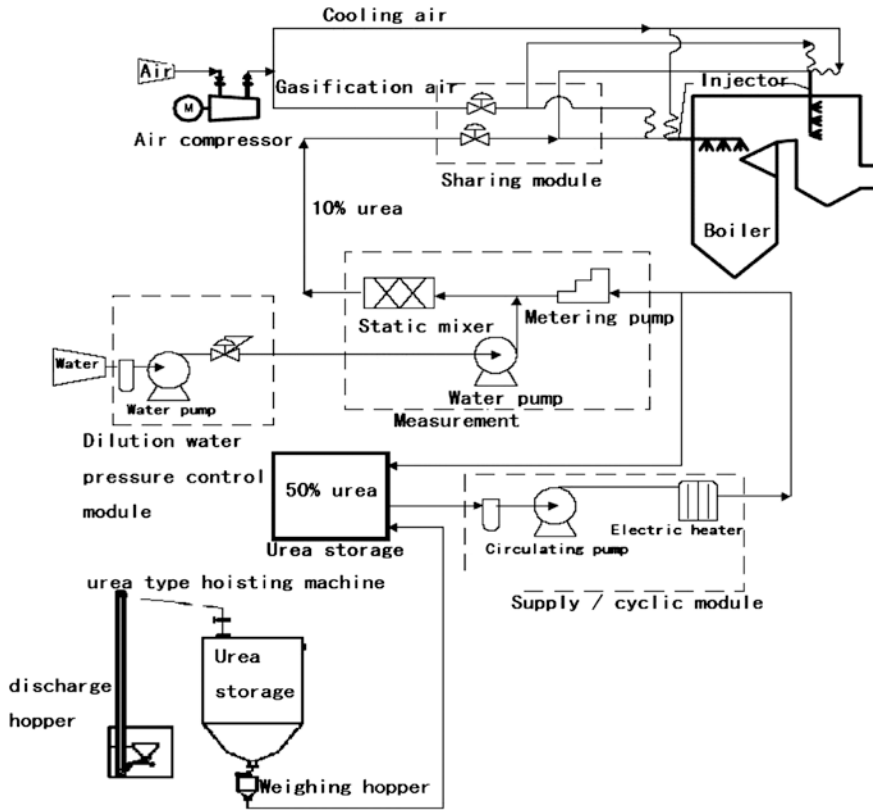


Fig. 26.2 The process of SNCR diagram

1100 °C, NH<sub>3</sub> will be oxidized to NO, which, in turn, increases its emission concentration. When the temperature is below 850 °C, its chemical reaction will not be complete, and will cause the so-called “ammonia penetration” with the higher rate of ammonia escaping, which will lead to the new pollution.

### 26.3.2 The Ingredients of the Smoke

All the ingredients in the smoke like O<sub>2</sub>, CO, H<sub>2</sub>O have some influence on the denitrating reaction.

- (1) Under the oxygen-deficient condition, no SNCR will occur. SNCR reaction only takes place with oxygen in it. When the temperature of the oxygen rises, the reaction temperature will slide to the low-temperature windows and also raise the densities of NO and N<sub>2</sub>O with the result of lowered denitrating rate.
- (2) Under the low temperatures, when the concentration of the vapor is low, it will be the accelerating agents for the reducing reaction, when high; it will be its

impediment. (3) When the temperature of the CO density rises, the temperature window of SNCR will move to the low temperature area, and its denitrating temperature will drop, thus with the fallen denitrating rate.

### ***26.3.3 The Ammonia Nitrogen Molar Ratio NSR***

Ammonia Nitrogen Molar Ratio NSR also has a great influence on the reducing rate. According to the chemical reaction equation, the ammonia nitrogen molar ratio NSR should be 1, but in fact, if we want to get an ideal NO<sub>x</sub> reduction rate, this number should be over 1. Although greater ammonia nitrogen molar ratio NSR is beneficial to the removal of NO<sub>x</sub>, new problem arises with the concomitant ammonia escaping rate and the increased operating costs. Generally speaking, in SNCR technique, the ammonia escaping rate is limited to 10 ppm or even lower. Meanwhile, the ammonia nitrogen molar ratio NSR is limited between 1.0 and 1.6, with the maximum number 2.0.

### ***26.3.4 Retention Period***

The longer the retention time of the reductants in the optimum temperature window, the better results of the NO<sub>x</sub> denitration. In the meantime, the increased retention time will lower the optimum temperature of the denitration process. In order to achieve the best NO<sub>x</sub> denitration rate, the retention time of NH<sub>3</sub> must be over 1 s, and that of the urea and the ammonia water must be between 0.3 and 0.4 s.

### ***26.3.5 The Mixability of Reducing Agents and the Smoke***

The injected nitrogen reductants must be blended fully with NO<sub>x</sub> for the better denitrating effect. The lower denitrating rate of SNCR technique in the industrial application is due to the limitation of the mixing process and its big temperature gradient. So the blending of ammonia and smoke must be quick. At the same time, the high momentum ratio of jet flow and smoke flow can increase the performance of denitration and the degree of the smoke turbulent flow can facilitate its blending.

## **26.4 The Implementation and the Testing of the SNCR Denitrating Process**

Basing on the above-mentioned theoretical research, the project team and a certain electric power company joined hands to complete this SNCR denitrating technique. We carried out this SNCR denitration with 4 matching units.

In SNCR denitrating process, we choose solid urea as the reductants, desolve and prepare them into 50 % urea solution. And then mix the solution with the water delivered from the dilution water module to make it into about 5 % urea solution. This solution is then delivered to the metering distribution module, and after the accurate metering distribution, send it into each spray gun and inject them into the hearth cavity to carry out the denitration process.

During the process, for the sake of energy-saving, this equipment set adopts the method of using both the short and long spraying guns. When the density of  $\text{NO}_x$  at the output mouth is under  $280 \text{ mg/Nm}^3$ , use the short spraying gun, and when the  $\text{NO}_x$  density of the boiler is near  $400 \text{ mg/Nm}^3$ , use the long spraying gun (as can be seen in Figs. 26.3 and 26.4).

## 26.5 Conclusion

SNCR denitrating method, compared with the traditional techniques, can have the optimum denitrating rate. It is simple, low-cost and effective with an optimum denitrating rate.

Since the urea SNCR system came into use, the  $\text{NO}_x$  density at the output mouth has been under  $280 \text{ mg/Nm}^3$ , that is, it can meet the current environmental emission requirement without the denitration of the furnace.

When the density of  $\text{NO}_x$  at the output mouth is under  $280 \text{ mg/Nm}^3$ , use the short spraying gun, and when the  $\text{NO}_x$  density of the boiler is near  $400 \text{ mg/Nm}^3$ , use the long spraying gun.

This project achieved the productivity result of over 35 % denitration rate and less than 5 ppm of the ammonia escaping rate.

The long spraying gun can stretch into the furnace cavity at the depth of 12 m. In order to prevent the high-temperature damage to the spraying gun; we need to

Fig. 26.3 Long spraying gun





**Fig. 26.4** Short spraying gun

pour continuously the demineralized water to make it cool. At the low temperature in winter, it is easy for the urea solution to be crystallized, and the density of urea solution cannot reach 50 %. It can only be prepared to the density of 33 % for the guarantee of its non-crystallizability.

During the manufacturing process, when the NO<sub>x</sub> density at the output mouth is less than 280 mg/Nm<sup>3</sup> and the denitrating rate is no less than 35 %, the urea consumption amount of each furnace is about 350 kg.

## References

1. Hongshen L, Weijuan Y et al (2009) The experimental study by reduction denitration of selective non catalytic on power plant boiler. *J Zhejiang Univ* 43(9):1655–1660
2. Wang Z, Zhou J et al (2004) Experimental and modeling study on the mechanism and sensitive parameters of the thermal de NO<sub>x</sub> process. *J Zhejiang Univ Eng Sci* 38(4):495–500
3. Zhong Q (2000) Experimental study of selective non2cata2lytic reduction of Nox. *J Nanjing Univ Sci Technol* 24(1):68–71

# Chapter 27

## Analysis on Accumulation Stability at Puji Slag Yard

Sugang Sui, Shiguang Xun, Zhuguo Fan, Wenlian Liu,  
Maobin Din and Jianliang Wang

**Abstract** The viewpoint is brought out based on analysis of physical composition and characteristics of accumulation at Puji slag yard, that stratum structure, chemical concretion and precipitation are main factors which affect stability of Puji slag yard. The dissertation establishes a three-dimension numerical model based on actual geological information, analyses accumulation at the slag yard with point safety coefficient method by applying software FLAC<sup>3D</sup> and verifies with Bishop's method. The result shows that, in natural status, slope on the east, the south and the west of the slag yard main basically remain steady and that safety precautions are insufficient. Generally speaking, the dissertation provides scientific basis for governance of the slag yard.

**Keywords** Slag yard • FLAC<sup>3D</sup> • Point safety coefficient method • Stability analysis

---

S. Sui (✉) · S. Xun · Z. Fan · J. Wang  
Kunming University of Science and Technology, Kunming 650093, Yunnan, China  
e-mail: suisui1@sina.com

S. Xun  
e-mail: xsg@sina.com

Z. Fan  
e-mail: fzg@sina.com

J. Wang  
e-mail: wjl@sina.com

S. Xun  
Yunnan Bureau of Geography and Mining, Kunming 653100, Yunnan, China

S. Sui · W. Liu · M. Din · J. Wang  
Kunming Prospecting Design Institute of China Nonferrous Metal Industry, Kunming 650224, Yunnan, China

M. Din  
e-mail: dmb@sina.com

J. Wang  
e-mail: wjl@sina.com

## 27.1 Introduction

Since Puji slag yard was put into use in 1958, it has been 53 years. Currently its accumulation height has reached 2037 m, which is 71 m higher than Hetian phosphate fertilizer plant ground on its southeast, 56 m higher than Sanyang fertilizer plant ground on its south and 50 m higher than detention house ground on its southwest. Three stages has taken into shape during accumulation process of the slag yard. As there is no blocking dregs dam, stability of the slag yard directly affect safety of Hetian phosphate fertilizer plant, Sanyang Fertilizer plant and the detention house and the slag yard has stopped accumulation. Therefore, it is of great significance to assess its stability qualitatively and quantitatively based on characteristics and form of the slag yard.

## 27.2 Basic Characteristic of Accumulation at Slag Yard

### 27.2.1 Physical Composition of Accumulation at Slag Yard

Main composition of accumulation at the slag yard is slag. Second to it is construction spoil. There is also life rubbish at some area in its northwest. Construction spoil are generally shapable. Life rubbish mainly include fiber, plastic, rubber, glass, tiles and dregs, which have loose structure and are dark grey, brown grey or black in color. In accordance with indoor geotechnical size distribution test, slag accumulated in the yard is generally gravel sand (partly coarse sand). Accumulated slag is soil with bad grading (Table 27.1).

### 27.2.2 Accumulation Shape in Slag Yard

Main accumulation at slag yard is located in gulch. The gulch has a U-shaped transect, which is higher in the northwest and lower in the southeast. Accumulation runs from northwest to southeast. The slag yard runs 438 m, with the maximum width of

**Table 27.1** Table of slag particle diameter grading data statistics

Item	Effective particle diameter $d_{10}$	Restricted particle diameter $d_{60}$	$d_{30}$
Statistics data	$\frac{0.008 \sim 0.75}{0.140} (19)$	$\frac{0.7 \sim 4.5}{1.78} (19)$	$\frac{0.085 \sim 0.8}{0.541} (19)$
Item	Non-uniformity coefficient $C_u$	Curvature coefficient $C_c$	
Statistics data	$\frac{1.61 \sim 93.8}{31.0} (19)$	$\frac{0.529 \sim 8.52}{3.33} (19)$	

Note  $\frac{1 \sim 17.4}{5.69} (78) - \frac{\text{minimum} \sim \text{maximum}}{\text{average}} (\text{samplenumber})$

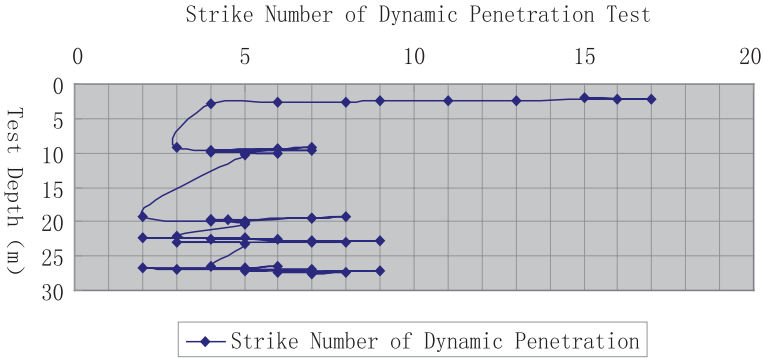


Fig. 27.1 Relation diagram between number of penetration in actual measurement and test depth

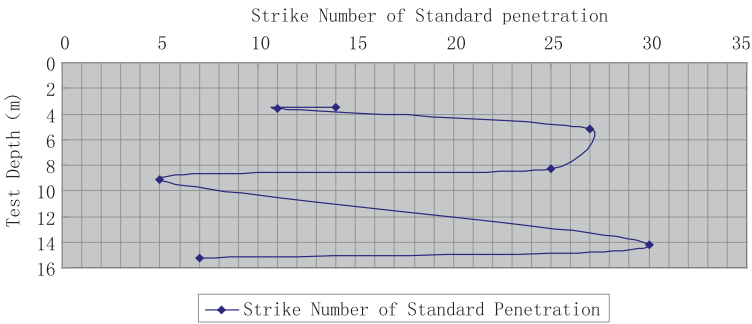


Fig. 27.2 Relation diagram between strike number of standard penetration on one platform and test depth

380 m and top elevation of 2037 m. Original topography of the slag yard is higher in the north and lower in the south. Drilling result shows that the bottom is about 1959 m deep. Based on geological survey and drilling and combined with data statistics analysis in on-site standard penetration and dynamic penetration test (see Figs. 27.1 and 27.2), the following opinions on accumulation sequence and method are brought forward. (1) In view of horizontal direction, slag density is uneven. (2) In view of longitudinal direction, due to increase of accumulation time and upper pressure, accumulated slag varies from loose status in upper level to densified status in lower level, which complies with normal rule of solid accumulation. However, in some part of longitudinal direction, the same position has different density in different depth. Slag density in lower layer might be less than that in upper layer. (3) Accumulation composition is uneven in both longitudinal direction and horizontal direction. Life rubbish layer is unevenly spread in the northwest. Construction spoil layer is unevenly spread everywhere in the slag yard. Due to uneven spread of accumulation composition, accumulation density is also uneven.

### **27.3 Analysis on Causes Affecting Accumulation Stability at Slag Yard**

Main causes affecting accumulation stability at slag yard are original topography, geological structure, physical mechanics characteristic of accumulation, chemical concretion action, stratum structure, underground water condition within accumulation, seismic effect, upper loading condition, slope forming, slope protection and human activity [1, 2]. This dissertation analyses main causes in accordance with actual condition of accumulation at the slag yard.

#### ***27.3.1 Stratum and Structure of Accumulation at Slag Yard***

Accumulation at the slag yard is mainly composed of slag, unevenly spread construction spoil and partly mingled life rubbish. 1.3–4.5 m thick life rubbish is unevenly spread on clay surface in the northwest slope of the slag yard. Construction spoil and slag are directly piled on life rubbish layer which has not been processed. Loose structure and low strength of life rubbish layer might cause potential failure surface of accumulation above it or slag accumulation crack in the northwest of the slag yard. Slag is generally gravelly sand with bad grading. It is mostly in quasi-circular shape, which also might cause sliding of slope. Construction spoil is of high strength in hard plastic status. However, in case of water, it will be softened and dramatically lose its strength. In the condition of soaking, it might form sliding surface.

#### ***27.3.2 Chemical Concretion Action of Accumulation at Slag Yard***

Accumulation method at slag yard is overlapping alternation of construction spoil layer (thickness of 0.50–5.40 m) and slag layer. Slag is piled as dry slag and construction spoil is piled in soft plastic or fluid plastic. Construction spoils mainly consists of acid mud and neutralized mud. Due to shower and filtration it permeates into slag to form an environment of alternating dryness and humidity and form chemical cementation between slag particles. As slag at the slag yard is gravel sand, it should have no  $c$  value as ordinary sand. However, due to unique chemical environment at the slag yard, chemical cementation occurs between slag particles, which gives slag  $c$  value and indicates chemical concretion. In natural accumulation status, slope gradient of noncohesive soil should not exceed natural repose angle of accumulation. However, the slag yard has a precipitous and straight slope with gradient of  $21^{\circ}$ – $38.3^{\circ}$  and even  $70^{\circ}$  in some area. Its high

natural repose angle is different from ordinary noncohesive soil, which might be the result of chemical concretion.

### ***27.3.3 Precipitation***

The slag yard has no developed surface water network and no steady surface run-off. Underground level at the yard is as deep as over 130 m. Therefore, surface water and underground water has little effect on stability of slope. Here, we will mainly discuss the effect of precipitation on slope. Precipitation permeation has multiple action forms on slope of the slag yard. Firstly, void ratio of accumulation at the slag yard is large. Most material has good permeability except construction spoil. Permeation and soaking of large precipitation cause saturation, which greatly weakens connecting action between sand particles and obviously decreases sand strength. Secondly, rain permeating into slope of accumulation causes seepage damage and water-soil chemical action, which results in loosening, separation, movement and even carrying away of sand particles in slope. This undermines slope of accumulation and causes local collapse at the slag yard. Thirdly, higher slope has deeper underground level and larger unsaturated area. Precipitation permeation causes matric suction variation of sand in unsaturated area and further causes low sliding deformation of sand in unsaturated area. Fourthly, slope water load increased during precipitation works together with other factors and causes deep landslide of slope during rebuilding of physical mechanics balance.

## **27.4 Assessment on Accumulation Stability at Slag Yard**

There are a lot of slope stability analysis methods, which falls into two types, i.e. slice method based on limiting equilibrium theory and numerical calculation method based on elasto-plasticity theory. Here we use FLAC<sup>3D</sup> method based on elasto-plasticity theory to analyze accumulation stability at the slag yard, calculate safety coefficient at the center of each unit and prepare area chart of accumulation stability. Then we use Bishop's method based on limiting equilibrium theory to verify analysis result of FLAC<sup>3D</sup> method [3, 4].

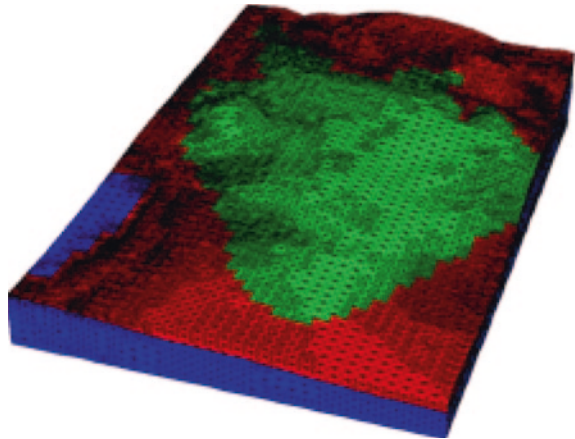
### ***27.4.1 Selection of Calculation Parameters***

Based on field shearing test, indoor test and back-analysis, we determine recommended value of shear strength standard of each soil-rock stratum. bulk modulus and shear modulus is converted from dynamic elasticity parameter obtained from boring wave speed test. Parameters used in calculation are shown in the following Table 27.2.

**Table 27.2** Calculation Parameters

Stratum	Natural density [kg·m <sup>3</sup> ]	Bulk modulus [Pa]	Shear modulus [Pa]	Cohesion [Pa]	Internal friction angle [°]
Slag	2,350	$2.66 \times 10^8$	$4.51 \times 10^7$	$2.5 \times 10^4$	20
Construction spoil	1,650	$3.00 \times 10^8$	$5.93 \times 10^7$	$4.01 \times 10^4$	11.2
Life rubbish	1,000			$9.0 \times 10^3$	5.0
Clay	1,800	$3.45 \times 10^8$	$6.43 \times 10^7$	$6.0 \times 10^4$	13
Limestone	2,500	$4.41 \times 10^9$	$1.74 \times 10^9$	$5.0 \times 10^6$	40

**Fig. 27.3** FLAC<sup>3D</sup>  
three-dimension model of  
accumulation at slag yard



## 27.4.2 Analysis on FLAC<sup>3D</sup> Calculation Result

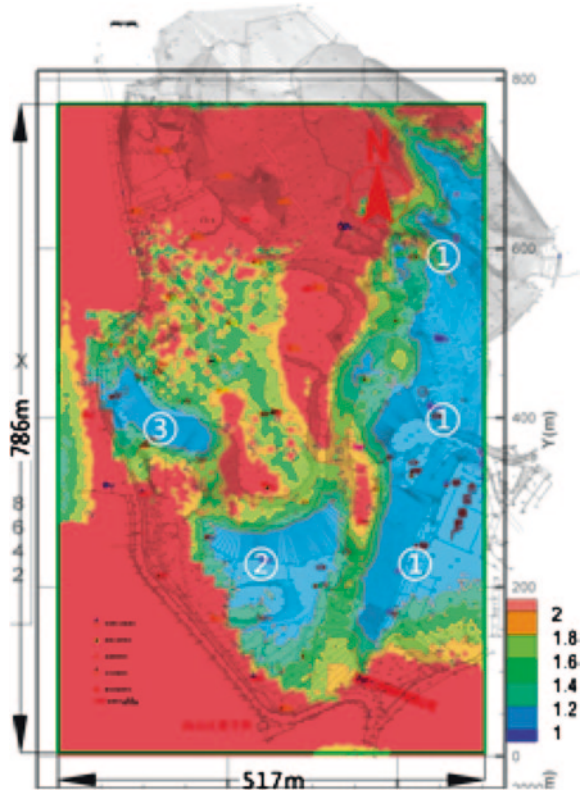
### 27.4.2.1 Calculation Model

Firstly, we input boring data into GoCAD to prepare stratum surface based on boring stratum data and extract element node information. Then we import node information obtained from GoCAD into Ansys and connect nodes to form an entity. We disperse the entity into tetrahedron element to generate 143,153 nodes and 768,835 elements. We prepare corresponding software and convert it into data format of FLAC3D as shown in Fig. 27.3.

### 27.4.2.2 Analysis on Safety Coefficient Result of Accumulation

We calculate safety coefficient of center point of each element during numerical analysis. Stability coefficient of center point of each element is interpolated to form stability coefficient graph. Based on stability coefficient graph, slag accumulation is divided into stability sections (see Fig. 27.4). Blue section (mainly including three parts: (1) slag accumulation edge area from Hetian phosphate fertilizer

**Fig. 27.4** Division graph of slag accumulation stability



plant to the north of model; (2) south part of the slag yard; (3) slag pile edge in the west of the slag yard) in the graph has a stability coefficient between 1.1 and 1.2, which is basically stable but has insufficient safety precautions. These sections are located at the edge of slag accumulation. As slag accumulation is formed by loose piling. Most slope sections remain in natural rest angle and basically stable. Therefore, value calculation result correctly reflects the actual situation and proves that boundary condition of numerical model and selected parameters are proper. Figure 27.5 is equivalence graph of  $\tau_{yz}$  of model surface (i.e., south–north shear strength) after stability analysis. High shear strength areas are mainly (1) slag accumulation edge area from Hetian phosphate fertilizer plant to the north of model; (2) South part of the slag yard; (3) slag pile edge in the west of the slag yard. They basically correspond to areas with low safety coefficient in Fig. 27.4.

**27.4.2.3 Analysis on Bishop’s Method Result**

We select 1–1’, 2–2’, 3–3’, 4–4’, 5–5’, 6–6’, 7–7’, 8–8’ and 9–9’ profiles and use Bishop’s method to calculate and check stability of slope of slag accumulation in natural condition [5]. Refer to Table 27.3 for stability coefficient of each profile. In



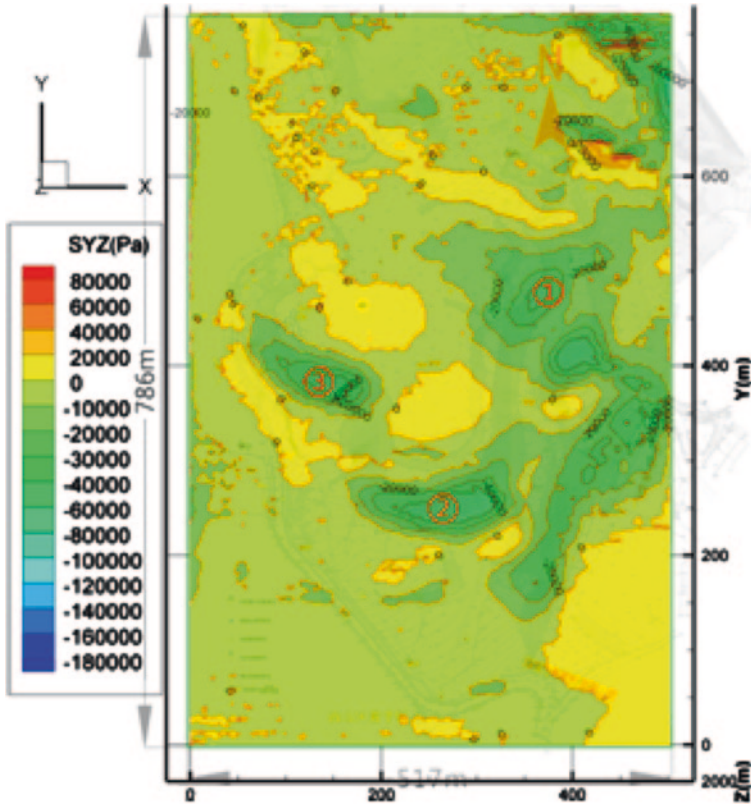


Fig. 27.5  $\tau_{yz}$  graph (unit: Pa)

Table 27.3 Calculation result of slope stability at slag yard

No. of calculation profile	1-1'	2-2'	3-3'	4-4'	5-5'	6-6'	7-7'	8-8'	9-9'
Stability coefficient	1.135	1.080	1.187	1.260	1.086	1.05	1.109	1.296	1.291

natural status, all profile stability factors  $K_s$  of accumulation at the slag yard are 1.050–1.296, which is less than 1.3. It indicates that slag accumulation remains basically stable in natural status but has insufficient safety precautions. The result comes close to calculation result of FLAC3D point safety coefficient method and proves reliability of FLAC3D point safety coefficient method.

### 27.5 Conclusion

In accordance with analysis on physical composition and characteristics of accumulation at Puget slag yard, we present that main causes affecting stability of accumulation at Puget slag yard are stratum structure, chemical concretion, and precipitation.

The dissertation establishes three-dimension numerical model based on actual geological information, uses FLAC3D based on elasto-plasticity theory to analyze with point safety coefficient method and uses Bishop's method based on limiting equilibrium theory to verify the result. Calculation result shows that, in natural status, east, south and west slope of slag accumulation basically maintains stable but has insufficient safety precautions. It is necessary to govern the slag yard.

## References

1. Zheng Y, Tang X (2007) Stability analysis of slopes under draw down condition of reservoirs. Chin J Geotech Eng 29(8):1115–1121
2. Yang HH (1988) Stability of soil slope (By W.H. Inmon, China), 19:27–33
3. Shen K, Zhang Z (2003) Point safety factor method for 3D anti-sliding stability analysis. Pearl River 2:21
4. Itasca Consulting Group Inc-FLAC (2005) (fast Lagrangian analysis of continua in 3 dimensions) user's manual (version3.0). Itasca Consulting Group Inc, Minneapolis
5. Bishop AW (1955) The use of the slip circle in the stability analysis of slopes. Geotechnique 5(1):7

# Chapter 28

## Characteristic and Environmental Risk Assessment of Heavy Metals in Farmland Soil of Based on Speciation Analysis

Xiao-yu Wang

**Abstract** In order to evaluate potential risks of farmland soil heavy metals to the Xinxiang city, more than 50 samples were practically collected and analysed. Results show that Cd, Ni and Zn are in higher degree of enrichment with reference of national quality standard for soil environment (GB15618-1995). Ranking order based on index of geo-accumulation assessment is  $Cd > Ni > Cu > Zn > Cr$ . Results of coefficients of potential ecological risk index show risk ranking order is  $Cd > Ni > Cu > Zn > Cr$ , and Cd is in class of extremely potential ecological risk. Result of integrated Hakanson potential ecological risk assessment show this farmland soil of the Xinxiang city is under very high potential ecological risk. Result of risk assessment code indicates Cd makes a very high risk to human health and stability of ecosystem not only because of its very high enrichment but also its high bioavailability.

**Keywords** Speciation analysis • Farmland soil • Potential ecological risk assessment • Index of geo-accumulation • Risk assessment code

### 28.1 Introduction

Under the rapid development of industries and urbanization all over the world, heavy metals, as one kind of well-concerned persistent toxicant, make increasingly great effects on stability of environmental eco-systems or human health. Soil heavy metals can transport and transform among environmental multi-pathways, such as soil-atmosphere pathway, soil-groundwater pathway, soil-surface water pathway and so on, and cause integrated risk to human health or stability of environmental ecosystems afterwards [1]. Therefore, the study and risk assessment on contamination of heavy metals in farmland soil become a hot topic and arouse widely public concerns. In recent years, the environmental risk triggered by soil heavy metals is considered being much more predominated by the speciation composition of heavy

---

X. Wang (✉)

College of Chemistry and Chemical Engineering, Xinxiang University, Xinxiang 453003, China  
e-mail: wangxy0373@163.com

metals in soil compared with their gross content. And based on the corresponding literatures and reports, the conclusion that the speciation of heavy metals has a direct relationship with its bioavailability is widely validated [2, 3].

The Xinxiang city, located in the north Henan province, is mainly a city of light industry. The city is the Chinese important grain-producing area, the national high quality wheat producing base and the animal husbandry producing base of the Henan province [4]. But, with the increasing population density of surrounding towns, the rapid development of industries and the prosperous development of animal husbandry production in recent years, characteristics of farmland soil make a significant degradation [4].

In this paper, the speciation composition of heavy metals in the Xinxiang's farmland soil is detected through practical sampling and instrumental detection. Afterwards, contents, enrichment levels, potential risk degrees are studied based on the index of geo-accumulation method, potential ecological risk assessment model and risk assessment code (RAC) in order to make a scientific reference for concerned decision-makers.

## **28.2 Materials and Methods**

### ***28.2.1 Sampling and Detection Method***

#### **28.2.1.1 Main Reagents and Instruments**

The main instruments include BL-6100 electronic balance, Teflon crucible, electric hot plate, atomic absorption spectrometry, centrifuge and constant temperature pot. The main Reagents HCl, HNO<sub>3</sub>, HF, HClO<sub>4</sub> are all in excellent purity and MgCl<sub>2</sub>, NaAc, NH<sub>2</sub>OH·HCl and ammonium acetate are all in analytically purity.

#### **28.2.1.2 Description of Sampling Site**

More than 50 Samples are collected in the suburban farmland soil of Xinxiang city based on the Chessboard type of stationing method and finally set 10 typically Sampling points. Each Sample set more than 5 duplicate samples, and the sampling depth of farmland soil samples was limited to 0–20 cm. Sampling is under the principle that it is as far as possible to keep away from where has obvious pollution sources such as landfill, gasoline station and ensure that the sample sites are at least 100 m away from the highway.

#### **28.2.1.3 Method of Detection**

Speciation Analysis is performed by method of Tessier's fractional extraction procedure [5]. Analytical precision is in good agreement. The relative errors for

all heavy metal elements are less than 5 %. The data of contents results, sensitivity analysis, and index of geo-accumulation assessment, potential ecological risk assessment and risk assessment code are all performed by the SPSS 16vers software.

### 28.2.1.4 Index of Geo-Accumulation Method

Index of geo-accumulation enables the quantitative assessment of pollutants enrichment degree by comparing current concentrations with pre-industrial concentrations [6]. It is calculated by the following equation [28.6]:

$$I_{geoi} = \log_2 [c_i / kc'_i] \quad (28.1)$$

Where,  $I_{geoi}$  is the index of geo-accumulation of heavy metal  $i$ .  $c_i$  is the practical content of heavy metal  $i$  in samples ( $\text{mg}\cdot\text{kg}^{-1}$ ).  $c'_i$  is the reference content of regional background ( $\text{mg}\cdot\text{kg}^{-1}$ ). Constant  $k$  ( $k = 1.5$ ) allows us to quantitatively consider natural fluctuations in the content of a given substance in the environment and very small anthropogenic influences [4].

Pollution level defined to 7 classes based on the geo-accumulation index is as follows:  $I_{geoi} \leq 0$ , Practically uncontaminated;  $0 < I_{geoi} \leq 1$ , uncontaminated to moderately contaminated;  $1 < I_{geoi} \leq 2$ , moderately contaminated;  $2 < I_{geoi} \leq 3$ , moderately to heavily contaminated;  $3 < I_{geoi} \leq 4$ , heavily contaminated;  $4 < I_{geoi} \leq 5$ , heavily to extremely contaminate;  $I_{geoi} > 5$ , extremely contaminated.

## 28.2.2 Hakanson Potential Ecological Risk Model

### 28.2.2.1 Coefficient of Hakanson Potential Ecological Risk

$$c_f^i = c_i / c'_i \quad (28.2)$$

$$E_r^i = T_r^i \times c_f^i \quad (28.3)$$

Where,  $c_f^i$  is the accumulation coefficient of heavy metal  $i$ .  $c_i$  is the practical content of heavy metal  $i$  in soil ( $\text{mg}\cdot\text{kg}^{-1}$ ).  $c'_i$  is the reference content of regional background ( $\text{mg}\cdot\text{kg}^{-1}$ ).  $T_r^i$  is the toxic coefficient of heavy metal  $i$ .  $E_r^i$  is the coefficient of Hakanson potential ecological risk about heavy metal  $i$ . And the criterion of the risk classes based on  $E_r^i$  is as follows:  $E_r^i < 40$ , low potential ecological risk;  $40 \leq E_r^i < 80$ , moderate potential ecological risk;  $80 \leq E_r^i < 160$ , high potential ecological risk;  $160 \leq E_r^i < 320$ , heavily to extremely potential ecological risk;  $E_r^i \geq 320$ , extremely potential ecological risk [7].

**Table 28.1** Heavy metals toxic coefficients and geochemistry background of soil in the Xinxiang city

Items	Cd	Ni	Zn	Cu	Cr
Toxic coefficient	30	5	1	5	2
Background content/ mg·kg <sup>-1</sup>	0.09	26.7	74.2	19.7	62.9

### 28.2.2.2 Hakanson Potential Ecological Risk Model

Integrated potential ecological risk model is described by the following equation [7]:

$$RI = \sum_{i=1}^n E_r^i \quad (28.4)$$

Where,  $RI$  is integrated Hakanson potential ecological risk index. And the criterion of the risk classes based on  $RI$  is as follows:  $RI < 150$ , low potential ecological risk;  $150 \leq RI < 300$ , moderate potential ecological risk;  $300 \leq RI < 600$ , high potential ecological risk;  $RI \geq 600$ , very high potential ecological risk.

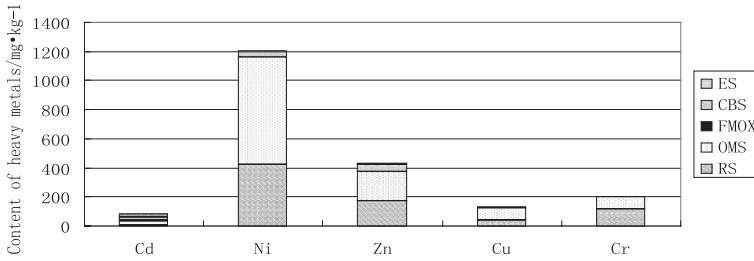
### 28.2.2.3 Parameters of Evaluation Model

Based on the corresponding literatures and reports, the value of  $T_r^i$  and  $c_i$  are showed in Table 28.1.

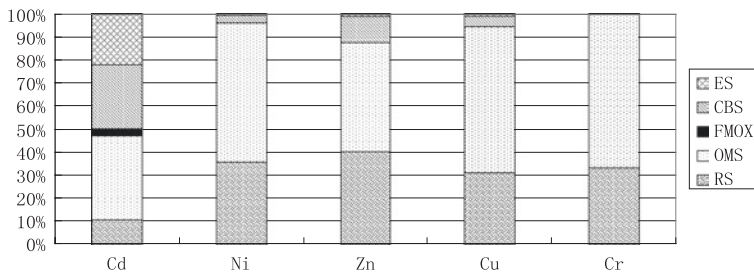
## 28.3 Results and Discussion

### 28.3.1 Heavy Metals Gross Concentrations in Farmland Soil

Results of the gross contents and speciation composition of 5 heavy metals in the farmland soil are showed in Figs. 28.1 and 28.2. According to the Fig. 28.1, it indicates that the averagely gross contents of Cd (81.93 mg·kg<sup>-1</sup>) exceed the content of the third class ( $\leq 1.0$  mg·kg<sup>-1</sup>) those set by national standard for soil environment (GB15618-1995) by a large margin. Besides, with Fig. 28.2, the gross content of Cd consist of Cd of exchangeable speciation (ES) which contributed 21.67 %, Cd of the carbonate bound speciation (CBS) which contributed 27.77 %, Cd of the Fe–Mn oxide speciation (FMOS) which contributed 2.90 %, Cd of the organic matter combined speciation (OMS) which contributed 35.80 % and Cd of the residual speciation (RS) which contributed 10.86 %.



**Fig. 28.1** Gross contents and characteristic speciation of heavy metals in soil of the Xinxiang city



**Fig. 28.2** Sensitivity analysis of heavy metals' speciation in soil of the Xinxiang city

Averagely gross contents of Ni ( $1217.452 \text{ mg}\cdot\text{kg}^{-1}$ ) are beyond the content of the third class ( $\leq 200 \text{ mg}\cdot\text{kg}^{-1}$ ) (GB15618-1995). Besides, with analysis of Fig. 28.2, the gross content of Ni consist of Ni of ES which contributed 0.31 %, Ni of CBS which contributed 2.56 %, Ni of FMOS which contributed 0.01 %, Ni of OMS which contributed 60.31 % and Ni of RS which contributed 35.82 %.

Averagely gross contents of Zn ( $430.53 \text{ mg}\cdot\text{kg}^{-1}$ ) is between the second class standard content ( $\leq 300 \text{ mg}\cdot\text{kg}^{-1}$ ) and the third class standard content ( $\leq 500 \text{ mg}\cdot\text{kg}^{-1}$ ) (GB15618-1995). Besides, with analysis of Fig. 28.2, the gross content of Zn consist of Zn of ES which contributed 0.80 %, Zn of CBS which contributed 11.56 %, Ni of FMOS which contributed 0.20 %, Zn of OMS which contributed 47.14 % and Zn of RS which contributed 40.30 %.

Averagely gross contents of Cu ( $129.48 \text{ mg}\cdot\text{kg}^{-1}$ ) general equal to the corresponding second class standard content ( $\leq 100 \text{ mg}\cdot\text{kg}^{-1}$ ) (GB15618-1995). Besides, with analysis of Fig. 28.2, the gross content of Cu consist of Cu of ES which contributed 1.45 %, Cu of CBS which contributed 4.60 %, Cu of FMOS which contributed 0.00 %, Cu of OMS which contributed 62.79 % and Cu of RS which contributed 31.49 %.

Averagely gross contents of Cr ( $120.96 \text{ mg}\cdot\text{kg}^{-1}$ ) is not beyond the corresponding second class standard content ( $\leq 250 \text{ mg}\cdot\text{kg}^{-1}$ ) (GB15618-1995). Besides, with analysis of Fig. 28.2, the gross content of Cr consist of Cr of ES

which contributed 0.00 %, Cr of CBS which contributed 0.00 %, Cr of FMOS which contributed 0.00 %, Cr of OMS which contributed 66.42 % and Cr of RS which contributed 33.58 %.

As a conclusion, with the criterion of national quality standard for soil environment (GB15618-1995), Cd, Ni and Zn share higher degree of enrichment in farmland soil of the Xinxiang city. And that phenomenon should to be concerned immediately by the corresponding department.

### 28.3.2 Results Based on Index of Geo-Accumulation Assessment

According to data of the gross contents of the 5 heavy metals and the Eq. (28.1), the results are showed in Table 28.2.

According to Table 28.2, it indicates that the degree of enrichment about Cd belongs to class of extremely contaminated. The degree of enrichment about Ni is in class of heavily to extremely contaminate. The degree of enrichment about Zn is in class of moderately contaminated. The degree of enrichment about Cu is in class of moderately to heavily contaminate. The degree of enrichment about Cr is in class of uncontaminated to moderately contaminate. And the ranking order is Cd > Ni > Cu > Zn > Cr. The results based on index of geo-accumulation are basically similar to the analysis in section an above. As a consequence, the Cd, Ni and Zn would be the prior pollution controlling factors in this farmland, especially Cd, Ni.

### 28.3.3 Results Based on Potential Ecological Risk Assessment

According to data of the gross contents of the 5 heavy metals and the Eqs. (28.2) and (28.3), coefficients of Hakanson potential ecological risk in farmland soil of the Xinxiang are calculated and showed in Table 28.3.

With the results in Table 28.3, coefficients of Hakanson potential ecological risk of 5 heavy metals are in an obvious diversity, and the ranking order is

**Table 28.2** Index of geo-accumulation assessment results on heavy metals in farmland soil

Items	Cd	Ni	Zn	Cu	Cr
$I_{geo}$	9.25	4.93	1.95	2.13	0.36

**Table 28.3** Potential ecological risk assessment results on heavy metals in farmland soil

Items	Cd	Ni	Zn	Cu	Cr	$RI$
$E_r^i$	27311.00	227.99	5.80	32.86	3.85	27581.50



$Cd > Ni > Cu > Zn > Cr$ . Coefficient of Hakanson potential ecological risk of Cd is in the class of extremely potential ecological risk and reach even 85 times than the correspondingly highest limited value (320). Coefficients of Hakanson potential ecological risk of Ni is in the class of heavily to extremely potential ecological risk. Coefficients of Hakanson potential ecological risk of Zn, Cu and Cr all belong to low potential ecological risk.

Integrated potential ecological risk index ( $RI$ ) of farmland soil in the Xinxiang city is in the class of very high potential ecological risk and the value of  $RI$  (27,581) is more than 45 times than the limited value of the highest class (600). It suggests that farmland soil from the Xinxiang city is under very high potential ecological risk. But without the value of  $E_r^{Cd}$  (27311.00), the remaining value of  $RI$  is 270.50 and is in the class of heavily to extremely potential ecological risk. Given the analysis above, there is a same conclusion that Cd must be the chief pollution controlling factors, and next the prior pollution controlling factor is Ni. By contrast, other 3 heavy metals share a relatively low potential ecological risk.

### 28.3.4 Results Based on RAC Assessment

In order to assess environmental risk and bioavailability for different speciation composition of heavy metals, according to Figs. 28.1 and 28.2 and the Eq. (28.4), RAC of 5 heavy metals are calculated and showed in Fig. 28.3.

According to Fig. 28.3,  $RAC_{Cd}$  belongs to the heavily to bioavailability and risk.  $RAC_{Ni}$  belongs to the risk low bioavailability and risk that make a big different to the conclusions through potential ecological risk assessment and index of geo-accumulation.  $RAC_{Zn}$  and belongs to moderately bioavailability and risk. And  $RAC_{Cr}$  and belongs to practically no bioavailability and risk. The bioavailability and risk class based on value of RAC' ranking order is:  $Cd > Zn > Cu > Ni > Cr$ .

As a conclusion, in the farmland of Xinxiang city, Cd makes a very high risk to human health and the stability of ecosystem not only because of its very high enrichment but also its high bioavailability. By contrast, risk sourced by other 4 heavy metals are relatively in a low class, but just like Ni, it would course a great

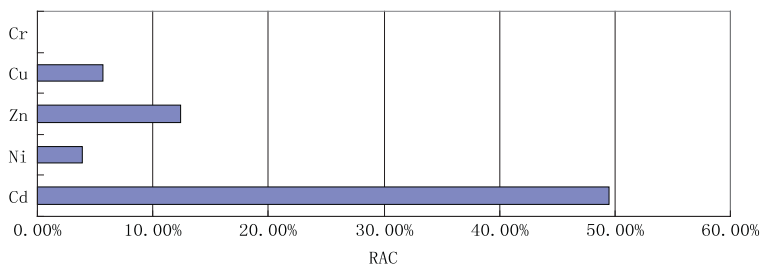


Fig. 28.3 Results based on RAC assessment

risk if its speciation composition make a change on condition of its very high enrichment. Therefore, the corresponding department should take Cd as the chief pollution controlling factors and monitor characteristics of heavy metals' variation in farmland of Xinxiang city frequently to make sure the farmland products safe.

## 28.4 Conclusions

The results show that: (1) Cd, Ni and Zn are in higher degree of enrichment in the farmland soil of the Xinxiang city by the reference of national quality standard for soil environment (GB15618-1995). (2) Ranking order based on index of geoaccumulation assessment is  $Cd > Ni > Cu > Zn > Cr$ . (3) Potential ecological risk ranking order is  $Cd > Ni > Cu > Zn > Cr$ , and the corresponding department should take Cd and Ni as the prior pollution controlling factors, especially Cd. (4) Result of integrated Hakanson potential ecological risk assessment showed that this farmland soil from the Xinxiang city is under very high potential ecological risk. (5) Results of the risk assessment code (*RAC*) manifest Cd makes a very high risk to human health and stability of ecosystem not only because of its very high enrichment but also its high bioavailability. By contrast, risks sourced by other 4 heavy metals are relatively in a low class.

## References

1. Xi DL, Sun YS, Liu XY (1995) Environmental monitoring, vol 2. Higher Education Press, Peking, pp 39–48
2. Remon EE, Bouchardon JL et al (2005) Soil characteristics, heavy metal availability and vegetation recovery at a former metallurgical landfill: Implications in risk assessment and site restoration. *Environ Pollut* 137(2):316–323
3. Qian J, Wang ZJ, Shan XQ et al (1995) Progress in the investigation on plant availability of soil trace metals. *Environ Sci* 16(6):73–75
4. Li F, Wang XY, Tang FQ (2011) Potential ecological risk assessment of heavy metals in the suburban farmland soil from Xinxiang city. *J Henan Normal Univ (Nat Sci Ed)* 39(5):84–87
5. Tessier A, Campbell PGC, Blanson M (1979) Sequential extraction procedure for the speciation of particulate traces metals. *Anal Chem* 51(7):844–851
6. Muller G (1969) Index of geoaccumulation in sediments of the Rhine River. *GeoJournal* 2(3):108–118
7. Hakanson L (1980) An ecology risk index for aquatic pollution control: a sedimentological approach. *Water Res* 14(8):975–1001

# Chapter 29

## Research on Architectural Style and Formative Causes of Traditional Tujia Residence

**Jin Hu**

**Abstract** The paper intends to expound the architectural style and formative causes of the traditional Tujia residence. Displaying the diligence and intelligence of the Tujia people, Diaojiaolou or stilt house epitomizes their traditional residence. Its construction process is difficult and complicated, teeming with ceremonies and beliefs. Boasting a number of advantages, Diaojiaolou is the stilt (ganlan) framing house that incorporates some characteristics of the pillars-and-transverse-beams (chuantou) and pillars-and-beams (tailiang) framing systems. It can be mainly classified as the individual building, the corner-turning building and the courtyard building. It is often well-decorated. Diaojiaolou is the tangible carrier and manifestation of the Tujia culture and it reflects, or rather, is determined by their architectural ideas, culture, for that matter, social being. It is a product of the integration of their geography, climate, philosophy, ethics and religion.

**Keywords** Traditional Tujia residence • Architectural style • Formative causes

### 29.1 Introduction

As a minority nationality, the Tujia people are the 7th largest ethnic group in the People's Republic of China, with a total population of approximately 8 million. They mainly live in the Wuling Mountains and the Wu Mountains, straddling the common borders of Hunan, Hubei and Guizhou Provinces, and Chongqing Municipality in Southwestern China. With a time-honored history, the Tujia at least can be traced back to the middle of the Tang Dynasty, and possibly beyond, to the ancient Ba people. In the long course of historical evolution, the Tujia have built a splendid civilization and unique culture of their own. Undoubtedly, their architecture is a shining pearl of their culture.

---

J. Hu (✉)

Animation School, Hubei Institute of Fine Arts, Wuhan 430205, China  
e-mail: okjinhu@sina.com.cn

More and more attention is being paid to the issue of the traditional Tujia dwelling nowadays, as more and more people are beginning to heed our quality of inhabited environment [1]. For various reasons, especially the cultural estrangement, however, there is general lack of understanding about it among the people, even among the academics. In the light of the situation, this paper intends to explicate the architectural characteristics and formative causes of the traditional Tujia residence [2]. It is hoped that the article will induce other scholars to come forward with more valuable contributions.

## **29.2 Architectural Style**

As a crystallization of the collective wisdom of the Tujia people, Diaojiaolou (literally means the leg-hanging building in Chinese), or stilt building, is the epitome of their traditional dwelling house without doubt. Developing from the cave and nest houses in the primitive society, the Tujia-style Diaojiaolou or stilt building took shape and came to maturity around the Tang Dynasty, approximately 1,000 years ago. It is a residential house with a dense architectural beauty and ethnic favor of the Tujia. The mostly wooden house is usually built in proximity to the mountain or above the water (creek or river) on the slope, with some parts on the foundation and the other overhanging ones supported by several wooden pillars, or with the whole merely propped up by several posts. From afar, the stilt building looks as if it hung or suspended a few legs and this is why it is known as Diaojiaolou in figurative Chinese.

### **29.2.1 Construction Process**

For the Tujia people, constructing Diaojiaolou is a milestone in their lives. Nevertheless, it is often a difficult, complicated process, encompassing selecting the site and date, obtaining building materials, processing the timber, connecting beams and pillars, erecting pillars and frames, setting the ridgepole or ridge beam, and decorating the house, etc. The building procedure is teeming with ceremonies and beliefs, and there is an art to it [3].

In the first place, the Tujia people will select the location and time in the belief that the site of a house will greatly determine the fortune of their family as their deities and ancestors will live with them in the house. It is common practice for them to consult a feng shui master or geomancer, since it involves a number of factors, such as the record of their horoscope and geographical conditions. In accordance with their feng shui principles, the treasured house with the best geomantic omen, for example, should face the south, with a vast field of vision and a tame river ahead, and the mountain running from west to east behind. In practice, their homes may face the east, the west and even the north, depending on a lot of

determinants, mainly geographical conditions and geomantic omens. Recovering their original simplicity and learning from nature, the Tujia people advocate the harmony between Man and nature. It is also of great significance to set dies faustus for all the important steps, such as breaking earth and setting the ridgepole. Under no circumstances will they offend their ancestors and deities like the God of the Year and the God of Land.

After that, they will, in their terms, “faqingshan”, logging in green mountains. China fir, which boasts a very straight, sturdy trunk, is very popular with the Tujia people. In some areas, they prefer toonasinensis roem and tupelo gum, which have the same pronunciations as “spring” and “children” respectively in Chinese, prophesying their being blessed with eternal prosperity and many children to their mind’s eye [4]. Then comes “jiadama”. The timber will be processed into the various parts of the house according to the plan, such as pillars, beams and walls, etc., and certain propitious patterns, such as the Eight Trigrams and Diagram of the Supreme Ultimate, will be painted on the ridgepole. Next, people will connect certain pillars and minor beams, or rather transverse tie-beams to form a fan-like frame and they call it “paishan”. The minor transverse tie-beams are mortised into the major pillars, knitting them together into a frame. Subsequently, they will erect kingposts and fan-like frames, thus establishing the house and this is called “liwushuzhu”. Then they will “shangdaliang”, as they describe, setting the ridgepole in place on an auspicious day, when a grand ceremony will be held to worship liang or ridgepole. The Tujia believe that liang is the basis of the whole house, determining their lifeline.

At last, they can decorate their house. It must be pointed out, however, that in reality, the details of the procedure and rites may vary from place to place and house to house, but the cardinal principles are the same, viz. advocating the harmony between Man and nature, revering deities and ancestors, and praying for prosperity and happiness.

### ***29.2.2 Structure and Shape***

Consisting of mostly or even entirely timber, the Tujia-style Diaojiaolou is the stilt (ganlan) framing house that incorporates some characteristics of the pillars-and-transverse-tie-beams (chuantou) and pillars- beams- and-strut (tailiang) framing systems.

The composite structure has a number of advantages. Firstly, raised on stilts, the building can stand almost everywhere, even at the otherwise most unsuitable place for housing like slopes and water, making the best of the land. Secondly, the elevation can protect people from vermin, keep out moisture or flooding, and offer enough light. Thirdly, the wooden frame, rather than the wall, bears usually the hip-and-gable roof, and provides earthquake-resistance as well as flexibility for the material and replacement of walls, doors and windows. In some cases, the wall of Diaojiaolou is made of earth or bricks. Last but not the least, it is relatively easier

to construct. Unlike the traditional Western stone house that might take years to build, Diaojiaolou may be completed in a few months. The problem is, however, that the timberwork is prone to corrosion and consumes large quantities of wood.

As for the Tujia commoner's Diaojiaolou, it combines the chuandou framing system in most cases, with smaller pillars and denser spacing to support the structural load. Albeit less imposing and more compared, the chuandou framing house is relatively simpler to construct economically with smaller building timber and more flexible structures to suit the mountainous site. In order to articulate the solemnity, some houses especially the ancestral temple of the very wealthy family are built with the tailiang framing system.

There are various stilt houses for the Tujia people and the pattern may vary greatly, depending on the wealth, size and taste of the family as well as the regional differences and geographic conditions. The following are some common types of Tujia-style Diaojiaolou.

Individual or independent type. As the name implies, this type of Diaojiaolou is an individual, rectangular house, similar to the horizontal I-Shape plan. If only part of the house overhangs, with the pillars supporting, it is usually on the short side of the rectangle.

Complex type. Since there is the individual building, there exists the complex or conjunct one. The complex can be mainly classified into Corner-turning Building (Zhuanjiaolou) and Courtyard Building (Sishuiwu).

Corner-turning Building enjoys high favor among well-off families. It comprises Erheshui and Sanheshui. Erheshui, similar to the inverted L-shape plan, is made up of two constructions; the one is large and the other small. If only part of the dwelling hangs, normally it is the small one. In the Tujia jargon, Erheshui means that the rain flows down the two orthogonal front sloping sides of the roof onto the ground in front of the main doors, prophesying accumulating wealth from two directions. By the same token, Sanheshui, analogous to the inverted U-shape plan, is composed of one large construction and two equally small ones, implying accumulating money from three directions. The same applies to Courtyard Building (Sishuiwu). Usually, the two small constructions are the hanging attics if any part suspends.

Courtyard Building or Sishuiwu is a quadrangle complex, with the two main buildings respectively in the front and rear and the two small structures on the left and right sides surrounding the open space. It bears a striking resemblance to the courtyard complex or Siheyuan in Northern China, in that both enclose the open space within themselves. Whereas the empty space called courtyard in Siheyuan is very large, maximizing the sunshine while keeping out the cold north winds, the open space known as sky well in Sishuiwu is quite small, just like a hole, serving to restrict the amount of sunlight and ventilate the hot air while discharging rain water from the roof tops. This type is usually for very wealthy or extended families.

These buildings tend to be two or three storied, with well-made verandas. The space below the house or the so-called ground floor may be used for storage or breeding, if circumstances permit. People live upstairs and girls often dwell in hanging attics.

Despite its diversity, the Tujia-style Diaojiailou generally follows the basic principles of laying out its rooms, i.e. revering deities and ancestors, showing respect for seniorities, and according with the nature. At the center of the principal building must be the main hall or tangwu, where a shrine of deities and ancestors is set up and family ceremonies held. Family members also discuss important matters or greet guests there. The Eight Trigrams in the middle of the ridgepole there must line up exactly with the main entrance. The principal building or the whole almost always consists of an odd or yang number of rooms. For one thing, an even or yin number is considered unlucky; for another, the main hall with bilaterally symmetrical wing rooms or renjian creates balance, harmony, order and aesthetically pleasing effects. Nevertheless, according with the rough terrain, the Tujia-style Diaojiailou doesn't strive for symmetry sedulously like the mainstream Chinese architecture. The rooms are allocated in order of seniority and sex. The parents are entitled to the main room, i.e. the room behind the shrine called qiangdoufang, if any, or the left-wing room while their children should live in minor rooms. If there are two brothers, the elder brother can enjoy the left-wing room while the younger should settle for the right-wing one. The Tujia regard the left superior to the right. The wing room can be further divided into two halves, kitchen and bedroom. Daughters often dwell in hanging attics.

### ***29.2.3 Interior Decoration***

Rich or poor, the Tujia people attach great importance to decorating their dwellings by constructing, painting and carving, aspiring to beauty and prosperity. Combining practical concerns and folk beliefs, their decoration has a triple purpose, far beyond pure ornamentation. They don't try to create a realistic rendering of the external appearance of the object, seeking instead to capture the inner spirit and express their wishes.

Particular attention is paid to doorways, windows, beams and pillars; because doorways and windows are the places that good or evil spirits are thought to pass while beams and pillars regarded as the skeleton or lifeline of a home. A tablet of the white tiger, the totem of the Tujia people, is often hung above the main entrance to ward off evil influences as well as beautify the doorframe. They post, paint, carve or enchase auspicious Chinese characters, animals and plants on doorways, windows, beams and pillars, praying for blessings, happiness, and prosperity through homophony, metaphor and positive association. For instance, Chinese character fu literally means luck, good fortune or blessings, and shou represents age and long life. A figure of fish symbolizes abundance as it sounds the same as abundance in Chinese. A combination picture of magpie, deer, bee and monkey, the homonyms of happy, salary, grant and marquis respectively in Chinese, signifies that the title of marquis will be conferred upon you with a fat salary. The plants with many seeds, such as lotus pods and watermelons, reflect a desire for many children. Peony and phoenix are the emblems of wealth and blessings, and pairs of ducks and cranes are the

indications of love and harmony, and so on. The lattice or hollowed-out patterns in doors and windows can also serve as ventilation and illumination.

If economic conditions permit, the Tujia people will construct the beautiful rooftop, characterized by upturned eaves, protruding corners and green or black tiles. The ridge tends to be adorned with small sculptures of a shoe-shaped gold ingot, treasure bottle, black gauze cap, or a triplex of bat, gourd and peach, which prophesy wealth, high position with handsome salary, good fortune and longevity. The protruding corners are frequently fashioned into turtles and phoenixes, and the upturned eaves are ornamented with various wooden flowers.

### **29.3 Formative Causes**

Displaying the diligence and intelligence of the Tujia people, Diaojiaolou is the tangible carrier and manifestation of the Tujia culture and plays an important role in their lives. Its construction process, structure, shape and decoration all reflect, or rather, are over-determined by their architectural ideas, culture, for that matter, social being. It is a product of the integration of their geography, climate, philosophy, ethics and religion.

#### ***29.3.1 Geography and Climate***

The Tujia people mostly inhabit the Wuling Mountains and the Wu Mountains with a subtropical climate. Blessed with plenty of rainfall and sunshine, the region abounds with wildlife. It is a double blade sword for them. On the one hand, it provides abundant natural resources, like food and timber; on the other, beasts and diseases in forests seriously threatened their lives, especially in ancient times. Meanwhile, numerous rugged mountains and very limited farmland are the hallmarks of the geography there. Facing the harsh realities, the wise Tujia people invented Diaojiaolou through ages of practice. With a lot of merits, such as high adaptability, maximum land utilization, humidity-resistance and earthquake-resistance, the building with the unique design fitted in with the surroundings perfectly. We can say that the geography and climate have shaped their homes.

#### ***29.3.2 Philosophy***

The Tujia people advocate the harmony between Man and nature, because they firmly believe that human beings are an integral part of nature. We human being should love nature like our mother, respect and conform to her laws, rather than conquering and plundering her as the Westerners did, so that we can obtain coordination with nature and develop healthily. They share the same philosophical idea with the Han people on this issue. Their ceremonies and beliefs in building procedure, which show that they revere



and worshipfully fear nature, are a very good point in case. Complying with the terrain, Diaojiaolou doesn't seek symmetry sedulously. Not very tall, it can radiate the beauty of nature in a seamless blending of the building and the natural world, thus achieving the harmonious beauty of Man and nature. As a matter of fact, Diaojiaolou is the result of adapting to nature, rather than of transforming it.

### ***29.3.3 Family Ethics***

The Tujia people are fond of living in concentrated communities. Filial piety, conubial love, brotherhood and domestic harmony are their traditional family virtues, which are exemplified by their layout of rooms and decorations. As a member of the Chinese nation, they have a lot in common with the other ethnic groups, such as the Han, Miao and Bai, in terms of family ethics. The main hall is in the center, with the other rooms surrounding it. It indicates that the parents especially father are the core of the family and play a central role in family affairs. The rooms are assigned in order of seniority and sex. The parents are entitled to the main room, sons the secondary ones and daughters the worst. The Tujia family is actually the patriarchal one. Their family ethics and aspirations are also embodied in their decorations.

### ***29.3.4 Religious Faith***

The people's cohabitation with deities and ancestors is one of the main features of the Tujia style Diaojiaolou, as a shrine of deities and ancestors is always set up in the main hall or central room. The Tujia believe in animism and polytheism. They hold anthropomorphically that non-human entities, such as houses and nature, are spiritual beings, or at least embody some kind of life-principle. They will never offend them, because they fear some evil will befall. That is why they are religious in the observance of various rites, endorsing the harmony of Man with nature. They worship their ancestors, nature, heroes and totems. Despite the demise of their ancestors, their souls are thought to be still with them in the house. Diaojiaolou gives expression to the Tujia's religious beliefs. They have a stronger religious consciousness or are more "superstitious" than the Han people.

## **29.4 Concluding Remarks**

Diaojiaolou or stilt house is the gem of traditional Chinese architecture, embodying the diligence and wisdom of the Tujia people. It can be seen from it that the Tujia, as a member of the Chinese nation, share a lot in common with the other nationalities, especially the Han, in principle, but they hold quite different, unique practices of their own in detail. The traditional Tujia Diaojiaolou is even considered as the living fossil of the Ba and Chu cultures since it retains a lot of

primitive characteristics in very ancient times. We can understand the Tujia people's daily life in ancient times by studying it as well as draw inspiration from it.

Of course, Diaojiaolou has its own problems. It corrodes easily and it demands a great deal of wood, resulting in serious deforestation in some areas and thus going against the harmony of Man with nature. With the advance of science and technology, particularly materials science and engineering, we can overcome these problems without much difficulty. In a word, it is very important that we should preserve and study Diaojiaolou further in contemporary society.

## References

1. The firsthand information on the Tujia-style Diaojiaolou I collected in Hunan, Hubei and Guizhou Provinces, and Chongqing Municipality in 2011
2. Duan C (2000) A cultural history of the Tujia nationality, vol 28. The Ethnic Publishing House, Beijing, pp 119–124
3. Song W (2010) Illustrated handbook of traditional Chinese architecture, vol 2. The Oriental Press, Beijing, pp 27–33
4. Zhang AW (2011) A literature review of Tujia Diaojiaolou. *J Sichuan Univ Nationalities* 20(2):16–23

# Chapter 30

## Decorative Beauty of Bionic Ceramic Vessels with Floral Rims

Yalin Zhang, Miaomiao Wang and Yong Yu

**Abstract** The paper investigates the decorative beauty of bionic ceramic vessels with floral rims. From the perspective of the shape, the paper reveals that bionic ceramic vessels simulate flowers and plants, reproducing the diversity in the composition of leaves and petals; their modes vary from the whole simulating a part to a part simulating a part; their decorative beauty consists in both their dynamic and their static bionic designs. It will enrich the theory about Chinese ancient ceramic design and provide guidance for the shape design of ceramic products.

**Keywords** Ceramics • Vessel with flower rim • Shape • Bionic design • Decorative beauty

### 30.1 Variety of Simulation Objects

“Compared to other forms of plastic art, handicraft pays more attention to decoration” [1]. It’s also true with ceramics as a branch of handicraft. For ceramics, decoration usually means decorative patterns on its surface. In a broad sense, decoration is more than that. It should include glazes, textures and crafting marks generated in the production process [2]. In addition, shapes of ceramics also have their own decorative implications [3]. Mr. Zhang Daoyi said, “Aesthetics exists in the shape of an object because it is made by man. Why it is shaped like this and not that is dictated by aesthetics.” [4] the decorativeness of a ceramic shape is a reflection of beauty in its form [5]. This characteristic is conspicuously emphasized with some vessels while not so with some others [6]. Ceramic vessels with

---

Y. Zhang (✉)

School of Art and Design, Wuhan University of Technology, Wuhan 430070, Hubei, China  
e-mail: 582109184@qq.com

M. Wang

Sanming University, Sanming 365000, Fujian, China

Y. Zhang · Y. Yu

School of Ceramic Art, Jingdezhen Ceramic Institute, Jingdezhen 333403, Jiangxi, China

**Fig. 30.1** Floral-rimmed bowls



floral rims are good examples of the conspicuously emphasized [7]. Functionally and proportionally well-built, they integrate the beauty of shape and decoration by simulating varieties of objects in multiple postures in different modes [8].

Ceramic vessels with floral rims simulate various flowers in nature. Of Chinese Tang Style bowls, the most representative are those in the shapes of lotus flower, begonia and sunflower (Fig. 30.1). Seen from the top, a lotus bowl is round in shape, like the namesake flower, its scalloped rim mimicking the flower

petals; the begonia bowl is oval in shape as seen from the top with its rim like the petals of begonia; the sunflower bowl is round in shape as seen from the top with its rim curved outward like the petals of a sunflower, creating the outline of the flower [9].

Besides those with flower rims, there are vessels with rims assuming the shapes of leaves, such as cups, saucers, brush washers, and bowls with rims of lotus leaves [10]. The rim shaped into a lotus leaf with three or five clefts is often seen in cups or saucers, the symmetrically folded often in brush washers, and the curvy flared often in bowls [11].

Vessels with floral rims have rich simulation sources ranging from flowers to leaves, which bring variety to the bionic ceramic shapes and add to their decorative beauty [12].

## 30.2 Variety of Simulation Modes

A ceramic piece is composed of several parts. Simple bionic ceramic forms like floral rimmed bowls, plates, cups, saucers and brush washers apparently consist of the mouth, the body, the foot, and the base. Simulation of floral objects in nature varies with the construction needs of different parts of a shape. It occurs either in whole or in part [13].

### 30.2.1 *Simulation of the Whole*

Simulation of the whole happens when the bionic design is to be done considering the whole shape as the medium. It focuses on crafting the whole vessel in the image of the simulated object. The vessel itself is an ornament to enhance the environment.

The bionic simulation of the whole occurs in two ways: the whole simulating the whole and the whole simulating a part.

The vessels with floral rims are crafted in the mode of the whole simulating a part. The floral structure is quite different from that of fauna and man. Its part and whole are relatively defined. Take a flower for example. When observed at the level of a plant, it is a part; but at the level of a flower itself, it is the whole, consisting of petals, stamens, and a pedicle. As we regard a flower or a leaf as an integral part of a plant, vessels in either shape are considered examples of the whole simulating a part. For example, the Qing Dynasty lotus leaf plate (Fig. 30.2) is crafted in the shape of a lotus leaf with veins in intaglio lines. On the wavy edge of the plate are a lotus flower and a seedpod. Whether in form or content, it affords an integral vision of the whole. Through the simulation of the whole, the vessel creates an imagined space of harmonious nature outside

**Fig. 30.2** Qing Dynasty  
lotus leaf plate



the world of functional reality. The contrast and the conversion between the real world and the imagined space it provides enrich the decorative beauty of the bionic shape.

### ***30.2.2 Simulation of a Part***

Simulation of a part occurs when bionic design is done for one or more components of a piece.

Simulation of a part also has two forms: a part simulating the whole and a part simulating a part.

Floral-rimmed ceramic vessels simulate a part in part. Bowls, plates, cups and saucers usually have their rim fashioned in the shape of a flower or a leaf and their body and foot in a geometrical form. The casualness of the free form floral rim sets off the rigidity of the geometrical-shaped body and foot, while, at the same time, the rigorous geometrical shapes of the body and foot accentuate the vivaciousness and naturalness of the free form of the floral rim. The interaction of a free form with a geometrical form and the fusion of the two in a ceramic vessel make the shape more meaningful and decorative.

## **30.3 Variety of Simulation Postures**

“Posture generally refers to the appearance of an object under specific conditions. It’s the result of the interactions between the object’s internal and external factors and the manifestation of its material, chemical and biological properties under external influence. It’s a visual form of content and is defined by its relevance to space and time.” “Shape” and “posture”, though different from each other in nature, constitute the entire appearance of an object. “Shape” refers to the objective, tangible, rational and static existence of an object. It is a physical form with its specific

sizes and physical features that can be viewed from a specific angle at specific time in a specific environment. “Posture” refers to the total impression of “shape” of an object when viewed at different levels from different angles. It is the real existence of the object. It results from our subjective perception of it as a whole in static and dynamic motions. Posture is ever changing for its time-dependence. Compared to shape imitation, posture imitation is more complete, lively and dynamic. The shape in the right posture displays more beauty, expression and distinction.

Floral-rimmed ceramic vessels mainly mimic the posture of a plant. Posture simulation is divided into dynamic simulation and static simulation according to the posture a simulation object is in.

### 30.3.1 Dynamic Simulation

Dynamic simulation captures the posture of a living thing (a plant) in motion, esp. its most dynamic moment, and represents it in a visually unbalanced form. The biomimicry shows a strong sense of instability in a moment of movement. Take for example a carved celadon peony-rimmed wine cup from Yaozhou Kiln in Song Dynasty (Fig. 30.3). It has six petals on the rim curled outward like a scalloped lotus leaf, ready to reach out with a burst of energy. Other examples can be found in jars with lotus leaf lids (Fig. 30.4), plates in similar shapes, etc., which were popular in Yuan Dynasty. The lid is shaped as if it were a lotus leaf afloat on the water of a pond being ruffled by the wind. The bionic simulation of the dynamic posture renders rhythm and melody to a shape, strengthens its visual effect and increases its aesthetic pleasure.

**Fig. 30.3** Carved celadon peony cup



**Fig. 30.4** Yuan Dynasty jar with lotus leaf lid



### **30.3.2 Static Simulation**

Static bionic simulation is a relative concept, defined as opposed to dynamic simulation, for nothing is absolutely still in the world. A bionic work emulates the posture of a plant in relative stillness, which it keeps unchanged for a long period of time. For example, flowers in full bloom and wide-open leaves are in a relatively static state. Bionic vessels with rims in their shapes do not bring the viewer the visual and spiritual enjoyment from dynamics and rhythm of life, but the pleasure of peace and stability.

Vigor and repose as manifested respectively in dynamic and static simulation through a floral-rimmed vessel are aspects of life in nature. They also render it its decorative beauty.

By using bionics in their design and production, floral-rimmed vessels are fashioned in shapes with unique decorative effects, which are further enhanced by varied decorative motifs, multiple decorative modes, and diversified postures of life.

## **30.4 Conclusion**

Ancient Chinese bionic ceramic vessels with floral rims are highly decorative. Their shapes simulate flowers and leaves in dynamic and static postures in the modes of the whole copying a part and a part copying a part.

The floral-rimmed ceramic vessels inspire us to tap the rich floral resources in nature and opens up great potentials for our bionic design of ceramic products. However, initiative is needed in the process of design. A bionic shape should be



developed as a perfect integration of form and function in line with the requirements for utility and construction. It should be the vehicle of culture, expressing ideas beyond words through a silent form with taste.

## References

1. Tian Z (1996) History of Chinese arts and crafts, vol 12. Shanghai Orient Publishing Center, Shanghai, pp 46–54
2. The Chinese ceramic society (1982) history of Chinese ceramics, vol 36. Cultural Relics Press, Beijing, pp 42–28
3. Jincheng C (2001) The art of Chinese ceramics, vol 3. Shanxi Education Publishing House, Taiyuan, pp 9–17
4. Yongshan Y (2004) Ceramic plastic art, vol 11. Higher Education Press, Beijing, pp 7–43
5. Jusheng W (2000) Principles of plastic art, vol 30. Heilongjiang Fine Arts Publishing House, Haerbin, pp 470–479
6. Yu F, Chen Y (2005) Bionic design, vol 44. Huazhong University of Science and Technology Press, Wuhan, pp 27–35
7. Li Zehou (2008) History of thought in ancient China, vol 01. SDX Joint Publishing Company, Beijing, pp 6–12
8. Shao Q, Li L et al (2009) A brief history of ancient Chinese design, vol 09. Shanghai Bookstore Publishing House, Shanghai, pp 01–04
9. Gao J, Zhang Y (2005) Bionic design of Chinese primitive pottery. *Chin Ceram* 32(11):89–91
10. Zhang Y, Li P (2006) Factors influencing shapes of porcelain bowls in Tang and Song Dynasties. *Chin Ceram Indus* 34:36–43
11. Li P (2007) The bionic characteristics of traditional Chinese ceramic shapes. *Jingdezhen Ceram Inst* 7:23–29
12. Dai Y (2008) Floral-rimmed porcelain vessels in middle and late Tang Dynasty. *Rongbaozhai* 3:92–97
13. Zhang Y, Fang Q (2009) Individualized design for daily-use ceramics. *Chin Ceram Indus* 5:46–48

# Chapter 31

## Study on Plants Community Succession in Land for Coal Gangue Dump in Fushun Mining Area

Chen Wang

**Abstract** On the base of site classification and site quality evaluation of land for coal gangue dump (LCGD) in Fushun mining area, the plants community succession of LCGD were systematically researched and analyzed. The relationship between dominant plants community succession distribution and soil fertility was studied. It was achieved that there existed the regularity of soil fertility influence on plants community succession on LCGD in Fushun mining area. The formation and distributions of natural existing plants community on LCGD were investigated. The plants community succession law was secondary nudation-grass-shrub-forest, which provided reliable evidence to recovery and recultivation of the LCGD in Fushun mining area.

**Keywords** Land for coal gangue dump • Plant community • Succession • Soil fertility

### 31.1 Introduction

The existing vegetation on land for coal gangue dump (LCGD) in Fushun mining area was formed through encroachment, ecesis, aggregation and competition of pioneer population, which has the character of primary succession [1]. There existed given difference in constitution and structure level of plants community on LCGD. It was concluded that there exist three different succession stages including the dominant single population community, secondary dominant population community and common dominant population community.

LCGD belongs to the secondary nudation in Fushun mining area. But the plants population recovery has the characteristic of primary nudation, namely,

---

C. Wang (✉)

Academy of Art, Qingdao Technological University, Qingdao 266033, China

e-mail: dollywang@126.com

the formation and succession of the plants community were the process of the encroachment, ecesis, aggregation and competition of pioneer population. The sites condition affected the ecesis and growth of plants so that the plants community structures were relatively simple and incompetent of anti-disturbance [2–4].

The vegetation types in peripheral area affected the secondary succession of vegetation community also. The thirty-six vegetation populations on dump in Laohutai mine all belong to the local natural distribution populations. The community types also were common local vegetation succession. The long-term plants community successions meet the general trend of secondary nudation-grass-shrub-forest. It was explained by the arbor and shrub species including *ulmus pumila* and *lespedeza juncea* presented in the quadrat investigation.

## **31.2 Influence of Soil Factor on Trend of Plant Community Succession on Land for Coal Gangue Dump**

Soil is a main environment factor for plant community. Plants community succession was the process of inter-influence and interaction between plants and soil. Former researches mainly concentrated on species constitution and structure changes of plants, while considering soil factor change were on the opposite. As the basic property of the soil, soil fertility played an important role for plant community [5–7].

From the correlation of dominant plants community distribution and soil fertility in Laohutai mine dump, obvious negative relativity existed between dominant plants community distribution and rapidly available phosphorus contents. It was concluded that excessively high level of rapidly available phosphorus in the upper soil layer (about from 0 to 15 cm) had severe influence on plants settlement, growth and distribution, and affected the succession of plants community. So the more complicated plants community could not be formed in the certain time.

## **31.3 Natural Vegetation Distribution Law of LCGD**

### ***31.3.1 Vegetation Distribution on Type I of LCGD***

Table 31.1 showed that frequency, cover degree and multiple frequency of *tribulus tenestris*, *salsola collina*, *cynanchur anstrale* and *bidens paneiflora* are 17.1, 23.6, 18.2, 14.4 %; 15.2, 26.3, 19.7, 10.1 %; 16.2, 24.9, 18.9, 15.3 % respectively. The above plants were dominant ones, and belonged to xerophytia. So site type of LCGD was drought and barren, which fitted for the growth of drought-enduring plants.

**Table 31.1** Vegetation distribution on Type I of LCGD

Plant	Frequency (%)	Cover degree (%)	Multiple frequencies (%)
Tribulus tenestris	17.1	15.2	16.2
Lexlis sonenifolia	3.5	2.6	3.1
Solsola collina	23.6	26.3	24.9
Cynanchur anstrale	18.2	19.7	18.9
Srrndinena hirta	3.5	3.2	3.3
Bidens paneiflora	14.4	10.1	15.3

**Table 31.2** Vegetation distribution on Type II of LCGD

Plant	Frequency (%)	Cover degree (%)	Multiple frequencies (%)
Bidens paneiflora	4.6	5.0	4.8
Cleistogenes spuarrosa	22.6	23.8	23.2
Cleistogenes caespitosa	22.6	25.3	23.9
Leourns collina	4.8	10.6	7.7
Solsola collina	25.1	16.3	20.7
Tribulus tenestris	11.3	6.5	8.9

### 31.3.2 Vegetation Distribution on Type II of LCGD

Table 31.2 showed that frequency, cover degree and multiple frequency of sol-sola collina, cleistogenes spuarrosa, cleistogenes caespitosa and tribulus tenestris respectively are 25.1, 22.6, 22.6, 11.3 %; 16.3, 23.8, 25.3, 6.5 %; 20.7, 23.2, 23.9, 8.9 %.

Except for ponieer plants, cleistogenes spuarrosa and cleistogenes caespitosa, suitably living at hill side or grassland, existed on the site type too. They belonged to mid-drought-enduring herbage vegetation, which meant site conditions were improved for plants growth. At Hongtou north hillside in Fushun, existed two-year growing hippophae with average height 1.02 m, average ground diameter 1.87 cm, and maximum height 1.5 m, maximum ground diameter 3.3 cm. Three-year growing amorpha with average height 0.67 m, average ground diameter 0.75 cm, maximum height 0.93 m, maximum ground diameter 1.7 cm, existed at the same site also.

### 31.3.3 Vegetation Distribution on Type III of LCGD

Table 31.3 showed vegetation distribution of Type III of LCGD. The percentage of pioneer vegetation was decreasing gradually, while plants fitting for mid-survivable site type appeared gradually. srrndinena hirta played a dominant role

**Table 31.3** Vegetation distribution on Type III of LCGD

Plant	Frequency (%)	Cover degree (%)	Multiple frequencies (%)
<i>Leourns collina</i>	4.8	3.1	3.9
<i>Tribulus tenestris</i>	19.9	21.3	20.6
<i>Srrndinena hirta</i>	25.6	26.8	26.2
<i>Solsola collina</i>	19.7	12.6	16.2
<i>Amaranthus retroflexus</i>	7.6	5.7	6.6
<i>Calystegia pellita</i>	1.5	2.3	1.9

on the site type. These kinds of herbaceous plants were saline-alkali-enduring and fitting for growth at hillside, grassland and rock land. Gradually the shrubs consisting mainly of *peripola sepium*, *lespedeza juncea* lived at the Type III of LCGD. These photophilous tree species were drought-enduring, barren-enduring and strong vitality. Especially the roots of *peripola sepium* propagated rapidly and clustered. *Hippophae*, *amorpha*, *prunus sibirica*, and *zizyphus* grown on Type III of LCGD by reforestation. On the south hillside of the Hongtou mountain in Fushun, exist three-year growing *amorpha* with average height 1.2 m, average ground diameter 1.55 cm, maximum height 1.40 m, maximum ground diameter 2.3 cm. On the top of the Hongtou mountain, there existed one-year growing *zizyphus*, with average height 0.21 m, average ground diameter 0.20 cm.

### 31.3.4 Vegetation Distribution of Type IV of LCGD

Vegetation distributions of Type IV of LCGD were shown as Table 31.4. It was indicated that there were almost no pioneer plants, except for the dominant *srrndinena hirta*, hygrophilous herbaceous plants such as *phragmites commanis*, *themeda japonica* etc., appeared at Type IV of LCGD too. The phenomenon meant that soil environment had been improved greatly and nutrient and moisture content of the soil fitting to the growth of the hygrophilous plants. Moreover, arbor and shrub species such as *ulmus pumila*, *populus simonii*, *thuja orientalis*, and *robinia pseudo-acacia* by reforestation could grow normally on Type IV of LCGD.

On the north hillside of Hongtou Mountain, there existed two-years growing *thuja orientalis* with average height 0.83 m, average ground diameter 1.9 cm, maximum height 1.35 m and maximum ground diameter 4.2 cm. On the south edge of Laohutai, there existed nine-year growing *ulmus pumila* with average height 4.6 m, average trunk diameter 5.2 cm, maximum height 7.5 m. On the north hillside of Hongtou Mountain, there existed six-year bastard *acacia* with average height 2.3 m, average trunk diameter 1.9 cm, maximum height 7.5 m and maximum trunk diameter 4.5 cm.

**Table 31.4** Vegetation distribution on Type IV of LCGD

Plant	Frequency (%)	Cover degree (%)	Multiple frequencies (%)
Nleicotus albus	6.2	4.2	5.2
Plantago asiatica	4.2	6.5	5.3
Phragmites commanis	19.6	16.8	18.2
Themeda japonica	16.9	12.3	15.6
Srrndinena hirta	20.1	13.8	16.1
Lxeris soncnifolia	12.1	13.8	12.9
Aretmisia cupillaris	15.6	16.9	16.3

**Table 31.5** Vegetation distribution characteristic on dump

Plant	Frequency (%)	Cover degree (%)	Multiple frequencies (%)
Cynanethum libiricum	6.9	7.2	7.1
Leourns collina	7.3	6.6	6.9
Solsola collina	14.5	15.2	14.8
Srrndinena hirta	16.8	17.1	16.9
Lxeris soncnifolia	10.3	9.5	9.9
Nleicotus albus	7.8	8.2	8.0
Plantago asiatica	8.7	7.6	8.2
Phragmites commanis	14.9	15.9	15.4
Themeda japonica	10.1	8.8	9.4

### 31.3.5 Vegetation Distribution on Dump

Dump is one kind of LCGD, where site conditions were relatively better and there existed abundant vegetation species. From Table 31.5, it was shown that there existed many vegetation species on dump where srrndinena hirta and phragmites commanis were dominant population. On dump there existed reforestation trees species such as rhus typhina, amorpha fruticosa, hippopha rhamnoides, robina pseudo-acacia and ulmus pumila, and natural growing trees species including little green populus and white ulmus pumila.

### 31.3.6 Diversity Analysis of Vegetation on All Site Types

Diversity analysis method is adopted to synthetically compare diversity of vegetation community on all site types. There existed variant vegetation communities on different site types. Maximum diversity characteristic value between dump and type IV of LCGD is 0.70, which meant that the difference between them is very little. Because it was the longest time to stop discharging coal waste on type IV of

LCGD, the natural growth condition is the best and near to the condition of dump. It was concluded that the bigger the characteristic value of different site types was, the more less the difference between them was.

In is dry and cold in Fushun area, so spontaneous recovery ability of vegetation was poor. While artificial recovery could shorten recovery direction and period of vegetation, and improve evolution velocity of vegetation. Therefore, artificial recovery on abandoned field might be effective.

### 31.4 Conclusions

Achievements indicated that *tribulus tenestris*, *solsola collina* and *cynanchur anstrale* were pioneer vegetation on type I of LCGD, whose characters were drought-enduring and barren-enduring. Except for pioneer vegetation on type II of LCGD, there existed *cleistogenes spuarrosa* and *cleistogenes caespitosa*, etc. They were mid-drought-enduring herbage vegetation, which meant site conditions improved better for growth. On type III of LCGD, pioneer vegetation decreased, while vegetation fitting for mid-survivable site type increased, which meant site conditions improved further. On type IV of LCGD, there were almost no pioneer vegetation, while *phragmites commanis*, *phameda japonica* etc., appeared dominantly. The phenomenon indicated that soil environments were approaching to common hill fields. Evolving trend of plants was from secondary naked soil, to hassock, to brush, and to forest. Achievement could attribute to artificial recovery on waste dump.

### References

1. Fangqing C, Lu B, Wang X (2001) Plant community succession species diversity phosphate mining wasteland Zhangcunping. *Acta Ecol Sin* 21(8):1347–1353
2. GEMOER (1987) *Vegetation settlement in abandoned industrial area*. Science Publishing Company, Beijing
3. Huancheng G (1990) Soil resume in China. *Acta Ecol Sin* 10(1):28–35
4. Li B (1993) *Ordinary bionomy*. Mongolia Publishing Company, Huhehaote, pp 111–114
5. Zhongxiang Q et al (1987) *Vegetation bionomy*, vol 1. Higher Education Publishing Company, Beijing, pp 213–222
6. Wang K et al (2003) Ecological restoration of land for waste dump in metal tailing ore. *Sichuan Env* 22(1):13–17
7. Li S (1996) Analysis on recultivated soil characters and section structure of land for rock waste dump. *Mine Env Prot* 10(4):25–27

# Chapter 32

## Research on Advanced Manufacturing Technology Foresight of Chinese Furniture Industry

Ming Chen and Jian-hua Lv

**Abstract** This chapter did a research on advanced manufacturing technology foresight of Chinese furniture industry in the future 5–20 years. It comprehensively expounded the technology foresight method, selected the initial optional items by the Experts Meeting Method, analyzed manufacturing technology of Chinese furniture industry in the future 5–20 years by the Delphi Method, and then forecasted and discussed the related key technologies which are useful to Chinese furniture industry.

**Keywords** Technology foresight • Advanced manufacturing technology • Chinese furniture industry • Delphi method

### 32.1 Introduction

Technology foresight is a system research on scientific, technical, economic and social development in the future in order to determine the strategic research area and choose the technology group which has the largest contribution to economic and social benefits [1].

At present, with the rapid economic growth, the strategic management is becoming the main work increasingly. The demand of strategic technology prediction is getting higher. The strategic prediction is not only the deduction and speculation of future, but also the guidance of future. The research for future is using of various resources allocation and effort to choose in many possible events under the influence of many factors, such as external environment and constraints.

Due to the strict quantitative system model is too complex to make macroscopical policy decisions with many social factors that is difficulty to quantify. Therefore, Technology foresight which can solve these problems developed and applied [2].

---

M. Chen (✉) · J. Lv  
Forestry College, Sichuan Agricultural University, Ya'an, China  
e-mail: chenming@sicau.edu.cn

J. Lv  
e-mail: ljh@sicau.edu.cn



## **32.2 Research Methods**

### ***32.2.1 Research Methods***

The Experts Meeting Method is used to select the optional items first, and the Delphi Method is used to do investigation and statistical analysis on manufacturing technologies of Chinese furniture industry in the future 5–20 years, and then forecast the relevant key technologies.

### ***32.2.2 Main Tasks***

The development of society demands and technology trends on furniture manufacturing fields are be analyzed. The Delphi expert questionnaire investigation is taking place on the development of Chinese furniture manufacturing technologies in the future. And the technologies innovation points are studied under induction and analysis of technology foresight investigation.

### ***32.2.3 Optional Items***

According to related research, the optional items areas are divided into three areas: furniture product research, development and design; furniture manufacturing and integration manufacturing systems; information production and manufacturing resource integration management technology [3].

From the next 5–20 years furniture industry trends starting, through the literature survey, expert meetings, foreign technology forecasts, and the status quo of Chinese furniture industry, the optional items were designed in Table 32.1. The expert meeting included 7 experts: 3 scientific researchers, 42.9 %; 4 industry experts, 57.1 %; 4 senior professional title experts, 57.1 %; 3 intermediate title experts, 42.9 %.

183 Questionnaire files were sent out, and 125 files were retrieved, the response rate is 68.31 %. The respondents are as follows: 53 researchers, 42.4 %; 62 furniture industry experts, 49.6 %; 10 furniture equipment manufacturing industry experts, 8 %; 73 senior professional title experts, 58.4 %; 52 intermediate title experts, 41.6 %.

### ***32.2.4 Delphi Questionnaire Index System***

The Delphi questionnaire index system includes 15 indexes, which was shown in Table 32.2.

**Table 32.1** Furniture manufacturing technologies optional items

Area	Serial number	Optional item name
Furniture product research, development and design	1	Computer aided design (CAD)
	2	Computer aided engineering (CAE)
	3	Computer aided process planning (CAPP)
	4	Concurrent engineering (CE)
Furniture manufacturing and integration manufacturing systems	5	Computer aided manufacturing (CAM)
	6	Computer aided detection(CAI)
	7	Computer integrated manufacturing system (CIMS)
	8	Numerical control (NC)
	9	Flexible manufacturing system (FMS)
	10	Group technology (GT)
	11	Just-in-time production (JIT)
	12	Lean production (LP)
	13	Agile manufacturing (AM)
	14	Agile manufacturing (VM)
	15	Green manufacturing (GM)
	16	Mass customization (MC)
Information production and manufacturing resource integration management technology	17	Enterprise resource planning (ERP)
	18	Bar code technology (BCT)
	19	Product data management (PDM)
	20	Product life cycle management (PLM)
	21	Total quality management (TQM)
	22	Customer relationship management (CRM)
	23	Supply chain management (SCM)

**Table 32.2** Delphi questionnaire index

Index	Evaluation level
1. Familiar	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum
2. Important level to Chinese furniture industry	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum
3. Technical level of China compare with leading countries	<input type="checkbox"/> Leading; <input type="checkbox"/> Equivalent; <input type="checkbox"/> Behind 5 years; <input type="checkbox"/> Behind 6–10 years
4. R&D foundation	<input type="checkbox"/> great; <input type="checkbox"/> good; <input type="checkbox"/> general; <input type="checkbox"/> poor; <input type="checkbox"/> very poor
5. Technology development way	<input type="checkbox"/> independent research and development; <input type="checkbox"/> joint development; <input type="checkbox"/> re-innovation; <input type="checkbox"/> imitation; <input type="checkbox"/> introduce
6. Independent intellectual property rights in next 5 years	<input type="checkbox"/> Yes; <input type="checkbox"/> No
7. Upgrade traditional furniture industry role	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum
8. Industrialization prospect	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum
9. Improve industrial competitiveness role	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum

(continued)

**Table 32.2** (continued)

Index	Evaluation level
10. Industrialization cost	<input type="checkbox"/> maximum; <input type="checkbox"/> larger; <input type="checkbox"/> medium; <input type="checkbox"/> smaller; <input type="checkbox"/> minimum
13. Realized industrialization time	<input type="checkbox"/> in 5 years; <input type="checkbox"/> 6–10 years; <input type="checkbox"/> longer than 10 years
14. Recommended measures (please choose 3 items)	<input type="checkbox"/> personnel training; <input type="checkbox"/> update equipment; <input type="checkbox"/> improve basic research; <input type="checkbox"/> increase investment in R&D; <input type="checkbox"/> strengthen research and industry cooperation
15. Your proposals (please comment freely):	Please fill in here

### 32.5 Delphi Questionnaire Analysis

These options: maximum, larger, medium, smaller, minimum, respectively represent N1, N2, N3, N4, and N5. Then the index is:

$$Index = (100 \times N_1 + 75 \times N_2 + 50 \times N_3 + 25 \times N_4) / N_{all} \quad (32.1)$$

$N_{all}$  is the number of all feedback experts.

In this study, the indexes use the above calculation method is as follows:

- $I_{index}$  Index on importance of technology;
- $T_{index}$  Index on the reform and enhancement of traditional furniture industry;
- $E_{index}$  Index on prospects for industrialization;
- $C_{index}$  Index on enhancing industrial competitiveness;
- $M_{index}$  Index on industrialization cost;

When calculate industrialization cost, the Eq. 32.2 is used to maintain the consistency of each index.

$$M_{index} = (100 \times N_5 + 75 \times N_4 + 50 \times N_3 + 25 \times N_2) / N_{all} \quad (32.2)$$

The maximum calculation method would be used when analyzing Chinese furniture industry technology gap, R&D foundation, development way, independent intellectual property rights in next 5 years and other issues.

When we judge a technology gap compared with the leading countries,  $N_1$ ,  $N_2$ ,  $N_3$ , and  $N_4$  respectively stand for “Leading”, “Equivalent”, “Behind 5 years”, “Behind 6–10 years” compared with leading countries. The most chosen option is a final value for it.

The comprehensive economic benefit analysis include  $E_{index}$ ,  $C_{index}$  and  $M'_{index}$  ( $M'_{index} = 100 - M_{index}$ ). In the Eq. 32.3, industrialization cost is the “investment”, and the prospect for industrialization plus industrial competitiveness is “output”, the comprehensive economic efficiency index is output divided by input.

$$ECO_{index} = Output / Investment = (E_{index} + C_{index}) / M'_{index} \quad (32.3)$$

### 32.3 Discussion on Research Results

According to the Delphi survey statistics, the investigation was made on indicator system of statistics, including the evaluation of importance on technology, the evaluation on research and development of technology, economic benefit analysis and so on.

#### 32.3.1 Evaluation of Importance

According to the evaluation results of investigation, the importance index of 23 items present the continuous normal distribution, with relatively concentration of exponential distribution, and the mean value is 69.6, which shows most experts recognized most items have important effects on the development of Chinese furniture industry. The top 10 items were shown in the Table 32.3.

#### 32.3.2 R&D Level and Capabilities

According to the investigation data, 10 items are lagged behind the developed countries 5 years, accounting for about 43.5 % of the total. 13 items are lagged behind the developed countries 6–10 years, accounting for about 56.5 % of the total. Therefore, we can draw conclusions that most manufacturing technology of Chinese furniture industry is lagged behind the developed countries 5–10 years.

According to the investigation data, 82.6 % R&D foundation of items is fair or poor, 17.4 % is good. The respondents believe that 23 items should be developed by independent or joint development way. Not an item is recommended by experts through introduction, imitation, or re-innovation, which shows the R&D of Chinese furniture manufacturing field enters the stage of “relying mainly on independent research, supplemented by joint development”.

**Table 32.3** The top 10 items of  $I_{index}$

Serial number	Optional item name	$I_{index}$
5	CAM	85.1
8	NC	83.2
17	ERP	80.2
16	MC	80
10	GT	79.8
9	FMS	79
11	JIT	76
18	BCT	75.8
1	CAD	75
3	CAPP	71

### 32.3.3 Economic Benefit

According to the investigation data, the top 10 items with good industrial prospects are: CAM, NC, ERP, MC, GT, FMS, JIT, CAD, BCT, and PDM, which are focus in information and NC technology.

The top 10 items with the better role in upgrading competitiveness are: CAM, NC, MC, FMS, ERP, GT, BCT, JIT, CIMS, and CE, which are focus in information, NC and JIT technology.

$E_{index}$  mean value is 47.9, and the top 10 items with lowest industrialization cost were shown in the Table 32.4.  $ECO_{index}$  mean value is 2.78, and the top 10 items were shown in the Table 32.5.

### 32.3.4 Industrialization Time

Research shows 20 items would achieve industrialization in the next 6–10 years, accounting for 87 % of all, 3 items would achieve industrialization over the next 10 years, accounting for 13 % of all. This result reflects that the experts generally

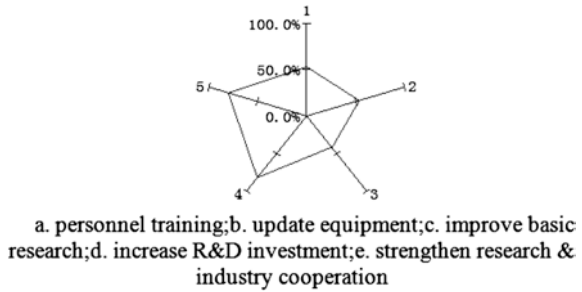
**Table 32.4** The top 10 items with lowest industrialization cost

Serial number	Optional item name	$M_{index}$
1	CAD	65.2
10	GT	61.2
9	FMS	61
18	BCT	58.7
17	ERP	58
16	MC	57
6	CAI	55.3
23	SCM	55.1
22	CRM	54.7
19	PDM	52.8

**Table 32.5** The top 10 items of  $ECO_{index}$

Serial number	Optional item				
	name	$E_{index}$	$C_{index}$	$M_{index}$	$ECO_{index}$
1	CAD	73.8	72	65.2	4.19
10	GT	77	76.6	61.2	3.96
9	FMS	75	78.8	61	3.94
17	ERP	79	78.2	58	3.74
16	MC	78.6	79.6	57	3.68
18	BCT	73.6	74.8	58.7	3.6
5	CAM	84.9	82.9	51.4	3.45
8	NC	82.4	80.8	47.4	3.1
23	SCM	69.3	65.3	55.1	3
19	PDM	72	66.5	52.8	2.94

**Fig. 32.1** Recommended measures



believe the manufacturing capacity of Chinese furniture industry will reach a higher level through the construction and development in the next 10 years.

### 32.3.5 Recommended Measures

The main measures were recommended through calculation and discussion of the expert selection proportion of 5 indicators. The result is expressed by the percentage of choosing a particular indicator number and the total number, which were shown as the Fig. 32.1.

## 32.4 Summary

This article has a data research on advanced manufacturing technology foresight of Chinese furniture industry in the future 5–20 years, makes systematic analysis on the status quo and technology application prospect, and does some judgments on the development of technology.

It determines the initial options by the Experts Meeting Method, and analyzes manufacturing technology of Chinese furniture industry in the future 5–20 years by Delphi Method, and then foresights related key technologies. It elaborates on the status quo of manufacturing technology of Chinese furniture industry.

It analyzes the key manufacturing technologies for Chinese furniture industry, judges the furniture industry technology needs, and provides a reference for selecting focus of development.

## References

1. Ben R (1989) Martin and John Irvine: research foresight: priority-setting in science. Pinter Publishers, Michigan 3:360–368
2. Research team of technical forecast and national key technology selection: from foresight to selection: theory and practice of the technology foresight (Beijing Publishing House, Beijing 2001) (in Chinese)
3. Dai Xiaofeng (2007) Chinese agricultural technology foresight and key technology selection. China Agricultural Science and Technology Publishing House, Beijing

# Chapter 33

## Analysis on Context of National Games Material for Industrial Development

Ya Liu and Fusheng Jang

**Abstract** Liaoning province revitalizing old industrial bases become the inevitable choice. Liaoning has a long sporting tradition of sports and sports province, Liaoning sports in the country is always in a leading position, always enduring position. Liaoning has a unique sports management system, the initial comprehensive sports service system, in a leading school sports innovation system, increasingly shape the city's industrial market and physical characteristics, as well as legal and scientific protection system. These are distinct advantages in Liaoning sport and features; it is bound to revive the old industrial bases play an important role.

**Keywords** Strategy analysis • Context of national games • Industrial development

### 33.1 Introduction

Twelfth National Games will be held in Liaoning Province, Liaoning Province, which sports to bring a new strategic adjustment of the good opportunity, but also can make an important contribution to the revitalization of Liaoning Province [1]. Sports are a regional economic power and an important manifestation of the degree of social civilization, sports, Liaoning province revitalizing old industrial bases to become the inevitable choice [2]. Liaoning has a long sporting tradition of sports and sports province, Liaoning sports in the country is always in a leading position, always enduring position [3]. Liaoning has a unique sports management system, the initial comprehensive sports service system, in a leading school sports innovation system, increasingly shape the city's industrial market and physical characteristics, as well as legal and scientific protection system [4]. These are distinct advantages in Liaoning sport and features; it is bound to revive the old industrial bases play an important role [5].

---

Y. Liu (✉) · F. Jang

School of Sports Training, Shenyang Sport University, Shenyang 110102, China  
e-mail: 2430031317@qq.com

## **33.2 Liaoning Provincial Sports Development Strategy**

Since reform and opening, Liaoning Province, has scored brilliant achievements in sports in the country always stay ahead of the trend, the world's major sporting events in the outstanding performance to win the honor for the country, as China's "Olympic glory Plan" and "fitness plan" made important contributions. Summary of competitive sports, Liaoning Province, the successful experience of Liaoning Province sports strategy for sustainable development, research, Liaoning Province, sports success of the excellent results achieved, not only for themselves and their sport, Liaoning Province, sustainable development is of great practical significance, and the development of the national sports has a good reference [6].

### ***33.2.1 Development of Liaoning Sports Achievements***

Liaoning has 20 years of sports glory, once known as the province of sports, sports province, has been called "Liao boss" of the title. Liaoning, a major player in the international gold medal game to get more medals and more, the sports industry has a certain size. Liaoning, sports scores, a comprehensive evaluation in the forefront. The end of 2002, Liaoning players on the Olympic Games and other major international competitions won 214 world champions, accounting for 13.3 % of world titles (National 1,806), the highest record of over 196 world, accounting for 8.1 % (National 1,086), Liaoning players also get 158 gold and 180 Asian Games gold medal. Can be said that Liaoning is China sports arena sports an evergreen tree. However, the delegation of Liaoning on the 10th National Games stadium and even missed the top three, five Games since the record low score, Liaoning sports has encountered unprecedented difficulties [6].

### ***33.2.2 Strategy Development, Liaoning Sports Features***

Liaoning is a low level of economic and social development, and competitive sports in the country is always in a leading position, always in the position of enduring development thanks to its unique strategic planning, Liaoning Sports distinct advantages and characteristics. Liaoning, a non-competitive sports development strategy for balanced development of the "two line" mode, point to line to line with faces. That is centered on Shenyang-Dalian line, westward to Jinzhou City. Shenyang, Liaoyang, Anshan, Yingkou, Dalian, Jinzhou connected line, and finally spread to the surface, to each other. Sports development should rely on urban development, economic conditions and the main line of development, so that the development of Liaoning sports and economic development strategies should take the same "two line" mode, combined with the urban status and population characteristics of sports development, the implementation of a purpose, targeted development strategy to achieve the optimization of the regional internal and external coordination [7].



### ***33.2.3 Liaoning Province Sports Development Strategy to Implement Specific Measure***

Seek to increase the professional athletes with Code, combined with the original preparation of the new configuration. Based on historical results, take on the role and other factors to ensure the needs of key projects, taking into account the potential advantages of project development, and strive to increase the gold medal point, change the situation of less competition for gold items. Enhance table tennis, athletics, football, basketball, volleyball, speed skating, freestyle skiing, shooting, archery, women's cycling, weightlifting, women's hockey, wrestling and other advantages of the project [8].

Explore the potential and energy to find from its own advantages, and to strengthen the incentive system of the building. Now take the gold medal tasks linked with the personal reward is a very effective incentive. Improve the incentive system; the athlete's performance will have a more substantial increase. Improve the province athletes, coach's treatment, in order to create better living conditions for the training, to encourage them to create outstanding results, the provincial, national glory.

Established to consolidate the development of "national high-level sports reserve talents base" and the provincial reserve individual talent base, so that "key provinces and cities have an advantage, the county has a fist, the traditional school." According to the ratio of 1:3:12 to adjust the basic structure, the formation of provincial outstanding sports teams (line), sports school (secondary), at all levels of amateur sports (three lines) of the echelon structure of the number system and the size of the training. Change the brain drain of talent out. Northeast in the training mechanism, the implementation of diverse forms of ownership, organizational forms, and train paid, the formation of a complete set of sports reserve personnel training system.

Mobilize the enthusiasm of all sectors of society, organized at home and abroad to enhance the ability of high-level sports competitions. Encourage and support businesses, schools and individuals to invest in sports competitions, sports competitions to achieve diversification. Organize various competitions, both to meet the level of outstanding sports teams need to improve movement, but also to expand the sports influence and enrich people's leisure life purpose.

## **33.3 Strategic Developments of Mass Sports in Liaoning Province**

Liaoning, China's sports career as a representative of the development of sports in China have made, had a glorious history, social and economic development of Liaoning also play an active role in revitalizing old industrial bases in large-scale development, Liaoning mass Sports will also play a significant role.

### ***33.3.1 Liaoning Province, the Achievements of Development of Mass Sports***

Physical fitness, Liaoning Province, perfecting service system: well-organized, well-developed network of service in place; Sports Association community organizations to develop rapidly; community, town sports organizations focused remarkable achievements. 14 City, Liaoning Province, a total of 47 urban areas, city streets, a total of 551 community 4,832, a total of 4,512 urban communities. According to statistics, the end of 2003, Liaoning has 50 communities were awarded National Sports advanced communities, 114 communities in a provincial-level advanced sports community. There are 1,016 rural towns across the province, villages 15,661. According to statistics, Liaoning Province, 26 rural counties, was named the National Sports advanced counties, 43 townships was named National Sports advanced town, there are 349 towns was named provincial advanced sports towns in the country's "five fitness activities, hundreds of millions of people, "the selection of activities in a total of more than 350 rural towns in Liaoning was rated advanced. According to another survey indicates that the current proportion of the population in Liaoning City Sports has close to 50 %, the proportion of rural sports has reached 40 % in the domestic leading position.

### ***33.3.2 Liaoning Province, Characterized by the Development of Mass Sports Strategy***

Liaoning has been good on the traditional mass sports, riding and shooting sturdy, heroic Manchu culture and sing and dance, the indomitable Korean culture, mass sports is a nation the most civilized, most advanced, most healthy symbol. Liaoning Province, a total of 44 ethnic minority population of 655 million, accounting for 16 % of the province, including the Manchu, Xibe inhabited by the number of Liaoning ranks first. More than a million ethnic Manchu, Mongolian, Hui, Korean, and Xibe, these five old ethnic minority households in Liaoning, in its long-term production, life process, the formation of a strong ethnic flavor, and a number of local features traditional sports. According to statistics, Liaoning Province, traditional ethnic sports 110 or so. Northeast Yangko, stilt-walkers, stilts Yangko, dragon dance, lion dance, winter swimming and other projects is still very hot. Civil shuttlecock, skipping, etc. are still young people are fond of fitness activities. Especially in winter ice sports such as skating, playing ice hockey, skiing, skating car, playing with tops, etc., has become the most representative of the physical characteristics of the mass content of Liaoning, Liaoning to the cold earth soil adds unique color and charm.

### ***33.3.3 Strategy Development of Mass Sports, Liaoning Province, the Implementation of Specific Measures***

Build and manage a gym, fitness paths, fitness plaza, fitness park, fitness center and other mass public health establishments, for the majority of the people to provide the necessary sports facilities and sports services, to facilitate the people locally to participate in sports activities; establish and improve the people at all levels sports organizations, to strengthen social sports instructor team-building and management, the formation of social organization of mass sports network; improve the national physique monitoring system, provincial and municipal levels, to guide the masses of scientific training, to enhance the effect of exercise; hold regular, new and interesting people physical activity, promote health, scientific and civilized way of life, well organized on an annual fitness activities; regular Minority Games, Peasant Games, Games for the Disabled, consistent implementation of the characteristics of sports activities for the elderly.

All levels of government and education, sports administration, and actively create “young ice winter camp” activities of the brand. Physical construction of traditional schools do a good job, we will focus on project layout, organize family competitions. Actively offer a variety of youth sports clubs give full play to its radiation, driving school sports activities carried out. Traditional items of all kinds of sports at all levels of school construction, so that from an early age, for the best sports teams and sports institutions to deliver more of the best sports reserve talents.

Work with farmers to rural sports targeted to towns focus on grassroots-oriented and unique. Actively implement the “hundreds of millions of farmers Fitness Project”, to run the annual “Village fitness big ring activities” to promote rural sports work, really loved by the farmers, for rural areas carry out sports activities. Focus on cultivating a number of organized bodies, there are sports activities, the backbone of the sport tourist towns.

To strive for advanced sports community as an entry point into the community to promote sports activities. Continue to build “community fitness of the General Assembly,” the brand, drive and attract more residents into the community fitness activities in the past. To carry out unique, colorful mass sports activities. In the residential development and urban planning, to ensure that every community have built a standard indoor and outdoor fitness venues, construction of sports parks, fitness plaza, a fitness center.

Government focus on supporting the construction of sports facilities, public welfare, mass sports organizations and sports activities to set up community-based. Encourage and support enterprises, institutions and individuals to invest in the construction of sports facilities, sports competitions and holding mass events. Public sports facilities and institutions owned enterprises stadiums, should be open to the public, to fully enhance the utilization of sports facilities, to achieve social and economic benefits.

### **33.4 Liaoning Provincial Sports Industry Development Strategy**

Liaoning Province sports industry has begun to take shape, development potential; remarkable body of industry, sports led to mass sports, amateur training, venue construction, sports training and the rapid growth of consumer markets, most notably the football industry the country in a leading position, physical characteristics in Liaoning football lottery spending, sports performance market was on fire, growing sports facilities, the development of mass sports activities continues unabated, the sports industry investment diversification begun to take shape, the gradual establishment of sports talent market, further inventory of tangible assets. Sports industry in the Northeast market, but still in its infancy, sporting goods manufacturing industry in a weak link in the overall level of urban and rural sports consumption is still relatively low, a larger room for development, sports management group is not able to meet the needs of the consumer market, the sports industry management level has yet to be improved.

As the vigorous development of mass sports and good sports momentum, driving the rapid development of the sports industry, sports industry but also for the rapid development of mass sports, sports play a role in fueling. Sports industry presents diversified investment trends. Liaoning Province, the main industry, the sports physical form the basis of developed simultaneously, the coexistence of diverse forms of ownership, joint development of the sports industry, a new pattern.

#### ***33.4.1 To Develop as the Center of Shenyang Ice and Snow***

Shenyang Ice and Snow Tourism prestigious, has formed a snow art, snow art, snow sports, snow play, ice and snow travel, ice food chain, including ice and snow culture. But snow and cultural facilities are more limited, yet large-scale, centralized distribution, has gathered a wide range of effective participation of snow cultural space.

Ice and Snow Festival in Shenyang Hui Shan should find a more appropriate theme, more attractive to consumers. Experts point out that Liaoning is expected in the near future becomes the center of the Asian cross-country skiing. With international competition, the contractor can not only improve the high-level competitive sports level, from the perspective of the tourism economy, can form a view tourism as a core race, outreach to the travel service system, resulting in huge economic gains, sports travel and sports competitions, perfect snow and ice combination of ice and snow sports to promote sustainable tourism development.

Ice and snow sports in the development of tourism resources, should focus on the coordinated development of related industries, such as skating, skiing equipment, production, research and development; tourism products, development and production of souvenirs.

To take full advantage of sports institutions of higher education resources, timely set in higher institutions sports snow sports professional direction or tourism-related courses, for the snow sports market tourism professionals, have to ensure that the tourism market for snow sports management more scientific and standardized. Strengthen the snow sports tourism market forecast analysis and business management training.

Tap China's traditional education, national sports, folk sports tourism and cultural resources, and to inherit and carry forward, is the trend of sports tourism. Sport Ice and Snow Tourism also use the advantages of multi-ethnic northeast; mining winter national sport, ice and snow build sports and cultural tourism.

### 33.5 Conclusions

Liaoning Sports in the development strategy should be held in the Twelfth National Games as an opportunity to focus on overall development, always with the construction of Liaoning, Liaoning sports closely linked to well-off society, from the perspective of the whole concept of thinking about development strategies. Sports, mass sports, the sports industry, "Trinity" interdependence, mutual promotion and coordinated development model, building a comprehensive well-off society in Liaoning Sports initiative, a comprehensive sports and objective requirements to build a moderately prosperous society.

### References

1. Birch et al (2002) In China since reform and opening up the evolution of sports development strategy and thinking. *Chengdu Inst Phys Educ* 3:1-7
2. Wang Y (2006) The whole Olympic transport strategy and the strategic interaction of. *Qufu Norm Univ* 4:12-16
3. Li W (2001) The Chinese sports regional development theory and empirical research. *Beijing Univ Phys Educ* 5:83-88
4. Lu G (2000) China's strategic development of mass sports in 2010 reflections. *Xi'an Inst Phys Educ* 2:21-23
5. Ling PW (2011) The needed optimal cycle for prediction accuracy of stock price behavior for traditional industries in Taiwan by moving average method. *IEIT J Adapt Dyn Comput* 2(2):7-13
6. Wu CC (2011) A study of synchronous and bucket trading behavior of institutional investors. *IEIT J Adapt Dyn Comput* 2(2):14-25
7. Li GF, Xiong HG, Xu SQ, Kong JY (2011) A hybrid particle swarm algorithm to JSP problem. *IEIT J Adapt Dyn Comput* 1(3):10-17
8. Vani MP (2011) Computer aided interactive process of teaching statistics methodology—II. *IEIT J Adap Dyn Comput* 1(3):18-21

# Chapter 34

## Research of Shale Gas in China

Haifeng Chen, Miao He, Bing Han, Zhonglin Li and Peihai Li

**Abstract** The shale gas is an efficient and abundant energy sources in the world, and is an important alternative energy resources in the future. Accordingly some countries give their attention to it. However, our country is late in this field. With the support of our country, shale gas research has very progress. The researchers commenced their study in the early period of 21st century. Shale gas research is mainly concentrated in aggregation conditions and potential evaluation of resource, evaluation favorable areas, development conditions, etc. In order to promote the exploration and development of shale gas in China, it must strengthen international cooperation. The chapter introduces the status and progress of China's shale gas and gives some suggestions.

**Keywords** Shale gas • Resource investigation and evaluation • Energy resource

### 34.1 Introduction

Energy resources is indispensable important material resources for the human survival, economic development and social progress [1]. With China's rapid economic development, China has become the second largest country in oil imports and consumption all around the world. According to the forecast by 2050, annual energy consumption will reach 38 billion tons of standard coal (equivalent to 3 times in 2000) and China will become the world's largest

---

H. Chen (✉) · M. He  
Northeast Petroleum University, Daqing, Heilongjiang 163318, China  
e-mail: haifch004@163.com

B. Han · Z. Li  
The Fourth Oil Production Plant, Daqing Oilfield Branch Company Petrochina, Daqing,  
Heilongjiang 163511, China

P. Li  
Liaohge geophysical department, Eastern geophysical company, Panjin, Liaohge 124010, China

energy consuming country. Energy issue has become more and more serious. If our country does not lead to speed up the development of new and renewable sources of energy as an alternative energy, it will probably be out of stock. Therefore, finding and exploitation of new energy is the main way to solve our country's future energy problems [2]. Unconventional oil and gas resources are good alternative energy, and shale gas is most potential and giant reserves in the Unconventional oil and gas resources. It has very enlightenment to our country that U.S. shale gas exploration and development achieved great success, many country starts to research it, our country also give their enough attention to it. It is estimated that shale gas resource can each  $456 \times 10^{12} \text{ m}^3$  in the world, and china is about  $26 \times 10^{12} \text{ m}^3$  which destined to become the primary energy in the future in our country [3, 4].

## 34.2 Research Situation in China

Shale gas is a very important unconventional natural gas resource which mint from shale and accumulation in absorption and Free State [5, 6]. It exists in dark mudstone and shale high content of organism and good organic type. Compared with conventional natural gas, shale gas development has the advantages of the exploration of long life and production cycle [7, 8]. Shale gas major ingredient is alkane, which accounted for 85 % methane ( $\text{CH}_4$ ), and a small amount of ethane ( $\text{C}_2\text{H}_6$ ) and Propane ( $\text{C}_3\text{H}_8$ ) and butane ( $\text{C}_4\text{H}_{10}$ ), in addition to general also contains hydrogen sulfide ( $\text{H}_2\text{S}$ ), carbon dioxide ( $\text{CO}_2$ ), nitrogen ( $\text{N}_2$ ) and water ( $\text{H}_2\text{O}$ ), Etc.

shale gas in China has the following basic features: Lithology is consist of abundance of organic matter in the dark mudstone and dark shale and high carbon shale and the sweat bituminous shale; the rock composition is generally 30–50 % of the clay minerals, 15–25 % of the silty (quartz particles) and 2–25 % organic matter; shale gas comes mainly from a biological effect or thermal maturation cleavage; which has high organic matter thermal that evolution of the total organic carbon content is generally greater than 2 %; shale gas is an “Self-generation and self-accumulation” and “continuous-type” of resources; pore is generally less than 12 % and penetration is general poor which with the degree of development of cracks that there are significant changes, natural fracturing and cracks can greatly improve penetration; Occurrence state of the shale is Change greatly, but adsorption and dissociative adsorption state is the most common. Shale gas reservoir is a hidden reservoir, which does not require conventional traps exist; shale gas reservoir depth in a wide range of changes [9, 10].

America is the earliest and successful countries on production shale gas in the world. As early as 1921 America began shale production, and then it doesn't attracted the great attention of people. But until the late 1970s, because of conventional resources shortage and high crude oil prices, experts and scholars started to put the focus on shale gas research, from that time shale gas research input

phase of rapid development. Shale gas production greatly eases the oil shortage crisis of America. To the present its annual production is more than  $200 \times 10^{12} \text{ m}^3$  which is far more than convention gas production [11, 12]. After the United States, Canada, Australia, Europe, China, Russia, India and other countries and regions have begun to research shale gas.

### ***34.2.1 Investigation and Evaluation***

Shale gas researches started relatively late in China. In the early of this century our country started to pay attention to it, and the foreign information were collected, especially American exploration and development experience. Due to the high degree of attention and strong support by the government, now it has become a hot research topic. In 2004–2008, Strategic Research Center of Oil and Gas Resources of Ministry of Land and Resources and some academic and institutions began to shale resource evaluation studies, in 2009, the Ministry of Land and Resources develop prospect region optimization of shale gas based mainly on “chongqing-guizhou-hubei” and north region. In 2001, for the purpose of further deepening Forerunner zone of shale gas research and studying resource evaluation method and favorable region optimization standard of shale gas, it has launched favorable region optimization and resources potential evaluation of shale oil and gas in the whole country subject, and two appraisal wells are drilled, shale gas resource data are obtained, provided the basic data evaluations of shale gas resources. Better economic and social benefits are getting, and this application can improve the productivity development in shale gas [13, 14].

At present, the evaluation of shale gas research work into the actual survey and experimental phase. CNPC develops shale gas exploration work in weiyuan-changning-shaotong-fushun-yogncuan of Sichuan basic southern, about ten appraisal wells are drilled, which the wei201 well obtains the initial production 10,000 m<sup>3</sup>/d, and ning201 well is 14,000 m<sup>3</sup>/d. China Petroleum and Chemical Corporation examined favorable zone in jiannan and huangping of eastern Guizhou and southern Anhui and northeastern Sichuan. Many appraisal wells are drilled, which the jian111 well obtains shale gas and anshen1 well gets shale oil-gas. According to The Zhangjiatan shale of the Mesozoic Yanchang Formation, Yanchang Oil Group company start shale gas exploration, four exploratory have achieved a breakthrough.

At present, China has made certain achievements in shale gas exploration. Especially in southern of China exploration has been done more work. By many experts' efforts China has broadly identified shale gas resources distribution in Chinese land and sea areas and its reserves have been estimated. Up to now the Ministry of land and resources and experts has been found a number of shale gas occurrence favorable regions, including the South of China, North of China, North western of China and qingzang. It has laid a solid foundation for the future of shale gas in actual mining in China.



### **34.2.2 Basic Research**

After the study of abroad information, evaluation of progress and understanding of foreign high technology and experiment, China has also launched a comprehensive basic research on shale gas. Understanding the geological conditions of shale gas is helpful to the exploration and development. So in this aspect our country has done a lot of work. Shale gas research is mainly concentrated in aggregation conditions, potential evaluation of resource, evaluation favorable areas, and development conditions.

Such as, through comprehensive analysis of shale gas reservoir forming mechanism, Zhang jinchuan think that the basic geological conditions of forming commercial shale gas reservoirs exist in many basins in China [9, 10].

In 2012, Northeast Petroleum University Lu Shuangfang Research on the valuation criteria of shale oil/gas which is conducted so as to accurately assess the resources potential of shale oil and gas. After making statistic analysis of the geochemical index of hydrocarbon source rock layers in five areas such as Songliao, Hailaer, Jiyang, based on the characteristic of triple-division between the oil content and TOC of source rock, this chapter classifies shale oil/gas into three levels of resources in terms of enrichment degree: scattered (ineffective) resources, low efficient resources and enriched resources. In practice, TOC variable values in well profile obtained by TOC-logging correspondence can be used to draw the TOC isopach map and calculate the resources amount of different levels. Then combined with the evaluation criteria, TOC and Ro isopach maps are superimposed to identify the favorable shale oil/gas areas [15].

In addition, in the aspect of shale gas formation kinetics mechanism, shale formation mechanical parameters, generating conditions, shale gas geophysics evaluation method and technology, horizontal well technology, horizontal well fracture technology our country has also done some research [14, 16].

### **34.2.3 Others**

To be able to better research, develop, use of shale gas, our country has set up a number of national key laboratories, research centers (institute) and others specializes in shale gas research which actively involved in the study of shale gas.

China also strongly support the research of shale gas, in 2007, the Chinese Petroleum Corporation and the United States XinTian oil companies signed the joint research agreement of Weiyuan shale gas. Further the period of Obama visited China, signed China and the United States memorandum on cooperation in the shale field. Some project has been project, 973,863 research projects and innovative projects both have shale gas project. In order to provide a good exchange of shale gas condition for the researchers, professional conferences on natural gas hydrates are frequently held, such as in 2009 International Symposium of the country shale gas is held in Wuhan.

### 34.3 Conclusion

The area having the conditions of the formation of shale gas in our country is vast. And its reserves are abundant. Shale resource is about  $26 \times 10^{12} \text{ m}^3$ .

Shale gas researches started relatively late in China. It relies on the country, strengthening the basic research of shale gas, as early as possible in order to realize the actual exploration of shale gas.

In order to promote the exploration and development of shale gas in China, it must strengthen international cooperation.

In short, shale gas as a clean, efficient and abundant energy sources, will replace coal and oil to become the twenty-first Century energy.

### References

1. Zhu X (2003) Implement global energy strategy and establish global supply system. *Min China* 12(5):1–8
2. Gu N, You L-X, Y-H Wu (2002) Expectation of development of our country new energy in the 21st century. *Eng China* 1:37–38
3. Zhang D (2010) Strategic concepts of accelerating the survey, exploration and exploitation of shale gas resources in China. *Oil Gas Geol* 31(2):135–139
4. Dai J (1999) Natural gas resources and its prospect in China. *Nat Gas Ind* 19(1):3–6
5. Lu S, Zhang M (2008) *Petroleum geochemistry*. Petroleum Industry Press, Beijing, vol 23, pp 123–125
6. Li X, Lu Z, Dong D et al (2009) Geologic controls on accumulation of shale gas in North America. *Nat Gas Ind* 29(5):27–32
7. Milici RC (2002) Autogenic gas (self sourced) from shales an example from the Appalachian basin. In: Howell DG (ed) *The future of energy gases: US geological survey professional paper 1570:253–278*
8. Curtis JB (2002) Fractured shale gas system. *AAPG Bull* 86(11):1921–1938
9. Zhang J-C, Jin Z-J (2004) Yuan Ming-sheng. Reservoiring mechanism of shale gas and its distribution. *Nat Gas Ind* 24(7):14–18
10. Zhang J-C, Xue H, Zhang D-M et al (2003) Shale gas and its reservoiring mechanism. *Geoscience* 17(4):466
11. Rogner HH (1997) An assessment of world hydrocarbon resources. *Annu Rev Eng Environ* 22:217–261
12. Hill DG, Lombardi TE, Martin JP (2004) Fractured shale gas potential in New York. *Northeast Geol Environ Sci* 26(1/2):57–78
13. Nie H, Tang X, Bian R (2009) Controlling factors for shale gas accumulation and prediction of potential development area in shale gas reservoir of South China. *Acta Petrolei Sinica* 30(4):484–491
14. Editorial Board of Geology (2011) Exploration and exploitation of shale gas. *Geological research progress of shale gas in China*. Petroleum Industry Press, Beijing, vol 523, pp 134–137
15. Lu S, Huang W, Chen F et al (2012) Classification and evaluation criteria of shale oil and gas resources: discussion and application. *Pet Explor Dev* 39(2):249–256
16. Li Y, Qiao D, Jiang W et al (2011) Gas content of gas-bearing shale and its geological evaluation summary. *Geol Bull China* 30(2/3):308–317

# Chapter 35

## Research on Football Flight Trajectory Based on Aerodynamic

Zhaonian Wang and Rui Jiang

**Abstract** The purpose of this research is to play football due to the effects of various conditions causing the ball to the rotation curves of the basic characteristics of the evaluation, and then from the air dynamics study of air in the ball rotation changes is how to affect ball flight. This article through two experimental test to investigate the football in the aerodynamic characteristics. In the first experiment, the hypothesis of a football not rotates at different speeds, start, and measurement and analysis of every ball flight trajectory. Second experiments using the same firing speed launched the football, but with a different spin conditions (in all cases to the axis of rotation is horizontal). Again, on each flight trajectory measurement drag lift coefficient. This information is used to simulate the three typical game and foot shocks, but also to the offset distance and weather conditions were measured.

**Keywords** Aerodynamics • Flight trajectory • Football

### 35.1 Introduction

This part of playing football curve research focuses on the impact of a typical movement, the spin of the ball flight results. The aerodynamics of sports balls, many scholars study results show that the drag and lift coefficients is the speed of rotation function and the function of the surface roughness [1]. Therefore, the seams of a football will play an important role in the flight of the ball through the air. Measurements to calculate the drag and lift coefficients to control the football track. These can be used to simulate a variety of launch conditions for flight football [2].

---

Z. Wang (✉) · R. Jiang  
School of Physical Education, Jiujiang University, Jiujiang 332005, China  
e-mail: jiang\_rui@126.com

### 35.2 The Experiment of Football Flight

#### 35.2.1 A Test: No Spin Applied to the Speed Range

Football is a test with a diameter of 215 mm, 420 g, and the swelling pressure of 75.8 kPa. The startup speed from 17 to 31 m/s, and provide a good range of data around the average ball 25.4 m/s, the experimental setup shown in Fig. 35.1. It set the speed record of 240/s and 1/1,000 s capture time [3].

The second camera (camera) shot each level of ball flight distance of 10 m. The purpose of this camera is monitoring the shape of the trajectory of each ball. Camera records the speed of 120/s and 1/500 s capture time [4].

And then use a dedicated image analysis program (RichimasV1.0), for the coordination of these two cameras for data collection, it can be used to calculate the launch conditions and trajectory for each test.

#### 35.2.2 Experiment 2: Mutarotation, Isokinetic

The test is repeated using a constant 18 m/s emission rate, but to teach from 211 to 224 rad/s different back spin to the ball (spin axis remained in all cases.). Experiment 2 used the football is a diameter of 218 mm, 430 g, when inflated to 75,800 kPa ball.

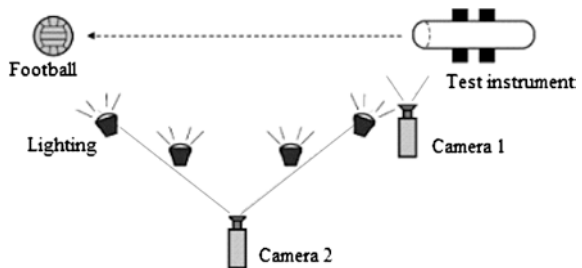
### 35.3 Data Analysis

Coordinate and time data is used to measure the trajectory and lateral variation (x) and vertical displacement (y). The original data will be used to carry out a two test with time X and Y changes, using the following equation [5]:

$$x = at + bt^2 \tag{35.1}$$

$$y = ct + dt^2 \tag{35.2}$$

Fig. 35.1 Diagram of experimental system



Through an example can be seen, as shown in Fig. 35.4. As long as the two coefficients A, B, C and D each trial found, these can imitate football flight lift and drag coefficient were determined the trajectory [6].

Football in the flight trajectory of the simulation model is a step by step, the model is affected by two forces are, FD and FL resistance caused by weight, and eliminate the influence caused by, in these conditions and the ground appears certain angle on the strength and speed diagram of Fig. 35.2.

The equations of motion can be derived, which can solve the acceleration and the vertical direction:

$$m \frac{d}{dt}(v \sin \theta) = mg - F_d \sin \theta - F_1 \cos \theta \tag{35.3}$$

$$m \frac{d}{dt}(v \cos \theta) = -F_d \cos \theta - F_1 \sin \theta \tag{35.4}$$

These equations can be rewritten, with limited differences in processing:

$$m\delta(v \sin \theta) = \delta_1[mg - F_d \sin \theta - F_1 \cos \theta] \tag{35.5}$$

$$m\delta(v \cos \theta) = \delta_1[-F_d \cos \theta - F_1 \sin \theta] \tag{35.6}$$

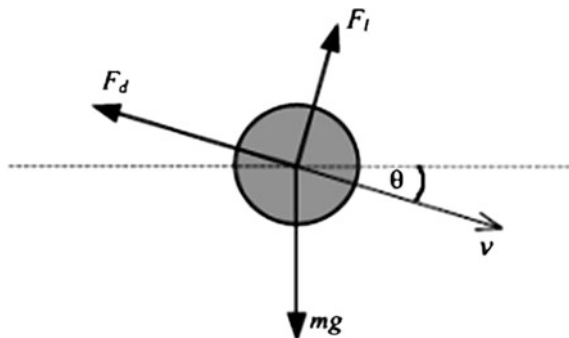
Comparison of different strength and a putative Fd, according to the following speed square equation:

$$F_d = \frac{1}{2} C_d \rho A v^2 \tag{35.7}$$

$$F_1 = \frac{1}{2} C_l \rho A v^2 \tag{35.8}$$

For the objectives of this model, it is assumed that the trajectory of the drag and lift coefficient remains unchanged. And  $\rho$ , A, v, Cd and Cl to a given value, V and theta initial values, with a small period of time the ball is calculated step by step trail. Test 1 trajectories using a 2.5 ms time and initial test of Cd is equal to 0.3

**Fig. 35.2** The force analysis of football

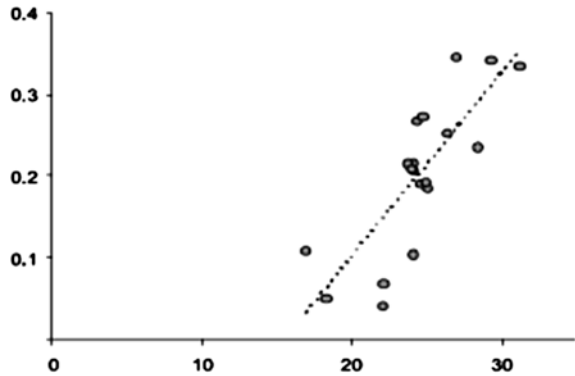


and equal to 0 (no rotation of the ball) [7]. When using an iterative algorithm to determine the trajectory simulation and measurement value by minimizing the difference between. The algorithm is a generalized reduced gradient solver, (GRG2) nonlinear optimized code.

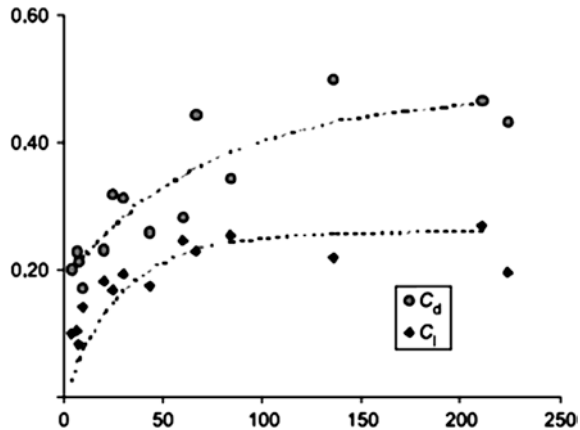
### 35.4 Experiment Result

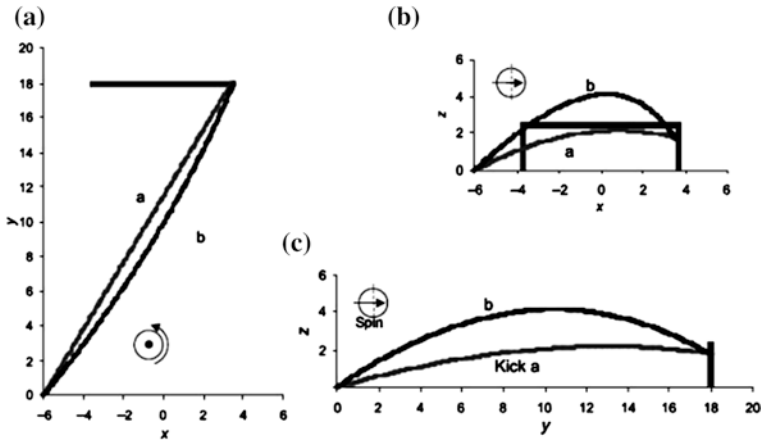
Figures 35.3, 35.4 shows the drag and lift coefficients change more and more spin. In order to organize the data, only the modulus has been drawn. In other words, the negative lift coefficient and found that the top of the rotation, has been given a lift as the positive value found lying spin coefficient. It can be seen, the increase in drag and lift coefficients of nonlinear spin. The lift coefficient increased rapidly, the increase in spin from zero to 100 rad, but later became constantly about 0.26. Curve fitting of the data (dotted line in Fig. 35.4), allows how to smooth the data

**Fig. 35.3** Launch the ball with velocity coefficient of resistance



**Fig. 35.4** The drag and lift coefficients change





**Fig. 35.5** The flight trajectory of three-dimensional space based on different projections of the impact site of two footballs

set was used to predict a ball’s trajectory will be affected by changing to impart spin. All trajectory calculate the flight time of 10.4. The simulations show that the flight of a significant impact on football alone by changing the spin. No spin, a typical parabolic fired the ball to see the track.

Drag and lift coefficients are used to predict the status of the football flying in a variety of race conditions, and then check the influence of geographical location and climatic conditions. According to Experiment 1, in the case of the 0.24 drag coefficient and lift coefficient is zero, the use of these coefficients, a three-dimensional trajectory model, and then used to simulate the target at the top of the upper right corner (just inside into the right goal post), and kick taken from the outside the restricted area, as shown in Fig. 35.5.

### 35.5 Conclusion

The purpose of this study is to assess how aerodynamics affect football trajectory, from the point of view of football in the aerodynamic spin to be considered. The measurements show that the trajectory of the football for the non-rotating ball, the speed measure of the scope of resistance to increase the launch speed. For the spinning ball, the resistance increase spin, use the same rate of fire for testing. Trajectory model simulations have proven that athletes can select a specific strategy, a kick in the foot struck the ball impact location on the basis of A central bunt will follow the nearby Before achieve a straight line trajectory. This is a ball removed the trajectory of the center it on the bend before reaching the target, but because such a kick, so lost speed, it needs to commence in a larger perspective,

and will lead to a longer flight time. These simulations also proved to reduce the friction and impact effects. If you reduce the friction between the boot and the ball, may be caused by the wet conditions, you will lose the grant spin the ball more and not curved flight. This study shows that changes in transition due to the drag coefficient is the impact on the speed that occurred during the football play, will be further more detailed test results.

## References

1. Wesson J (2002) The science of soccer. Bristol press 32:1137–1138
2. Goff JE (2010) Research on aerodynamic of football. *Phys Today* 7:62–66
3. Goff JE, Carre MJ (2010) The Aerodynamic. *Eur J Phys* 21:775–777
4. Anderson JD (2005) Football analysis on Biotechnology. *Phys Today* 12:42–47
5. Cao Z (2010) Football is also science: force and rotating. *Rev Front phys* 7:23–25
6. Sun YJ, Hu Z, He X (2011) The height control modeling based on fan and air dynamics of seal air duct balloon. *Sci technol eng* 11(5):970–974
7. Jia Q, Cui E (2008) Sport aerodynamics. *Mech eng* 30:84–86



# Chapter 36

## Efficient Plastic Mould Design of Condiment Box

Guangjuan Chen and Meiling Hao

**Abstract** Through the analysis of the plastic parts can note sex, realize the injection mould manufacturability, and then to determine the mould design scheme design, mold cavity design scheme of analysis, determine the type exactly two mold cavity, using the oblique slippery pieces of side parting, the mold cavity layout, the choice of the gate.

**Keywords** Injection mould • Condiment box • Design

### 36.1 Can Injection Analysis

#### 36.1.1 The Wall Thickness of the Minimum Requirements

According to drawings, four groups condiment box of wall thickness of 1.5 mm. The plastic mould design and manufacturing training course “legs commonly used plastic wall thickness selection scope, ABS material wall thickness a range of 1.25–1.6 mm. Four groups condiment the box wall thickness medium plastic parts, need to be checked by the least wall thickness. The plastic mould designs reference material assembly “P160 wall thickness (S) and process (L) equation: ABS liquidity for medium [1].

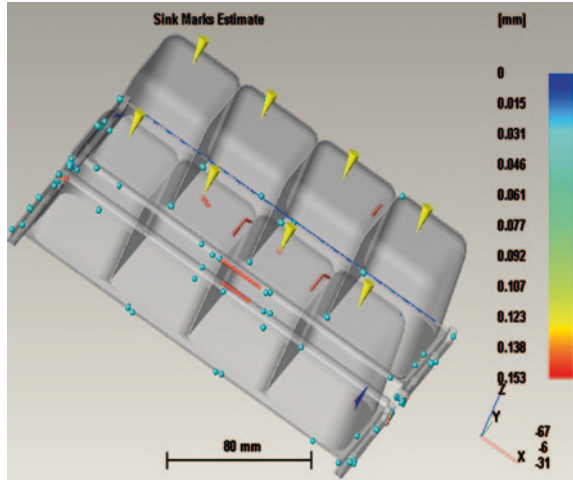
$$\begin{aligned} S &= (L \div 100 + 0.8) \times 0.7 = (150 \div 100 + 0.8) \times 0.7 \\ &= 1.61 > 1.5 \text{ mm} \end{aligned} \tag{36.1}$$

---

G. Chen (✉) · M. Hao  
Yantai Vocational College, Yantai 264670, Shandong, China  
e-mail: chgjuan@tom.com, chgjuan118@163.com



**Fig. 36.2** Meets mark and bubbles



## 36.2 Manufacturability Analysis

### 36.2.1 The Precision of the Check

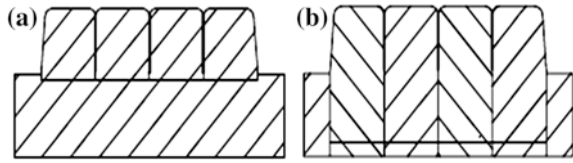
According to the plastic parts accuracy plastic parts on the surface of the  $Ra = 0.8 \mu m$  according to experience formula can be have to mold surface requirements  $Ra = 0.27 \mu m$  by fine milling-to grinding accuracy [6].

### 36.2.2 Structure Analysis

Plastic parts whole uniform structure, holding small pore structure, with R3 chamfering, type core mechanism designed to integral, as shown in Fig. 36.3a shows, need to use line and CNC processing, mould processing more expensive, and small Angle slot easy to wear, a but wear excessive, the entire cavity need to replace, waste a lot of cost, from the mold machining, the economic Angle consideration, so type core mechanism design into patchwork combined, as shown in Fig. 36.3b shows, be helpful for processing, convenient to replace, can save the cost mould. Cores design into combination sets pattern can be used alone finish machining milling [7].

Plastic parts in one side has a hustle hole, hustle hole diameter: 4.2 mm, long: 8 mm, hustle pore structure with the main points against type surface together points type, so must use the lateral core-pulling classification can classification.

**Fig. 36.3** Cores of form.  
**a** The whole. **b** Patchwork combined



Conclusion: four groups condiment box of plastic parts, and meet the minimum injection wall thickness, injection no obvious shrink mark phenomenon, injection type into bubble less and reasonable mol merged clearance can exhaust. Mold machining simple, reasonable structure.

### 36.3 The Numbers of the Cavity were Identified

According to the production batch mould for mass production, a model more cavity can improve efficiency and reduce each product the tooling charges. According to the two cavity of plastic parts volume  $V = 40951.0$  was the plastic parts volume is bigger, according to preliminary selection of injection machine G54-S200/400 rated injection quantity is  $200\text{--}400\text{ mm}^3$ , forming a mold cavity more. But with the increase of the number of mold cavity, the precision of the plastic parts reduced, die structure is complex, manufacturing costs, injection molding quality is poor. Comprehensive consideration, four group condiment the box mould design using the two cavity structure [8].

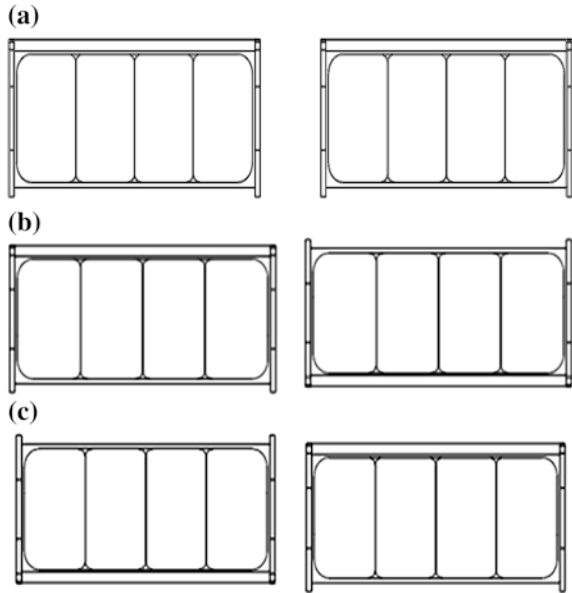
### 36.4 Determine the Types of Mould

Plastic injection is molding production method. To ensure the plastic surface quality, using a runner forming, due to the large plastic parts, so the plastic parts by four point's runner, so mould should be double the parting surface injection mould (three board type injection mould). The mould adopts the exactly two cavities, mould larger scale, in order to reduce processing difficulty; the mould adopts the combination sets pattern. From the plastic parts hustle pore structure Angle consideration, holding smaller parts pore structure, the smoke core force is not large, so take advantage of oblique slippery pieces of side parting.

#### 36.4.1 The Mold Cavity of the Layout of the Choice

The reasonable layout of the cavity can simplify the mould structure; improve the quality of life [9, 10].

**Fig. 36.4** Mould chamber layout. **a** Rectangular horizontal on row. **b** Longitudinal on row hustle rectangular hole in the lateral. **c** Longitudinal on row hustle rectangular hole in the inside



**Fig. 36.5** Gate choice of analysis

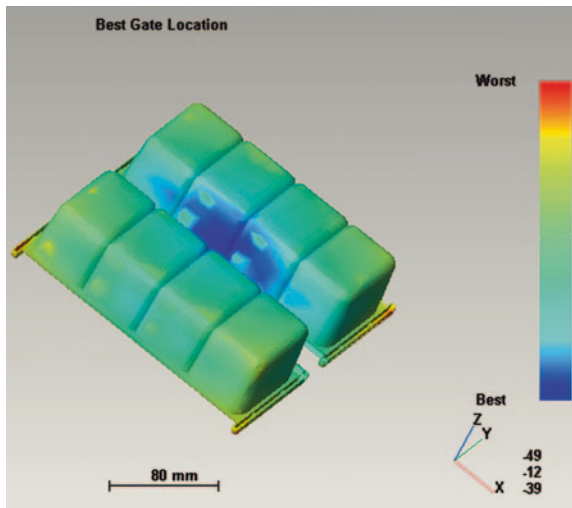


Figure 36.4a, b and c for four group condiment the box in four of the die design of the die cavity arrangement.

Use Fig. 36.4c rectangular longitudinal on row hustle hole in the inside of the hole in the recruitment longitudinal structure.

### 36.4.2 *The Mold Point Gate Choice*

The mold cavity volume is bigger, plastic parts wall thickness, the plastic expert analysis, injection molding a runner best position is for two plastic parts a small part of the relative, as shown in Fig. 36.5 shows.

Figure 36.5, the blue said gate best choice area, red said the worst choice area. According to the analysis report, to achieve good gate location choice effect, gate chooses in green area and in the bottom of the plastic parts.

## References

1. Huachang F (ed) (2006) Plastic forming technology and die design, vol 7, 2nd edn. Higher Education Press, Beijing, pp 35–36
2. Xing Z (ed) (2006) Plastic mould set and manufacturing training tutorial, vol 45. National Defense Industry Press, Beijing, pp 4–7
3. ZhiYu T (ed) (1999). Plastic mold designers' guidelines, vol 67. National Defense Industry Press, Beijing, pp 6–7
4. Chen X (ed) (2004) China mold and die design award ceremony, vol 25. Database, electronic version, pp 145–147
5. Jiang Z (ed) (2005) Plastic mould design reference material assembly, vol 46. Tsinghua University Press, Beijing, pp 9–10
6. Lieaie J (2002) the plastic mould design manual “i. Plastic mould design manual, vol 52. Mechanical Industry Press, Beijing, pp 156–163
7. Yuan K (ed) (2007) Die material and surface treatment, vol 84. Peking University Press, Beijing, pp 6–7
8. JiAn W (ed) (2004) Engineering material and material forming technology, vol 474, 2nd edn. Higher Education Press, Beijing, pp 12–18
9. Wlaselisa K (2003) Mold design and manufacturing technology education board, series ed. Common mould mechanism design. Mechanical Industry Press, Beijing, 67:8–11
10. Shilin Y (2007) Pro/e wildfire 3.0 product modelling and die design case fine solution, vol 78. Higher Education Press, Beijing, pp 9–12

# Chapter 37

## Petroleum Sulfonates as Oil Displacement Agent and Application

Shengchun Xiong, Ying He, Maolei Cui, Weicheng Zhang and Wei Xiong

**Abstract** In terms of the condition of injection water after polymer flooding of Gudao oilfield, the following water quickly broke through the bank to the production wells, while most of residual oil remains in the formation. To solve the problem, two kind of petroleum sulfonates made in China are selected to form oil displacement agent (ODA) solution. The petroleum sulfonate available for crude oil of Gudao oilfield with the ultra-low interfacial tension is found by drawing an oil/water interfacial tension contour diagram. The results show that the interfacial tension can be lower than  $3.6 \times 10^{-4}$  mN/m when the active agent contained with 0.25 % KPS + 0.225 % APS, and the agent reduces water resistance of entering the hole to improve sweep coefficient and oil displacement efficiency. The existence of the polymer has no influence on the balanced value of interfacial tension, but just delays the interfacial tension to reach the balance. Pouring into 0.3 pore volumes (PV) high-efficient ODA can improve 17 % oil recovery. Synergistic effect of two kind of petroleum sulfonate with low cost to enhance oil recovery will have a great prospect for enhanced oil recovery (EOR).

**Keywords** Petroleum sulfonates • Interfacial tensions • Enhanced oil recovery • Displacement agent • Synergism effect

### 37.1 Introduction

Producing ultra-low interfacial tensions is one of the most important mechanisms for enhancing oil recovery with respect to surfactant flooding. Surfactant flooding aims at producing the residual oil remained after secondary recovery with water

---

S. Xiong (✉) · Y. He  
Research Institute of Petroleum Exploration and Development-Langfang Box 44,  
Langfang, Hebei, China  
e-mail: xshch0000@sina.com

M. Cui  
Research Institute of Petroleum Exploration and Development, SINOPEC, Beijing, China

W. Zhang · W. Xiong  
Research Institute of Exploration and Development of Qinghai Oilfield, Dun Huang, China

flooding or gas injection. The petroleum sulfonate can be used as surfactant for making the water/oil interfacial tension reach ultra-low value and driving crude oil out to improve oil recovery. The oil composition of raw materials for producing petroleum sulfonate is complicated, and the sources for sulfonate are different, so the petroleum sulfonate is made up of complicated mixture and different molecular structure. And it is difficult to take sulfonate as the single component to combine and study on its interface chemical property of sulfonate. When designing a prescription of sulfonate at present for strengthening EOR efficiency, the 'average molecular weight' and 'active component' of the sulfonate are usually concerned.

Petroleum sulfonate is widely and inexpensive. It is suitable for temperature below 120 °C and formation water salinity lower than  $3 \times 10^4$  mg/L. Gudao oil field layer [1, 2] oil reservoir temperature is about 70 °C and the water salinity is up to 6049 mg/L. The petroleum sulfonate can be chosen as the oil displacement agent for Gudao oilfield.

## 37.2 Experimental

### 37.2.1 Apparatus and Reagents

KPS provided by Kelamayi Chemical plant is a kind of petroleum sulfonate. Average relative molecular weight is 485, Effective content is 44.56 %,Kraft value is about 40 °C, aromatic ring is less but more alkyl radical base figures in hydrocarbon radical. The average relative molecular weight of APS made in An'qing Chemical plant is 540 [3, 4].

Crude oil of Gudao oilfield includes bitumen 12.42 % with acid value 1.9358 mgKOH/g, colloid 20.65 %, density 0.9440 g/cm<sup>3</sup>, and 70 °C viscosity 237 mPa.S.

HPAM parameters: content 91.37 %, hydrolysis degree 32.48 %, relative molecular weight  $1.462 \times 10^6$

The experimental water is formation water produced by Gudao oilfield, and its analysis result of sample is tabulated in Table 37.1.

Texas500 interface-tension instrument, Model DDS II A Type conductivity instrument, Abe refract light instrument, purple-outside spectrophotometer, PHS-2A type accurate acidity instrument, 1/10,000 electronic balance and flow device.

**Table 37.1** Experimental water analyses

Water type	PH	Ion concentration mg/L						Total salinity mg/L
		Na <sup>+</sup>	Mg <sup>2+</sup>	Ca <sup>2+</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>	HCO <sub>3</sub> <sup>-</sup>	
Formation water	8.12	1,787	20.5	179	2,766	58.6	192.5	5,004
Flooding water	8.0 cm	2,112	17.6	68.4	2,825	49	977	6,049



### 37.2.2 Test Method

Determination of the effective content surfactant: Take Regard Hyamine1622 as the standard liquid, and the mixed solution of Disulphine blue V and Dimidium bromide as indicator [5]. Apply the titrimetric law to test the effective content of sulfonate surfactant.

Determination of the oil/water is interfacial tension. Adopt the Texas500 interface-tension instrument to determine the interfacial tension value under the temperature the same as formation zone. Measure the column diameter of oil in the capillary after it is stable. Calculate the equilibrium interfacial tension through the diameter data of the oil column.

Drawing isogram of the interfacial is tension. Regard quality mark in the prescription of two kinds of petroleum sulfonate as x-axis and y-axis. Points in the graph stand mass fraction of two petroleum sulfonate, mass fraction for this point corresponding x-axis and y-axis value. Finally, obtain the interfacial tension isogram.

## 37.3 Results and Discussion

### 37.3.1 Oil/Water Interfacial Tension

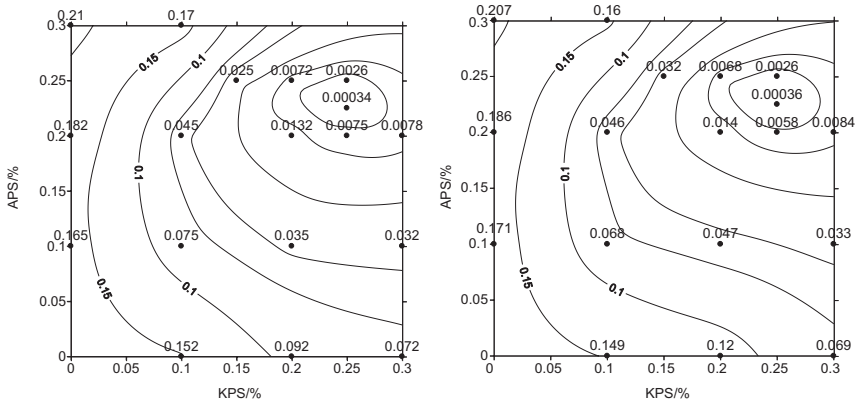
#### 37.3.1.1 Oil/Water Interfacial Tension Without HPAM

Use the Texas500 interface-tension instrument at 70 °C to test interface-tension of crude oil and petroleum sulfonate surfactant (ODA) solution contained with different mass fraction of KPS and APS. Mark the test values at different mass fraction in the graph, print the contour line, finally form the isogram graph.

Apparently in Fig. 37.1, 0.005 mN/m isopleth forms a closed circle. In theory, any point in the circle area can produce ultra-low interfacial tension of crude oil and ODA aqueous solution, and can be used as efficiency oil displacement agent. The minimum equilibrium interfacial tension ( $3.4 \times 10^{-4}$  mN/m) corresponding concentration is 0.25 % KPS + 0.225 % APS. Interfacial tension is a major parameter for evaluating the interfacial performance of ODA flooding.

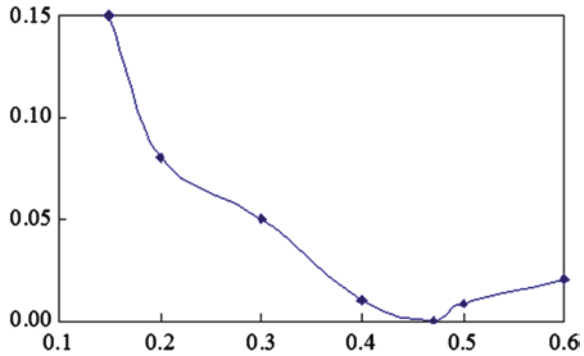
Because ODA is of mixture with different relative molecular weight, petroleum sulfonate with the same total mass fraction can be regarded as a kind of mixing surfactant. Figure 37.1 is about oil/water balance interfacial tension (BIT) with different mass fraction.

In Fig. 37.2, with the increase in the total mass fraction of ODA in the solution, oil/water balance interfacial tension value reduce first, and when mass fraction of ODA is up to 0.47 %, the interfacial tension value reaches minimum. With the continual increase in the mass fraction of ODA, the interfacial tension value increases gradually. For mixing surfactant, the minimum of the interfacial



**Fig. 37.1** Crude oil/ODA interfacial tension isogram graph

**Fig. 37.2** Relation between the surfactant and balance interfacial tension



tension corresponds to critical intermicellar concentration of surfactant in the solution. At the moment, surfactant monomer concentration is up to the highest value, forming the high interface density of surfactant, and making the interfacial tension reach the minimum value.

### 37.3.2 Oil/Water Interfacial Tension with HPAM

In Fig. 37.2, when HPAM exists in the solution, 0.005 mN/m isopleth forms an enclosed circle. As the one in Fig. 37.1, any point in the circle area of the graph can reach ultra-low interfacial tension between crude oil and ODA solution. The mass concentration corresponding to minimum equilibrium interfacial tension ( $3.6 \times 10^{-4}$  mN/m) is 0.25 % KPS + 0.225 % APS. Compared Fig. 37.1 with

Fig. 37.2, with the same concentration, the interfacial tension is identical. In the range that the error allows, the existence of HPAM will not change the equilibrium value of the interfacial tension.

### 37.3.3 Dynamic Interfacial Tension

The existence of the HPAM will not affect the equilibrium interfacial tension, but HPAM will influence the dynamic interfacial tension. Test dynamic interfacial tension (DIT) value of the crude oil and surfactant with 1,750 mg/L polymer or no polymer at different time.

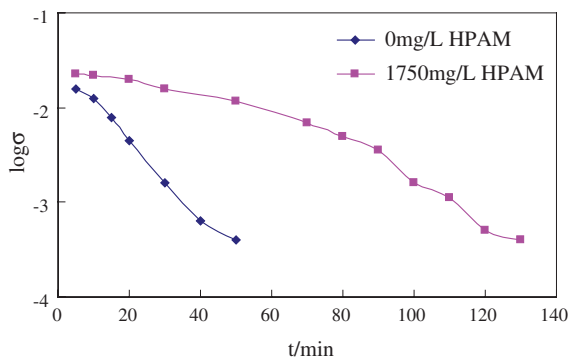
In Fig. 37.3, two curves show that whether the HPAM exists or not, the final interfacial tension value is about  $3.5 \times 10^{-4}$  mN/m. Without HPAM, the time to reach the final value about 52 min is shorter than the solution with 1750 mg/L HPAM about 132 min. Because the existence of HPAM increases the viscosity of the solution, decreases the speed of the surfactant spreading to the surface of solution. When being applied to oilfield, the high-efficiency displacement agent will keep a long time in the oil reservoir, and the existence of the polymer will not affect the final interfacial tension in the formation.

### 37.3.4 ODA Physical Flow Test

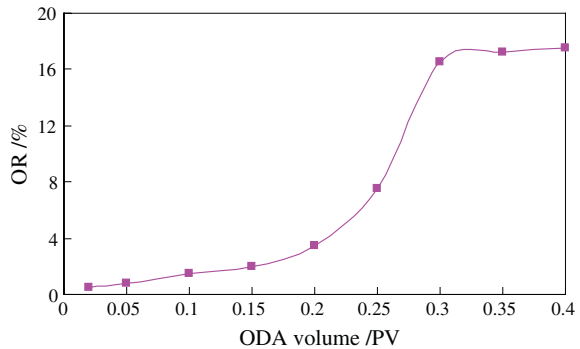
#### 37.3.4.1 ODA Optimum Consumption

The experiment is divided into 7 groups with the physical modeling: Saturate the sandy model with water, then fill the model with crude oil, and flood water through the model, pour into ODA (0.25 % KPS + 0.225 % APS) 0.02, 0.05, 0.1, 0.15, 0.20, 0.25, 0.3, 0.35 and 0.4 PV separately after HPAM flooding, then cease

**Fig. 37.3** Relation between the surfactant and balance interfacial tension



**Fig. 37.4** Relation between the surfactant and balance interfacial tension



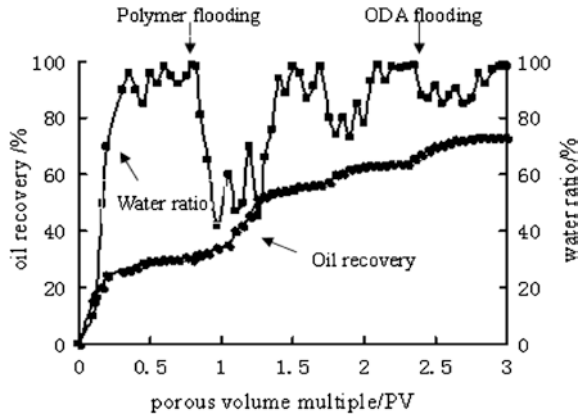
water-flooding until output water ratio up to 98 %. Note down the change of the oil recovery during whole course.

As we can see from Fig. 37.4, pouring ODA into the model after polymer flooding, the final oil recovery will further increase up to 18 %. When Polymer flooding, most of the crude oil of swept region is displaced by polymer, but the crude oil of the tiny narrow hole stay in the former place, because polymer can't enter the tiny narrow hole. The ODA can change the properties of the interface of oil and water, reduce the interfacial tension and decrease the polymer aqueous solution resistance of entering the tiny porous passage. With constant growth of ODA consumption from 0.02 to 0.4 PV, oil recovery increase continuously from 0.8 to 18 %. After the consumption of ODA was more than 0.3 PV, the increasing degree of the oil recovery reduced. When the consumption increase from 0.3 to 0.4 PV, the oil recovery just rise 1 %. When there is less ODA consumption, agent will be diluted and consumed by the stratum, can't play an active role to sweep the oil. On the contrary, excessive ODA cannot fundamentally solve the problem. Proper ODA consumption can change property of interface, and excessive ODA is unreasonable in economy. In the laboratory experiment, the optimum consumption is 0.3 PV.

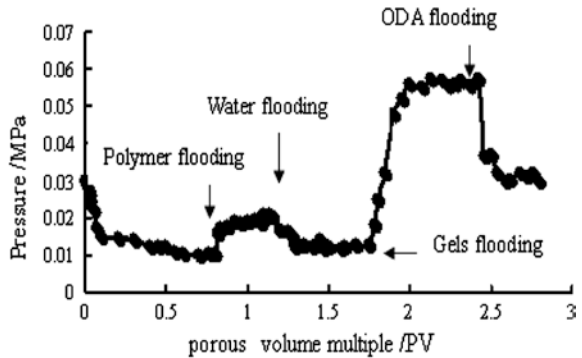
### 37.3.5 Pressure, Water Ratio and Oil Recovery Curves

Based on the optimized ODA consumption, select the 0.3 PV as the optimum consumption to pour into the model. At first, pump the model to vacuum, then saturate the formation salinity water, and oil later. Drive with water until the out water ratio at 98 %, pour HPAM 0.3PV 1,750 mg/L into the model, then input 0.2 PV gels, wait and congeal 50 h under 70 °C. Change water drive again after freezing the glue and totally becoming and freezing until the out water content rises again to 98 %, then inject 0.3 PV ODA, finally, transfer to water drive until the out water recovery up to 98 % again. Record the change of the oil recovery, water ratio and

**Fig. 37.5** Relation between injection fluid pressure and oil recovery



**Fig. 37.6** Relation between injection fluid porous volume and pressure



injection pressure in the whole course. The curves about injected fluid and water ratio or oil recovery are shown in Fig. 37.5, and relation between volume injection fluid and pressure are shown in Fig. 37.6.

As can be seen in Fig. 37.5, from water-flooding beginning to water ratio up to 98 % in the first stage, the oil recovery only reached 27 % and the injection pressure gradually reduced to 0.01 MPa. The residual oil remained in the formation without water swept. Due to improper mobility ratio between oil and water, following water flowed along the high permeability layer to the producing outlet, which caused water cut in a short time and reduced the sweep coefficient of water flooding. From the data of the injection pressure, less effective circulation of water caused the low injection pressure. After polymer flooding and gels injection, 0.3 PV ODA was injected. The enhanced oil recovery reached 17 % and final recovery was up to 75 % under laboratory situation. The ODA can reduce the interfacial tension between oil and water. Synergistic effect of gels and ODA can simultaneously increase the sweep coefficient and oil displacement efficiency.

## 37.4 Conclusion

KPS and APS as ODA possess excellent capacity and efficiency in reducing the interfacial tension of the aqueous solution and the dynamic interfacial tension between oil and water and can decrease the tension of crude oil–water interface to ultra-low at very low mass concentration, 0.25 % KPS + 0.225 % APS. The existence of the polymer wouldn't exert an influence on the balanced interfacial tension, but delay interfacial tension of the solution to reach the balance value. Injecting 0.3 PV high-efficient ODA could improve crude oil 17 % recovery. Synergism effect of petroleum sulfonates, decreasing the cost of oil recovery, would have a great prospect for enhanced oil recovery.

## References

1. Dai C, Wang Y, Leng Q (2003) Studies on profile-control oil-displacement agent with long gelation time for the formation far from wellborn. *J Xi'an Petrol Inst (Nat Sci Ed)* 1:21–26
2. Smith JE (1995) Performance of polymers in aluminum citrate colloidal dispersion gels. *SPE* 28989:461–490
3. Zhao Z, Liu F, Li Z (2006) Dynamic interfacial tension between crude oil and novel surfactant flooding systems without alkali. *Pet Sci Technol* 24:1469–1476
4. You Q, Zhao F et al (2007) Research and application of deep plugging water in oil well. *Drilling Producing Technol* 2:85–88
5. Mack JC, Smith E (1994) Depth colloidal dispersion gels improve oil recovery efficiency. In: *SPE/DOE 27780*, presented at the SPE/DOE 9th symposium on improved oil recovery, Tulsa, pp 527–539

# Chapter 38

## Research on Anxiety and Influential Factors of Occupational Female

Qi Ren, Qian Li and Weijun Guan

**Abstract** Object to analyze vocational female's anxiety degree and its influential factors. Methods Self-designed questionnaire was used to be the survey tool. The questionnaire includes basic information and Self-Rating Anxiety Scale, SAS. 1,000 questionnaires were provided for the vocational women who are up to the standard. And effective recovery rate is 98.3 %. Results 49 % of doctors showed moderate and severe anxiety sentiments. More serious than other occupation ( $p < 0.001$ ); 25 % of 60-years group showed moderate and severe anxiety; Female with Master and higher educational degree showed the highest percentage in moderate and severe anxiety. Conclusions Occupation, age and educational level could obviously influence vocational female's anxiety degree. Improve their working environment, health condition, and relieve the pressure could reduce their anxiety and enhance the life quality.

**Keywords** Anxiety • Vocational female • Occupation • Age • Educational level

### 38.1 Introduction

Modern vocational female has already played the active and important role appeared in many fields in today's society. However, female's high employment rates bring the heavy stress to vocational female which was from families, jobs and society. They have to make greater efforts on the job if they want to achieve

---

Q. Ren (✉) · W. Guan

Hebei Province Key Laboratory of Occupational Health and safety for Coal Industry, Division of Social Medicine, School of Public Health, Hebei United University, No. 57 Jianshe Road, 063000 Tang Shan, People's Republic of China  
e-mail: Jessie\_az@hotmail.com

Q. Li

Tangshan Gongren Hospital, No. 27 Wenhua Road, 063000 Tang Shan, People's Republic of China

the same occupational level as men because they usually can not enjoy the same social resources and support as male. And female generally take more responsibility to the family that is influenced by Chinese traditional custom and people's instinct [1]. They have to do the housework, to take care of the child, to look after the elder, and so on. A study shows that no matter what achievement the outstanding characteristic women reached, family remains as a leading factor to Chinese women [2]. However, female can seldom receive their partners' help on family housework. At the same time, in the work aspect, they still lack enough supports from organization and even whole society. Therefore, they usually feel tired and exhaustion. Anxiety is one of the most important expressions of stress. And this anxiety emotion could negatively influence their working efficiency, family life and even social stability. Therefore, to analyze vocational female's anxiety degree and its influential factors is necessary to reduce their anxiety emotion and improve their life quality and working efficiency.

## **38.2 Subjects and Methods**

### ***38.2.1 Research Subjects***

Cluster random sampling 1,000 female who are working in enterprises or institutions in Tangshan as the subjects. The samples' inclusion criterion is the research subjects should have well health condition, full-time job and relatively stable working hours.

### ***38.2.2 Research Methods***

Self-designed questionnaire was used to be the survey tool. Anonymous fill was used to all participator in the survey. 1,000 questionnaires were provided for the vocational women who are up to the standard. And then recycling valid questionnaires 983 copies, effective recovery rate is 98.3 %. All data were processed by SPSS. Chi-squared statistic was used to analyze the data.

### ***38.2.3 Survey Tool***

The questionnaire includes two parts:

The basic information: occupation, age, education standard, monthly income, and marital status, children status and so on.

Self-Rating Anxiety Scale, SAS: 20 questions were included. Both reliability and validity are preferably. There are 4 score levels to value the results. "1" means no or rarely, "2" means sometimes, "3" means often, "4" means all the times. The



**Table 38.1** The demography characters of subjects

Item	Groups	n	%
Age (years)	20–	246	25.0
	30–	162	16.5
	40–	321	32.7
	50–	186	18.9
	60–	68	6.9
Occupation	Teacher	112	11.4
	Doctor	155	15.8
	Official	179	18.2
	Office clerk	165	16.8
	Technician	195	19.8
	Worker	177	18.0
Educational standard	Junior high school and below	38	3.9
	Senior high school/technical secondary school	214	21.8
	Bachelor degree	423	43.0
	Master degree and higher	308	31.3
Marital status	Spinsterhood	54	5.5
	Married	821	83.5
	Divorced and bereft spouse	108	11.0

final score is between 50 and 59 means mild degree anxiety, between 60 and 69 means moderate degree anxiety, more than 70 means serious degree anxiety.

## 38.3 Results

### 38.3.1 *The Demography Characters of Subjects*

There are 32.7 % subjects aged in 40-years group, which is the highest percentage among the 983 working female. And the percentage of technician is the highest, which is 19.8 %, followed by official (18.2 %) and worker (18.0 %). Teachers take the lowest percentage, which is 11.4 %. In educational level aspect, female with bachelor degree are the most and that with Junior high school and below are the least. Married female' percentage is 83.5 %, which is the highest in marital status. The demography characters can be seen from Table 38.1.

### 38.3.2 *The Comparisons of Anxiety Between Different Occupations*

Doctors showed severe anxiety sentiments. Its percentage is 49.0 %. It is the highest percentage among the working female. Instead, the percentage of doctors

**Table 38.2** The comparisons of anxiety between different occupations

Occupation	No		Mild degree		Moderate and severe degree	
	n	%	n	%	n	%
Teacher	58	51.8	34	30.4	20	17.8
Doctor	9	5.8	70	45.2	76	49.0
Official	70	39.1	75	41.9	34	19.0
Office clerk	69	41.8	69	41.8	27	16.4
Technician	92	47.2	80	41.1	23	11.7
Worker	71	40.2	76	42.8	30	17.0
X <sup>2</sup>	126.221					
p	<0.001					

without anxiety is the lowest, which is only 5.8 %. The working pressure of doctor is extremely heavy. They have to deal with all kinds of illness and complain that are from patients and their relatives. At the same time, medical technology changed with each passing day so that they need to study all the time in order to treat illness with the advanced skill. And also, doctor's working hours are not fixed, which could negatively influence their health, especially emotional health. Doctors have to intensively work for long period. They are facing heavy pressure. Therefore, doctors showed the most serious anxiety emotion. Oppositely, teachers showed the better condition. More than half of teachers do not explain anxiety. The percentage is 51.8 %, followed by technician, which percentage is 47.2 %. Teachers and technician usually have higher educational background which could effectively help them to adjust their emotion, to relieve their pressure. At the same time, they usually have stable working hours and appropriate holiday, which could obviously reduce their anxiety emotion and improve their mental health. And also, they usually enjoy a better working environment and resources, and even social status [3]. Therefore, they usually feel more relaxed than other occupation. The difference between different occupations is statistically significant ( $p < 0.001$ ). It can be seen from Table 38.2.

### 38.3.3 The Comparisons of Anxiety Between Different Age Groups

The comparisons were showed by Table 38.3. The results showed that 60-years group explained the highest percentage of both no anxiety and moderate and severe degree, 64.7 % and 25.0 %. Health is the most important issue that the elder care about [4]. Some elder people often worry about their health condition. So that, this proportion of elder revel more serious anxiety than other age group. However, more elder enjoy a relax life without anxiety, because they have already

**Table 38.3** The comparisons of anxiety between different age groups

Age (years)	No		Mild degree		Moderate and severe degree	
	n	%	n	%	n	%
20–	60	24.4	129	52.4	67	23.2
30–	63	38.9	61	37.6	38	23.5
40–	119	37.1	137	42.7	65	20.2
50–	83	44.6	70	37.6	33	17.8
60–	44	64.7	7	10.3	17	25.0
$X^2$	54.346					
$p$	<0.001					

retired and do not need to pay attention on the job [5]. And mostly, they children have already grown-up. They do not need to take care of children. Therefore, most elder people do not have anxiety emotion. 50-years group showed a better condition. They have a higher percentage of no anxiety and the lowest percentage of moderate and severe degree. The vocational female in this age group usually already got the achievements in their job. And at the same time, their children have already grown-up, which means they do not need to pay as more attention as young mothers to the family and children. So female in this age group seldom have anxiety. Unfortunately, young female in 20- and 30-years groups revealed the worse condition. Their percentages of mild degree and moderate and severe degree are relative higher. Vocational female in these age groups are just enduring the heaviest pressure from work and their families. They are still fresh in the job. They have to learn a lot of skill and knowledge to deal with many problems in the work. And at the same time, many young female have little children who are waiting them to take care of. The conditions above could make them be utterly exhausted. Thereby, anxiety usually accompany with them. The differences between different age groups are statistically significant ( $p < 0.001$ ).

### 38.3.4 *The Comparisons of Anxiety Between Different Educational Standard*

Table 38.4 showed that vocational female with junior high school and below educational level showed the best condition. The percentage of no anxiety is 47.4 %, and moderate and severe is 7.9 %. However, Master degree and higher showed the opposite condition. The percentage is the lowest in no anxiety and the highest in moderate and severe degree respectively. This research result showed that the anxiety feeling would become more serious along with the educational level increasing. The job which is appropriate for people with lower educational level usually requires less to its employee. Therefore, female who are worked for this kind of job can not feel the heavy pressure, competition and anxiety. Oppositely, female

**Table 38.4** The comparisons of anxiety between different educational standard

Educational standard	No		Mild degree		Moderate and severe degree	
	n	%	n	%	n	%
Junior high school and below	18	47.4	17	44.7	3	7.9
Senior high school/technical secondary school	85	39.7	88	41.1	41	19.2
Bachelor degree	186	44.0	172	40.6	65	15.4
Master degree and higher	80	26.0	127	41.2	101	32.8
$X^2$	46.696					
$p$	<0.001					

with higher educational background usually engaged in the job that requires its employee know well about new skills, advanced knowledge, interpersonal relationship and so on [6]. That could significantly make female feel anxiety. The differences between different educational standard are statistically significant ( $p < 0.001$ ).

### 38.3.5 The Comparisons of Anxiety Between Different Marital Status

In this survey, the respondents who are in divorced and bereft spouse group showed the worst anxiety condition. They have the highest percentage of moderate and severe degree. And married group have the best condition. The percentages of no anxiety and mild degree are the highest. Usually, married female could receive more helps and supports from their families than single women, which could obviously reduce the negative emotion [7]. However, the research result did not reveal the significant different between different groups. This might caused by the significant difference between different groups. But the differences between different marital status are not statistically significant ( $p > 0.05$ ).

## 38.4 Conclusions

Occupation, age and educational level could obviously influence vocational female’s anxiety degree. Improving their working environments to let them working within a comfortable environment could reduce their anxiety. Increasing

holidays and adjusting working hours appropriately for those female that are under heavy pressure, could help them reduce the anxiety emotion. Proving more working resources and social supports can significantly give the vocational female useful help and decrease their negative emotion. And importantly, providing more opportunities to young female could help them to establish confidence and abilities on the job, which could reduce their anxiety as well. At the same time, appropriately reducing requirements to high educated women could help them to relax the pressure. And working female should learn to relax themselves is also very important. Therefore, whole society should make great efforts together to reduce vocational female's anxiety and improve their life quality.

## References

1. Zhai L, Hou D, Zhai Y (2005) Survey on the effects of modern life on urban women's physical and mental health. *J Shandong Inst of Phys Edu* 21(3):51-52
2. Ren Q, Guan W, Pang S (2010) Analysis on the sensation of happiness of working women and the influences in Shijiazhuang. *China J Health Psych* 18:160-161
3. Chen Y, Liu X (2010) The research progress of the influence of occupational stress from teachers in university on the quality of life. *J Liaoning med coll* 31:555-559
4. Angela C, Alberto CM (2008) Relationship between oxidative and occupational stress and aging in nurses of an intensive care unit. *AGE* 30:229-236
5. Feng S (2007) Gender, age and subjective happiness. *Econ Sci* 1:95-106
6. Lilin, Guohui (2010) The relative research on life satisfaction of undergraduate. *Sci & Technol Inf* 19:546
7. Dan H (2009) Leisure life of city married professional women and restrictive factors. *J Hubei Normal Univ* 29:72-75

# Chapter 39

## Research of Occupational Stress in Mine Emergency Rescuers

**Xiaoming Li, Sanqiao Yao, Jia Li, Ruzhu Wang, Yuan Liu, Yuping Bai,  
Yulan Jin, Fuhai Shen, Shoufang Jiang, Qingzhao Li and Qian Wang**

**Abstract** Objective to compare occupational stress of the mine emergency rescuers who had provided assistance and who not. Methods 530 mine emergency rescuers were requested. A demographic and Occupational Stress questionnaire were employed to collect demographic variables and assess occupational stress. Chi-square test and analysis of covariance was used for analyzing the difference of age, marital status, education and stressors between the groups. Results Age was significantly difference between two groups ( $p < 0.05$ ). In external conflict, task control, job demand, changing work load, opportunities for further development and participation, competitiveness, coping strategies, control strategies, support strategies and daily life stress, the scores of the rescuers who had provided assistance are significantly higher than other rescuers ( $p < 0.05$ ). In job control, decision control, environment control, job monotonicity, patience, work locus of control, Self-esteem, psychological health, satisfaction and mood calm, the scores of the rescuers who had provided assistance are significantly lower than others.

**Keywords** Provided assistance • Emergency rescuers • Occupational stress

### 39.1 Introduction

With the world economy the global environment is changing, natural disasters and all kinds of accidents have often occurred. The mine rescuers not only bear mine disaster relief and mine safety checks tasks, but also they participated

---

X. Li (✉) · S. Yao · J. Li · Y. Bai · Y. Jin · F. Shen · S. Jiang · Q. Li · Q. Wang  
School of Public Health, Hebei United University, TangShan City, Hebei Province, China  
e-mail: lxmxxh@163.com

X. Li · S. Yao · Y. Bai · Y. Jin · F. Shen · S. Jiang · Q. Li · Q. Wang  
Hebei Province Key Laboratory of Occupational Health and Safety for Coal Industry,  
TangShan City, Hebei Province, China

R. Wang · Y. Liu  
Natal Mine Rescue Base Kailuan Department, TangShan City, Hebei Province, China

in earthquake and fire relief ect. When disaster rescues, they have to face the complex work environment and overloaded work, what result in a certain amount of psychological pressure. Therefore, they are high risk of occupational stress. Numerous studies have shown that [1–3]. While some study [4] show that the more rescue, more stress. In this paper, a survey was carried out to all emergency rescuers of one mine company, we compare the different of occupational stress who had provided assistance and who not in disaster.

## **39.2 Sample and Methods**

### ***39.2.1 Design***

The study used across-sectional survey design in which data were gathered with a questionnaire. The occupational stress questionnaires which had modified by Sanfa Yu professor are good reliability and validity [5]. It completed under the guidance of the investigators who had been systematic trained.

### ***39.2.2 Sample***

We select the study sample by cluster sampling. It was composed of all mine emergency rescuers working in National mine rescue base kailuan department. In total, 548 questionnaires were scented, 540 were returned, and 530 of these were valid (if some items in the questionnaire were missing, the questionnaire was excluded from the study).

### ***39.2.3 The Survey Informations***

The demographic informations include age, education, marital status, etc. length of service and provide assistance situations were also investigated. The occupational stress questionnaire was composed of occupational stressors, stress reactions and buffer factors. Occupational stressors include physical environment; job conflict; job control; job demand; job insecurity; job responsibility; job role; job prospect; opportunities for further development and job monotonicity. Stress reactions include type A behavior; work locus of control; coping strategies; self-esteem and social support. Buffer factors include Job satisfaction; psychological health; psychosomatic symptom; depression; frequency of drug using; daily life stress; emotion.

**Table 39.1** Comparison of age, marital status and education background between two groups

Variables	Provided assistance		
	Yes	No	
Age			
≤30	139	71	
30~	96	44	$\chi^2 = 7.068$ $p = 0.029$
≥40	100	80	
Marital status			
Married	304	177	
Unmarried	20	14	$\chi^2 = 0.942$ $p = 0.624$
Other	11	4	
Education			
Junior	105	74	
Senior	173	93	$\chi^2 = 2.518$ $p = 0.284$
College and above	57	28	

### 39.2.4 Statistical Analysis

Analysis was performed using SPSS 11.5 for windows. All investigations were divided into two groups according to whether they provided assistance. The demographic characteristics were compared with chi-square test, occupational stress items were compared with analysis of covariance.

## 39.3 Results

### 39.3.1 Comparison of Age, Marital Status and Education Background Between Two Groups

In Table 39.1, age was significantly difference between two groups ( $p < 0.05$ ), marital status and educational level was uniform in two groups.

### 39.3.2 Comparison the Scores of Occupational Stressors Between Two Groups

The Table 39.2 show that in conflict among the groups, task control, job demand, changing work load and opportunities for further development and participation, the scores of the rescuers who had provided assistance are significantly higher than the scores of other rescuers who had not provided ( $p < 0.05$ ). In job control, decision control, environment control and job monotonicity, the scores of the



**Table 39.2** Comparison the scores of occupational stressors between two groups

Occupational stressors	Provided assistance		F value	P value
	Yes	No		
Physical environment	14.31 ± 2.19	14.19 ± 2.43	0.459	0.632
Job conflict	38.94 ± 10.07	38.15 ± 10.33	1.189	0.305
Internal conflict of the group	18.32 ± 5.66	18.53 ± 6.22	0.307	0.736
Conflict among the groups	20.68 ± 5.47	19.63 ± 5.41	3.772	0.024
Job control	39.21 ± 10.44	39.71 ± 11.60	5.162	0.006
Task control	19.70 ± 4.96	19.62 ± 5.52	4.729	0.009
Decision control	9.35 ± 3.61	9.91 ± 3.94	6.728	0.001
Resource control	5.45 ± 1.72	5.35 ± 1.86	0.197	0.821
Environment control	4.71 ± 1.95	4.88 ± 2.00	6.323	0.002
Job demand	32.30 ± 4.71	31.31 ± 5.17	3.333	0.036
Basic work load	13.72 ± 3.21	13.10 ± 3.10	2.377	0.094
Changing work load	10.41 ± 2.32	9.65 ± 2.67	7.977	0.000
Using techniques	8.17 ± 2.63	8.55 ± 3.00	1.180	0.308
Job insecurity	8.32 ± 2.67	8.10 ± 3.00	0.560	0.571
Job responsibility	21.76 ± 6.24	21.14 ± 7.66	2.207	0.111
Responsibility for people	11.10 ± 3.27	10.85 ± 4.04	2.546	0.079
Responsibility for work	10.72 ± 3.38	10.30 ± 4.18	2.483	0.084
Job role	47.93 ± 9.49	48.30 ± 9.81	0.807	0.447
Role conflict	29.84 ± 7.88	29.84 ± 9.37	2.838	0.059
Role ambiguity	18.24 ± 5.91	18.46 ± 7.17	0.829	0.437
Job prospect	13.63 ± 3.23	13.47 ± 3.73	0.167	0.846
Job monotonicity	8.23 ± 2.70	8.26 ± 2.28	3.430	0.033
Opportunities for further development and participation	14.90 ± 4.91	14.60 ± 5.71	2.270	0.104
Opportunities for development	6.95 ± 2.35	6.69 ± 2.97	6.488	0.002
Opportunities for participate in	7.99 ± 3.11	7.91 ± 3.53	0.061	0.940

rescuers who had provided assistance are significantly lower than the rescuers who had not provided assistance.

### 39.3.3 Comparison the Scores of Buffer Factors Between Two Groups

The Table 39.3 show that in competitiveness, coping strategies, control strategies and support strategies, the scores of the rescuers who had provided assistance are significantly higher than the scores of other rescuers who had not provided. In patience, Work locus of control and Self-esteem, compared with the rescuers who had not provided assistance, the scores of the rescuers who had provided assistance are significantly lower.

**Table 39.3** Comparison the scores of buffer factors between two groups

Buffer factors	Provided assistance		F value	P value
	Yes	No		
Type A behavior	21.06 ± 2.81	21.22 ± 2.49	0.278	0.757
Patience	10.24 ± 2.39	10.72 ± 2.33	7.101	0.001
Competitiveness	10.82 ± 2.34	10.50 ± 2.22	4.774	0.009
Work locus of control	52.44 ± 9.62	52.77 ± 9.64	3.794	0.023
Coping strategies	42.04 ± 7.45	40.02 ± 7.53	6.110	0.002
Control strategies	25.84 ± 4.79	24.50 ± 4.78	4.948	0.007
Support strategies	16.20 ± 3.63	15.52 ± 3.68	6.808	0.001
Self-esteem	26.78 ± 6.16	27.50 ± 5.05	5.767	0.003
Social support	22.19 ± 7.43	23.31 ± 9.07	1.211	0.299
Supervisory support	8.07 ± 3.19	8.47 ± 3.48	1.094	0.336
Family support	6.60 ± 2.73	7.17 ± 3.53	2.527	0.081
Co-workers support	7.59 ± 2.69	7.67 ± 3.19	0.062	0.940

### 39.3.4 Comparison the Scores of Stress Reactions Between Two Groups

In Table 39.4, we can see that the scores of the rescuers who had provided assistance are significantly higher than the scores of daily life stress for other rescuers who had not provided, in psychological health, satisfaction and Mood calm, compared with the rescuers who had not provided assistance, the scores of the rescuers who had provided assistance are significantly lower.

## 39.4 Discussion

Mine accident, fire, earthquake, etc., kinds of natural disasters were very unpredictable, emergency, uncertain and harmful to society [6]. They impact progress of social, development of economic, standard of people's lives and psychological health. When rescuers provide assistance, they not only bear the strain from social, family, public, responsibility and so on, but also face the painful scene. It took a deep impact on rescuer's visual, hearing and feeling. So that it is very easy, rescuers feel occupational stress [7, 8].

In this study, we found that the score of daily life stress for mine emergency rescuers who had provided assistance are higher than rescuers who not. This is probably because, when providing assistance, mine emergency rescuers suffer from harsh environment, a painful scene, great psychological pressure and difficult task to work. Therefore they had more mental health and stress after provided assistance. We found also that the score of job control, work locus of control, Job monotonicity, self-esteem and psychological health for mine emergency rescuers

**Table 39.4** Comparison the scores of stress reactions between two groups

Stress reactions	Provided assistance		<i>F</i> value	<i>P</i> value
	Yes	No		
Job satisfaction	54.11 ± 10.43	54.27 ± 11.04	0.100	0.905
Job itself satisfaction	27.39 ± 5.09	27.38 ± 5.31	0.004	0.996
Job organization Satisfaction	26.73 ± 5.66	26.89 ± 6.03	0.271	0.763
Psychological health Satisfaction	50.92 ± 8.63	51.83 ± 9.14	4.524	0.011
Enough confidence	20.59 ± 4.70	21.27 ± 4.79	3.095	0.046
Mood calm	18.91 ± 3.76	18.42 ± 3.92	1.211	0.299
Psychosomatic symptom	11.42 ± 2.79	12.14 ± 2.83	15.148	0.000
Depression	28.32 ± 10.14	28.11 ± 11.80	0.054	0.947
Frequency of drug using	17.21 ± 8.17	17.28 ± 9.82	0.737	0.479
Daily life stress	8.25 ± 2.71	8.79 ± 3.96	2.79	0.063
Affection balance	7.12 ± 2.43	6.83 ± 2.49	7.227	0.001
Positive affection	2.63 ± 2.02	2.65 ± 1.98	2.143	0.118
Negative affection	6.64 ± 1.37	6.68 ± 1.56	0.065	0.937
	8.97 ± 1.39	9.01 ± 1.35	5.445	0.005

who had provided assistance are lower than rescuers who not. One obvious reason is that the work is unpredictable and uncertain, rescuers work tasks depend on the complexity and changing of the environment, they have to adjust to a changing environment. After provided assistance they need more support from the community, family, leadership and colleagues.

### 39.5 Suggestion

After the disaster, we should pay more attention to rescuers, as much as possible to help get family members, colleagues, leadership support, train calm mood. More opportunity for development of rescuers.

### References

1. Richang Z (2003) Disaster coping and psychological assistance. *Int J Beijing Normal Univ* 5:28–31 Social sciences
2. Sijing W (2011) Concerned about the mental health of emergency rescuers. *Int Labour Prot* 7:104–106
3. Toori EDG (2009) Survey of prevalant rate post traumatic stress disorders in emergency people one hospital in iran. *Int: Proceedings of 17th world congress on ergonomics* 32:44–49
4. Ming X, Meibian Z, Jianfang Z (2010) Analysis on influencing factors of occupational stress in spot rescue workers during sudden public event. *Int Chin J Ind Med* 2:123–125

5. Shanfa Z, Rui Z (2000) Study of the occupational stress measure instrument. *Int Henan Med Res* 2:171-174
6. Wuli H, Shangjiong Y, Wanghong S (2002) Analysis of mental health of military rescue personnel after wreck in yantai. *J Fourth Military Med Univ* 1:46-48
7. Quanchao L, Xingwei C, Yang Y (2009) Characteristics and implication of psychological stress of soldiers in earthquake rescue. *Military Med J South China* 5(62-63):67
8. Huanlin W, Wei G, Jin Hua (2010) The prevalence of post traumatic stress disorder and impact factors in military first responders 6 months after wenchuan earthquake in china. *Chin J Psychiatry* 2:97-101

# Chapter 40

## Effect of Curcumin on Biological Behavior of T24 Cells of Bladder Cancer and its Mechanism

Yu Su, Zhuo Wang, Lei Zhou, Qunxi Li and Yanbo Peng

**Abstract** The paper aims at a study of the effect of curcumin on the biological behavior of T24 cells of bladder cancer and its mechanism. After a treatment of T24 cells of bladder cancer with curcumin of different concentration for 24, 48 and 72 h, MTT method is used to examine cell proliferation inhibiting rate, FCM method is used to examine Apoptosis rate, and western blot method is used to examine the NF-KB expression after a treatment of 24 h. Curcumin can inhibit the proliferation of T24 cells and induce its apoptosis. This inhibiting effect bears dependence relation with time and dosage; examination result with western blot method shows that NF-KB expression level lowers with the increase of curcumin treatment concentration, and differences among groups are of statistical significance ( $P < 0.05$ ). Curcumin can inhibit the proliferation of T24 cells of human bladder cancer and induce its apoptosis, which might be related to the lowering of NF-KB expression level.

**Keywords** Curcumin • Bladder tumor • Proliferation • Apoptosis • NF-KB

### 40.1 Introduction

Bladder cancer is the most common tumor in urinary monolayer system, and very likely to recur after operation. The curative effect of current medicines in prevention and treatment is not satisfactory or has obvious side effect. The research and development of new medicine is one question calling for prompt solution in treatment of bladder cancer. Curcumin is an effective component extracted from curcuma. Research shows that Curcumin has such pharmacological effects as

---

Y. Su (✉) · Z. Wang · L. Zhou  
Hebei United University, Tangshan, Hebei Province, China  
e-mail: [imsuyu1979@163.com](mailto:imsuyu1979@163.com)

Q. Li · Y. Peng  
Hebei United University Affiliated Hospital, Tangshan, Hebei Province, China

anti-inflammation, anti-oxidation, antiviral, anti-tumor etc., and can be used as antimutagen and anti-cancer agent. It can induce tumor cell apoptosis and cell differentiation, inhibit cell cycle progression and proliferation, and inhibit the formation of tumor angiogenesis [1].

Recently, study of the antitumor effect of curcumin has grown into a hot research area. This experiment explores the treatment effect and possible mechanism of curcumin on treatment of bladder cancer by observing its effect on the biological behavior of T24 cells of bladder cancer, which is expected to cast new light on the treatment of bladder cancer.

## **40.2 Material and Method**

### ***40.2.1 Material***

T24 cells of human bladder cancer (provided by Institute of Urological Surgery of Tianjin, China); RPMI 1640 culture medium bought from American Gibco Company; calf serum (Hangzhou Sijiqing Biological Engineering Materials Co., Ltd.); curcumin (American Sigma company), Annexin V/propidium iodide kit bought from American BD Pharmingen company; MTT bought from American Sigma company; rabbit anti-human polyclonal antibody against NF-KBp65 (American Santa Cruz company);  $\beta$ -actin antibody and HRP-labeled Goat Anti-Rabbit IgG (H + L) (Wuhan Boster Bio-engineering Co, Ltd).

### ***40.2.2 Method***

#### **40.2.2.1 Cell Culture**

o culture T24 cells of human bladder cancer, RPMI 1640 culture medium with 10 % fetal bovine serum, 100 u/ml Penicillin, and 0.1 mg/ml Streptomycin is used, and 37 °C incubator with 5 % volume fraction CO<sub>2</sub>, and saturated humidity is used. When the fusion rate reaches 80, 0.25 % Trypsin is used for digest and passage.

#### **40.2.2.2 MTT Colorimetry Method is Used to Examine Cell Viability**

T24 cells in logarithmic growth phase is used to produce single cell suspension in which the cell density is adjusted to  $2 \times 10^4$ /ml, and then inoculated in 96-well plate (100  $\mu$ L/well). When it reaches the state of cell attachment, medium with different concentration is used in experimental groups to intervene: Control group

(group A); group treated with 10  $\mu\text{mol/L}$  curcumin (group B); group treated with 20  $\mu\text{mol/L}$  curcumin (group C); treated with 50  $\mu\text{mol/L}$  curcumin (group D); treated with 100  $\mu\text{mol/L}$  curcumin (group E); after 24, 48, and 72 h respectively for different groups, 20  $\mu\text{l}$  MTT (5  $\mu\text{g/ml}$ ) is put into each well. After another 4 h of incubation, then culture process is over. Suchek off and discarded the supernatant fluid of culture carefully, 150  $\mu\text{l}$  DMSO is put into each well. After 10 min of vibration, enzyme-labeling instrument is used to examine the absorbance (D) where wave length is 570 nm. The experiment is repeated for three times to figure out the average value. Cell growth inhibition rate can be calculated with the following formula: inhibition rate (IR) % =  $(1 - D \text{ of experiment group} / D \text{ of control group}) \times 100 \%$ .

#### 40.2.2.3 Flow Cytometry Analysis

To make T24 cells treated with 20, 50, 100  $\mu\text{mol/L}$  curcumin respectively for 24 h into  $1 \times 10^6/\text{mL}$  single cell suspension, and then wash it with pre-cooling 4  $^{\circ}\text{C}$  PBS buffer solution for two times, put in 100  $\mu\text{L}$  label Solution of cells suspended (end mass concentration of FITC-Annexin V and PI were all 1  $\mu\text{g/mL}$ ), culture it for 30 min under dark condition and room temperature, wash it for two times with HEPES. Flow cytometry is used to examine the change of Apoptosis. Repeat the experiment for three times.

#### 40.2.2.4 Western-Blot

After cell counting, it is made into single cell suspension with an intensity of  $1 \times 10^6/\text{ml}$ . Then the single cell suspension is inoculated in a 6 cm culture dish. After 24 h, we use culture medium of different concentration to intervene different groups: control group (group A); group treated with 50  $\mu\text{mol/L}$  curcumin (group D); group treated with 100  $\mu\text{mol/L}$  curcumin (group E); Three holes were dealt in each group, and sucked culture medium out at the scheduled time with drug intervention, protein samples are extracted from all groups. Then the samples are denatured by boiling. After electrophoresis, transmembrane, sealing, first antibody incubation, second antibody incubation, photos are taken, and image analysis software is use to analyze absorbency, taking  $\beta$ - act in protein as a reference.

#### 40.2.2.5 Statistics Method

All experiment data are analyzed with statistic software SPSS 16.0. measurement data are expressed by  $\bar{x}$  s. Two sample means are compared with Dunnnett t-test. The difference is of statistic significance ( $P < 0.05$ ).

**Table 40.1** Difference in time and dosage is of statistic significance ( $P < 0.05$ )

Curcumin ( $\mu\text{mol/L}$ )	Growth inhibition rate (%)			24 h apoptosis rate (%)
	24 h	48 h	72 h	
0				1.23 $\pm$ 0.51
10	11.36 $\pm$ 1.56	16.28 $\pm$ 2.36	25.63 $\pm$ 5.94	
20	20.31 $\pm$ 3.57	35.03 $\pm$ 4.88	46.94 $\pm$ 2.43	20.56 $\pm$ 0.68
50	44.31 $\pm$ 2.53	75.64 $\pm$ 5.84	82.96 $\pm$ 3.87	
100	65.74 $\pm$ 5.83	83.98 $\pm$ 4.36	89.24 $\pm$ 4.23	45.93 $\pm$ 0.72

## 40.3 Result

### 40.3.1 After a Treatment of T24 Cells of Bladder Cancer with Curcumin of Different Concentration for 24, 48, 72 h

MTT examination shows that the value of D570 lowers and the inhibition rate for T24 cells of bladder cancer rises with the increase of concentration and treating time of curcumin, that means it bears a dependence relation with time and dosage. Difference in time and dosage is of statistic significance ( $P < 0.05$ ), please refer to Table 40.1.

### 40.3.2 The Examination Result of FCM Method Shows that the Apoptotic Rate in Late Stage Differs Between Experiment Group and Control Group

After the T24 cells of bladder cancer is treated with curcumin for 24 h, and such difference is of statistic significance ( $P < 0.05$ , Table 40.1).

### 40.3.3 Effect of Curcumin on the NF-KB Expression of T24 Cells of Bladder Cancer

After the T24 cells of bladder cancer is treated with curcumin of different concentration for 24 h, the NF-KB expression (NF-KB/ $\beta$ -action) of T24 cells of bladder cancer in group A, C, D, E are (0.889  $\pm$  0.019), (0.640  $\pm$  0.019), (0.503  $\pm$  0.014), (0.349  $\pm$  0.022) respectively. The difference among the four groups is of statistic significance ( $F = 472.53$ ,  $P = 0.000$ ).



## 40.4 Discussion

Curcumin, a yellow pigment from *Curcuma Longa*, is of extensive biological activity, such as antitumor, antioxidation, Anti-Inflammatory, anti-HIV etc. recently, its anticancer effect attracts more and more attention. Curcumin shows its antitumor effect by inhibiting the initiation and progression of tumor, that is, to inhibit tumor cell proliferation, growth, survival, transfer, angiogenesis and tumor invasion. In addition, it also inhibits several signal channels so as to inhibit tumor cell proliferation etc [2]. Research shows that curcumin can inhibit the occurrence of breast cancer and skin cancer, substantially reduce the number of tumors, decrease myoma volume, and substantially reduce the possibility of transplanted cancer (to mice) growing into tumor [3]. Because curcumin is characteristic of low toxicity, little side effect, wide anticancer spectrum, so it is listed 3rd generation cancer preventive drug by American National Cancer Institute [4], and entered clinical trial stage.

The research explores the effect of curcumin on the biological behavior of bladder cancer cell through MTT method, FCM method, and western blot. MTT result shows that the inhibiting effect of curcumin on the proliferation of T24 cells of bladder cancer bears a dependence relation with curcumin concentration and treating time. Meanwhile, substantial apoptosis rate of bladder cancer cell treated with curcumin is detected with flow cytometry. All these show that curcumin can inhibit the proliferation of bladder cancer cell and induce its apoptosis. Squires et al. [5] reported that curcumin could inhibit the proliferation of breast cancer cell HBL100 and MDA-MB- 468 by affecting cell cycle of S/G2/M.

Apoptosis is a process of cell death in ontogeny, which is controlled by a serial of gene. Tumor is caused by the imbalance of cell proliferation and apoptosis. Because the activity of gene promoting apoptosis is inhibited and the activity of anti-apoptotic gene is activated, so that the apoptosis of tumor cell is inhibited and tumor cell can survive [6, 7]. The antitumor activity of curcumin is closely related to its effect on inducing apoptosis, so we can induce tumor apoptosis through extrinsic and intrinsic pathway. Caspase-3 inhibitor, Z-VAD-fmk, can completely cut off the apoptosis of Leukemia cell HL-60 induced by curcumin [8]. While it is through extrinsic pathway that curcumin induces Apoptosis of Melanoma Cells [9].

NF-KB is a eukaryotic cell transcription factor which distributes extensively and plays many roles. It is a member of NF-KB/Rel protein family, and can integrate changes of genetics and abnormality of immune reaction of contagious genes, which enables it to take part in many biological function, such as cell differentiation, immune response, inflammatory response, apoptosis, growth and development of tumor. Activity disorder is closely related to tumor, and plays an important role in growth and development of tumor [10]. It is reported that curcumin regulate the expression of both proto-oncogene and tumor suppressor gene, thus to play its anticancer role, such as lowering the expression level of NF-KB, c-myc, c-ras [11], raising the expression level of p53, bax [12]. However, its effecting mechanism is still unknown. Xie Donghua etc. [13] find obvious expression of NF-KB and its regulatory genes in bladder cancer, which lead to the inference that

this expression disorder plays an important role in the growth and development of bladder cancer. Western blot method is adopted to examine the expression of NF-KB (p65) of T24 cells in groups treated with curcumin of different concentration. Result shows that the expression level of NF-KB (p65) in treated groups lowers with the rising of the curcumin concentration, and the expression levels are much lower than that of control group. Among many tumors, such as Prostate Cancer, multiple myeloma, Melanoma, Pancreatic Cancer, Head and Neck Squamous Carcinoma etc., curcumin is found to inhibit constitutive activation of NF-KB, and induce its apoptosis [14] Thus, we can conclude that curcumin can be used as a relatively strong stimulating factor to induce the expression of NF-KB in the bladder cancer cell.

## 40.5 Conclusion

In conclusion, curcumin can inhibit the expression of NF-KB in bladder cancer cell, inhibit cell proliferation, and induce its apoptosis. It suggests that NF-KB can be a new breakthrough point in treatment of bladder cancer. Curcumin might be a new drug to treat bladder cancer. This research result cast new light on the treatment of bladder cancer in terms of idea and method.

## References

1. Dorai T, Cao YC, Dorai B, et al (2001) Therapeutic potential of curcumin human prostate cancer. 111 Curcumin inhibits proliferation, induces apoptosis, and inhibits angiogenesis of uncap prostate cancer cells in vivo. *Prostate* 47(4):293–303
2. Aggarwal B, Sung B (2009) Pharmacological basis for the role of curcumin in chronic diseases: an age-old spice with modern targets. *Trends Pharmacol Sci* 30(2):85–94
3. Sindhwani P, Hampton JA, Baig MM et al (2001) Curcumin prevent s int ravesical tumor implantation of the MBT-2 tumor cell line in C3H mice. *J Urol* 166(4):1498–1501
4. Gomez G, Mansouraty G, Gardea J, et al (2007) Acceleration of oxidative protein folding by curcumin through novel non-redox chemistry. *Biochem Biophys Res Commun* 364(3):561–566
5. Squires MS, Huds on EA, Howells L et al (2003) Relevance of mitogen activated protein kinase (MAPK) and phosphotidyl inositol- 3-kinase/protein kinase B (PI3 K/PKB) pathways to induction of apoptosis by curcumin in breast cells. *Biochem Pharmacol* 65(3):361–376
6. Suzuki O, Abe M (2008) Cell surface N-glycosylation and sialylation regulate galectin-3-induced apoptosis in human dif fuse large B cell lymphoma. *Oncol Rep* 19(3):743–748
7. Takai N, Ueda T, Nishida M et al (2008) Histone deacetylase inhibitors induce growth inhibition, cell cycle arrest and apoptosis in human choriocarcinoma cells. *Int J Mol Med* 21(1):109–115
8. Tan TW, Tsai HR, Lu HF, et al (2006) Curcumin-induced cell cycle arrest and apoptosis in human acute promyelocytic leukemia HL-60 cells via MMP changes and caspase-3 activation. *Anticancer Res* 26(6B):4361–4371

9. Reuter S, Eifes S, Dicato M et al (2008) Modulation of anti-apoptotic and survival pathways by curcumin as a strategy to induce apoptosis in cancer cells. *Biochem Pharmacol* 76(11):1340–1351
10. Yu HG, Yu LL, Yang Y et al (2003) Increased expression of RelA/nuclear factor-kappaB protein correlates with color cetal tumorigenesis. *Oncology* 65(7):37–45
11. Limtrakul PP, Anuchapreeda S, Lipigorngoson S et al (2001) Inhibition of carcinogen induced c-H a-ras and c-fos proto-onco-genes expression by dietary curcumin. *BMC Cancer* 1(1):1–6
12. Choudhuri T, Pal S, Agwarwal ML et al (2002) Curcumin induces apoptos is in human breast cancer cells through p53-dependent Bax induction. *FEBS Lett* 512(1–3):334
13. Dong hua X, Xiao da T, Shu jie X, Jian ming T, Xiang hui W, Yong C (2006) Expressions of NF-KB in human bladder cancer and its clinical significance. *Chin J Cancer* 21(6):663–667
14. Aggarwal BB, Sung B (2009) Pharmacological basis for the role of curcumin in chronic diseases: an age-old spice with modern targets. *Trends Pharmacol Sci* 30(2):85–94

# Chapter 41

## Effect of Soyasaponin on Expression of Fas/FasL of Pneumonocyte in Silicotic Fibrosis Rats

Houjun Xu, Yulan Hao, Yu Su, Qingzhao Li, Jianhui Wu, Hongmin Fan, Manman Wang, Licheng Yan, Haijuan An and Yanshu Zhang

**Abstract** Objectives to discuss the effect of SS on expression of Fas and FasL of Pneumonocyte in the Silicotic Fibrosis Rats. Methods Superoxide dismutase (SOD) and malondialdehyde (MDA) of pulmonary tissue and changes of that after SS intervened were observed. The immunohistochemical method was used to detect the level in the expressions of Fas and FasL protein. Results Compared with NS group, the level of SOD decreased constantly in SiO<sub>2</sub> group ( $P < 0.05$ ). MDA was increased significantly and maintain the high level ( $P < 0.05$ ). Expression of Fas protein of SiO<sub>2</sub> group was 4.51 and 5.05 times compared with its NS group. Its positive staining was located in epithelial cells of bronchi-duct and alveolar endothelial cells. Conclusions Fas and FasL system might take part in the pulmonary fibrosis. A certain dose of SS might down regulate the expressions of Fas and FasL to relieve the development of pulmonary fibrosis.

**Keywords** Silicosis • Pulmonary fibrosis • Soyasaponin • Fas • FasL

### 41.1 Introduction

Silicosis is caused by the long-term inhalation of a large number of free SiO<sub>2</sub> pulmonary fibrosis, the early pathological changes of silicosis is alveolar damage and inflammation, and at last it will become fibrosis. The study shows that: silicosis on AM apoptosis induced by ROS and Caspase-mediated, the activation of AM and AEC cells can express FasL in order to achieve the apoptosis [1]. Therefore, during the process of pulmonary fibrosis, the study of Fas/FasL-mediated apoptosis is very significant. Soyasaponin (SS), an active ingredient is extracted from soybeans, which have antioxidant [2], inhibition of tumor, immune regulation, and other physiological functions. Thus, we chose SS as a means of intervention to

---

H. Xu (✉) · Y. Hao · Y. Su · Q. Li · J. Wu · H. Fan · M. Wang · L. Yan · H. An · Y. Zhang  
Hebei United Univeristy, Tangshan Hebei Province 063000, China  
e-mail: houjunxu@126.com

observe the effects of Fas/FasL expression in lung tissue cells, and at last we can offer the experimental data for silicosis prevention and the pathogenesis.

In recent years, lipid oxidation has aroused widespread concern in the development process of the occurrence of silicosis fibrosis. Studies have shown that the cause respiratory burst [3], SiO<sub>2</sub> dust into the body, producing free radicals, these free radicals attack the cell membrane of lung macrophages, lipid peroxidation, resulting in structural damage to macrophages (AM), membrane damage to the giant macrophage release of SiO<sub>2</sub> was engulfed by other AM, and so forth, resulting in the AM, proliferation and aggregation provide a basis for, the formation of silicotic nodules. Shi X[4], electron spin resonance (ESR) technology to detect SiO<sub>2</sub> suspension in the generation of ROS, proof of SiO<sub>2</sub> dust can stimulate AM to produce oxygen free radicals cause cell damage. [5] That, silicosis pathogenesis SiO<sub>2</sub> start the alveolar macrophage surface peroxide radical reaction, so that the macrophage damage and release of many active factor is the direct cause leading to pulmonary fibrosis. And SiO<sub>2</sub> dust can also lead to the AM of free radical chain reaction, leading to biofilm lipid peroxidation, malondialdehyde (MDA) and the formation of end products, MDA, and free amino groups on the protein and phospholipid covalent binding, and DNA and RNA cross-linking, cell structural changes, functional impairment, metabolic abnormalities, resulting in pathological changes.

Body antioxidant enzyme defense system, which SOD to scavenge superoxide anion specificity were in body. Radical scavenging enzymes of SOD, CAT and GSH-PX activity have different degrees of increased oxidative stress [6], increased free radical metabolism in compensatory increase of antioxidant enzymes in dye dust early JUI-SHENG SUN, and other. With the number of free radicals, these anti-free radical enzyme activities decreased significantly, while lung tissue MDA content increased significantly, after dust lung tissue lipid peroxidation, reduced antioxidant capacity. Wanjun et al. [7] that endogenous anti-free radical enzymes in the consumption of large quantities of free radical scavenging and free radical-induced decrease in enzyme activity, leading to a reduction in endogenous antioxidant capacity, thereby increasing the lung tissue lipid peroxidation damage. The experimental results show that the SS can significantly reduce the pulmonary inflammatory response after dust and increase SOD activity, reducing the content of MDA in lung tissue, thereby inhibiting lipid peroxidation.

Fas (also known as CD95/APO-1), is tumor necrosis factor (TNF) receptor superfamily member, apoptosis induced by death receptor pathway. Recent studies suggest that dysfunction of Fas and FasL system is one of the important pathogenesis of some diseases [8]. Fas/FasL are not only able to induce apoptosis, and the role of pro-inflammatory factor.

## 41.2 Materials and Methods

Experimental animals and animal model: 40 clearer SD rats, weighing 200 g ± 30 g, male, offered by Beijing Vital River. SD rats were randomly divided into control group (saline group), exposed to silica (SiO<sub>2</sub>), intervention group1 (SS 10 mg/kg) and intervention group 2 (SS 15 mg/kg), each group has 10 rats.

Rats under ether anesthesia will open device plugs entrance, under direct vision to inject 1 ml of the experiment liquid, 0.5 ml to each left and right lungs. The control group was injected with sterile normal saline, model group and intervention group was given SiO<sub>2</sub> dust suspension (50 mg/ml). After the modeling is completed, the intervention group with SS according to the 10 mg/kg and 15 mg/kg orally, 5 times a week, the control group and model group were given an equal volume of NS gavage, animals in each group after the modeling and 40d, 80d, respectively, were killed half. SS solution with normal saline dubbed to the concentration of 4 mg/ml, use 0.22 μm millipore filter sterilization and kill the bacteria, 4 °C to save.

Animal handling and sample collection: intraperitoneal injection of the mass fraction of 0.3 % sodium pentobarbital anesthesia, get the heart blood, 2,000 r/min centrifuge 15 min, put the lung tissue and serum in -70 °C storage spare.

Serum superoxide dismutase (SOD), lung tissue malondialdehyde (MDA). Each is got from the Nanjing Jiancheng Institute of Biotechnology kit, do according to the manual operation.

Universal immunohistochemical staining kit (Beijing Zhongshan Biotechnology Company) detection of Fas, FasL expression. The primary antibody was rabbit anti-rat expression of Fas and FasL (dilution for 1:100,1:75, Santa Cruz Biotechnology Inc.), 3, 3-aminophenyl hydrazine (DAB) color, mounting with neutral resin. Instead of primary antibody as a negative control, phosphate buffered saline (PBS) with a microscope to observe the lung tissue expression of Fas and FasL expression. Each animal were randomly observed a slice, a magnification of 10 × 40, each slice randomly selected five fields of vision, use MoticMed system 6.0 image analysis system for quantitative analysis of the expression of Fas and FasL in.

Statistical analysis: All results are presented as mean ± standard deviation ( $\bar{x} \pm s$ ), single factor analysis of variance, and q test statistic SAS6.12 software.  $P < 0.05$  indicated a statistically significant difference.

## 41.3 Results

### *41.3.1 At Different Times, the Content of SOD Changes in Each Group of Animal Serum*

The SiO<sub>2</sub> serum SOD was significantly lower than the NS group, the difference was significant ( $P < 0.05$ ), with the extension of time after dust, SOD content decreased slightly, but the difference was not statistically significant. Giving SS SOD activity enhanced the SOD content increased nearly 30 % than the average and which is closely related to SS that has antioxidant activity. However, high doses of the SS group compared with the low dose group, no significant impact differences in SOD ( $P > 0.05$ ). Indicate in the Table 41.1.

**Table 41.1** The comparison of serum SOD in different groups (U/ml)

Groups	40d ( $\bar{x} \pm s$ , n = 5)	80d ( $\bar{x} \pm s$ , n = 5)
NS	101.86 $\pm$ 24.57	103.05 $\pm$ 33.41
SiO <sub>2</sub>	66.24 $\pm$ 13.50	60.96 $\pm$ 12.03
SiO <sub>2</sub> + SS(10 mg/kg)	85.50 $\pm$ 16.16	84.43 $\pm$ 26.63
SiO <sub>2</sub> + SS(15 mg/kg)	86.00 $\pm$ 21.38	85.82 $\pm$ 18.45

### 41.3.2 At Different Times, the MDA Content in Each Group's Pulmonary Tissue

After silica dust into the rat in vivo, it results in a lot of excess free radicals, these free radicals can attack the pulmonary biomembrane's unsaturated fatty acids (PUFA) and arise from lipid oxidation end product malondialdehyde (MDA), MDA can accumulate in the pulmonary organization, the content and lung peroxidative damage were positively correlated. Seen from Table 41.2, after getting dust 40d, the MDA content of pulmonary tissue in the group of exposed to SiO<sub>2</sub> is in a sharp rise and which is 3.38 times than the content of NS group, the volume average 43.6 nmol/mgprot at 80d, 7.71 times than which of the control group. MDA content of SS in the intervention group with the same period in SiO<sub>2</sub> have significant decrease, and the difference was statistically significant. Show that SS is able to resist the attack of free radicals on the biomembrane, and made the protection effect during its anti-oxidation.

### 41.3.3 Fas and FasL Protein Express the Results

The positive signal of Fas and FasL protein expressed in the cell membranes of lung tissue and surrounding area of cell membrane, the NS group of Fas and FasL expressed weakly positive. Dust on 40d, the expression of Fas expression was significantly higher, mainly in bronchial epithelial cells and alveolar epithelial cells; FasL is mainly distributed in the alveolar epithelial cells and interstitial lung inflammatory cells. Dust on 80d of SiO<sub>2</sub> lung of Fas protein expression is still maintained at high levels of FasL expression declined slightly. SS intervention 40d Fas expression decreased, but still significantly higher than the control group; reduced FasL expression after 80d, compared to the differences seen between the groups was statistically significant ( $P > 0.05$ ) (Table 41.3).

**Table 41.2** The comparison of pulmonary tissue MDA in different groups (nmol/mgprot)

Groups	40d ( $\bar{x} \pm s$ , n = 5)	80d ( $\bar{x} \pm s$ , n = 5)
NS	4.99 $\pm$ 1.26	5.66 $\pm$ 1.83
SiO <sub>2</sub>	16.38 $\pm$ 4.11	43.62 $\pm$ 10.71
SiO <sub>2</sub> + SS(10 mg/kg)	10.52 $\pm$ 8.10	19.09 $\pm$ 9.22
SiO <sub>2</sub> + SS(15 mg/kg)	9.15 $\pm$ 2.64	17.11 $\pm$ 6.58

**Table 41.3** The AOD of Fas, FasL of pulmonary tissue in different groups

Groups	40d		80d	
	Fas ( $\bar{x} \pm s$ , n = 5)	FasL ( $\bar{x} \pm s$ , n = 5)	Fas ( $\bar{x} \pm s$ , n = 5)	FasL ( $\bar{x} \pm s$ , n = 5)
NS	0.094 ± 0.013	0.029 ± 0.006	0.078 ± 0.037	0.031 ± 0.008
SiO <sub>2</sub>	0.424 ± 0.058	0.171 ± 0.018	0.394 ± 0.062	0.048 ± 0.012
SiO <sub>2</sub> + SS (10 mg/kg)	0.244 ± 0.031	0.088 ± 0.009	0.332 ± 0.050	0.041 ± 0.010
SiO <sub>2</sub> + SS (15 mg/kg)	0.256 ± 0.036	0.036 ± 0.010	0.266 ± 0.066	0.036 ± 0.013

## 41.4 Conclusions

There is evidence that ROS can up-regulate the expression of Fas/FasL system and activation of the cell death program; antioxidants can block the Fas/FasL system-mediated apoptosis. The study of the above results can be seen that the SS with a stable membrane, scavenging free radicals and improve cell protective effect of endogenous SOD activity, by reducing the expression of Fas and FasL in lung tissue expression. The specific mechanism needs further study.

**Acknowledgments** Hebei Province Key Laboratory of Occupational Health and safety for Coal Industry, Hebei United University, Tangshan Hebei Province, China, 063000. Science and technology research and development program of Tangshan City. (Grant No.10150 204A-36).

## References

- Borges VM, Lopes MF, Falcao H et al (2002) Apoptosis underlies immunopathogenic mechanisms in acute silicosis. *Am J Physiol Lung Cell Mol Physiol* 27:78–84
- Yinping W, Jiayang W, Fenglan Z et al (1993) The influence to SOD and LPO of diabetic rat caused by soyasaponin and ginsenosides from stems and leaves saponins. *J Norman Bethune Univ Med Sci* 19(2):122–123
- Buccellato LJ, Tsa M, Akinci OI et al (2004) Reactive oxygen species are required hyperoxia-induced bax activation and cell death in alveolar epithelial cells. *J Biochem* 278(8):6753–6760
- Distelhorst CW, Shore GC (2004) Bcl-2 and calcium: controversy beneath the surface. *Oncog* 23(16):2875–2880
- Li M, Cai JF, Chiu JF (2002) Arsenic induces oxidative stress and activates stress gene expressions in cultured lung epithelial cells. *J Cell Biochem* 87(1):29–38
- Sun JSH, Lu FJ, Huang WCH et al (1999) Antioxidant status following acute ischemia limb injury: a rabbit model. *Free Radic Res* 31(1):9–12
- Wanjun L, Shengxi C, Jiaxin H et al (1999) The influence of lipid peroxidation caused by reperfusion lung injury on ischemic preconditioning. *Chin J Pathophysiol* 15(8):27–29
- Rieux-Laucat F, Le Deist F, Hovroz C et al (1995) Mutations in fas associated with human lymphoproliferative active syndrome and autoimmunity. *Sci* 268:1347–1349



# Chapter 42

## Study of Electre II Multiple Attribute Decision-Making Method in Construction Project Management Mode Selection

Jingzhong Ma and Yuxin Liang

**Abstract** Construction project management mode selection are more complex multi-attribute decision-making problems, it has very high demand to the application of multiple attribute decision-making method. Electre II of multi-attribute decision-making method takes into account the cognitive characteristics of people in decision-making, constructed two preference relations that strong is better than weak, the whole sort of multi-attribute decision-making program, which has great application value. This chapter analyzes the basic problem of the construction project management mode selection, and pointed out that the nature of the problem of multi-attribute decision-making, and give basic steps about the application of Electre II method.

**Keywords** Construction project management mode • Multiple attribute decision-making • Electre II • Decision scheme of total ordering

### 42.1 Introduction

In the modern decision activity, multiple attribute decision-making problems is the actual with most of the decision-making problems. Because in decision-making, must consider at the same time satisfy the more goals (rule) requirement, and between multiple targets and restrict each other, often contradictory, this makes the multi-objective decision problem become more complicated. The goal of the construction project management is usually composed by the cost quality security and progress, there are complex relationships between each of the target. Therefore, construction project management model decision-making is more

---

J. Ma (✉)  
Tangshan College, Tangshan 063000, Hebei, China  
e-mail: majingzhong11@163.com

Y. Liang  
Hebei United University, Tangshan 063000, Hebei, China

complex multi-attribute decision-making problems, it has very high demands to the application of the multi-attribute decision-making.

The traditional multiple attribute decision-making method has simple weighting method, multiple attribute value function method and close to ideal point, the Analytic Hierarchy Process (AHP) and Electre decision-making methods developed since the 1970s. AHP method is particularly suited to the hierarchical structure of decision-making problems, mature and widely applied in practice, Professor Salty taking into account the relationship between the layers goal to develop into the ANP network analysis. Compared with other decision method, Electre method is able to fit selection, order and group and so on the different decision the goal request, consider people decision-making cognitive characteristics, suitable for true attribute and pseudo attributes, etc. Various kinds of decision-making preferences relationship, not necessarily rely on determining weight, for sensitivity analysis etc., and has great application value. This chapter analyzes the construction project management target relationship, put forward the construction project management mode decision Electre II method used in the basic step.

## **42.2 Literature Review**

### ***42.2.1 Multi-Objective Decision-Making Method of Construction Projects***

Management of construction projects was founded since the 1960s, and matured gradually, After the 1990s, a variety of advanced decision-making methods start introduced, the characteristics of technical specialization more distinctive, such as Tam et al. [1] built the safety management index system of construction projects, put the non-structural fuzzy decision method used in the evaluation of the safety management of construction projects. Nang-Fei Pan [2] Fuzzy Analytic Hierarchy Process bridge construction program selection and evaluation.

The Baniyas et al. [3] built a decisions of evaluation index system about the location of garbage disposal plant, and adopt the Electre III multi-objective decision-making methods to systematic reviews.

Marques et al. [4] proposed a multi-objective decision-making method. which based on KPI's system analysis and evaluation for the mission, goals, policy makers characteristics and competitive. Fully visible, a variety of multi-attribute decision-making methods has begun to gradually introduce to the field of construction project management in recent years.

### ***42.2.2 The Electre Multi-Attribute Decision-Making Method***

Electre method (Elimination et Choice Translating Reality) belongs to decision-making methods which the level not inferior to the relationship (Outranking

**Table 42.1** Decision support of Electre decision-making methods

Classification of decision problem	Purposes of decision support	Decision-making method
Select	Elect a more satisfactory solution in the waiting program	Electre I, IS
Grouping	Grouping the program whereas doesn't order	Electre TRI
Sorting	Sort of program	Electre II, III, IV

Relation), The method has created a new ideology of decision-making. Consider the preferred incomparability and weak preference relation is the most typical feature result in the level not inferior to the relationship. After that proposed the expansion model of Electre II, Parts III, IV, IS and TRI, etc. The applications of the various decision-making models are shown in Table 42.1.

The application purpose of Electre Act II is to identify the program's total sorting, It provides a strong level not inferior to the relationship and the weak level not inferior to the relationship, Duckstein and Gershon [5] built a system of vegetation management evaluation, and use the Electre II method carried out the systematic evaluation, Hokkanen et al. [6] applied Electre II to the decision-making of solid waste management.

Overall, Electre II method is a sorting-wide decision-making which balanced strong level not inferior to the relationship and the weak level not inferior to the relationship, it isn't seen on the application of this method in construction project management of the existing studies, It's use space is also worthwhile to continue exploring.

### 42.3 Mode Selection and Evaluation of Construction Project Management

One of the development trend of the construction project management is the diversification of management control objectives, From the traditional three control of the schedule, quality and cost transition to the coordinated control of the schedule, cost, quality, safety gradually, There is both Contradictory aspects and unified in these control objectives, They must be used as an organic system to carried out the overall control.

The management model of construction project mainly include Design-Bid-Build Method, Construction Management Approach CM, Design Build Method, Design-Manage Method, Management Contracting Method and Novation Contract, NC ect. There are certain advantages and disadvantages of various management models.

Based on the above analysis, we can regard safety, quality, function, schedule and cost as the evaluating properties of management objectives, a variety of project management model as a viable program, Build a multi-attribute

decision-making model, Adapt Electre II method for mode selection decisions of construction project management.

### 42.4 The Implementation Steps of the Electre II Model

In this study, Electre II is introduced into construction project management decision. Implementation of the method does not need a comprehensive (omitted worst scheme) process, the main implementation steps are as follows:

1. Policy makers raised questions, then analysis the questions whether multiple attribute decision-making or not.
2. To determine the decision attribute, build decision-making evaluation index system.
3. To develop and implement scheme.
4. To selection of information, and give attribute information and the attribute information of the relationships of the program.
5. In view decision problems of m scheme, n decision attribute, constructing decision matrix  $X$ , and standardization of decision matrix for.  $R = [r_{ij}]$ ,  $r_{ij} = X_{ij} / \sqrt{\sum_{i=1}^m X_{ij}^2}$ .
6. Structuring a weighted norm of matrix

$$V = [v_{ij}], V = R \cdot W \begin{bmatrix} w_1 r_{11} & \cdots & w_n r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \cdots & w_n r_{mn} \end{bmatrix}, \text{ in, which } W = \begin{bmatrix} w_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & w_n \end{bmatrix}$$

7. Determining attribute consistent and inconsistent sets.

For any pair of solution a and b, attribute set is divided into consistent set Cab and inconsistent set Dab = [j/x a j < x b j] = J-Cab. Consistent set Cab is attribute set which is not inferior to plan b and its complement is incongruent set Dab.

8. Calculating consistency index matrix C.

Consistency index C (a, b) is the sum of all the advantages of the attribute weight, and is the degree of all reflect decision support scheme which is not inferior to b.

9. Calculating inconsistency index matrix D.

Inconsistent index d (a, b) said the degree of no satisfaction to selection scheme a, comparing to b.

10. Establishment of the preference relation matrix.

$$d(a, b) = \frac{\max_{j \in D_{ab}} |V_{aj} - V_{bj}|}{\max_{j \in J, s, t \in I} |V_{sj} - V_{tj}|} \tag{42.1}$$

First identified two sort of relation between the critical value,  $C^*$ ,  $D^*$  is critical value of strong relationship SF,  $C^-$ ,  $D^-$  is critical value of weak relationship Sf. The two ranking critical value of meet  $C^* > C^-$ ,  $D^* < D^-$ .

The strong relationship between a SFb meet:  $c(a, b) \geq C \times d(a, b) \leq D^*$  and  $c(a, b) \geq c(b, a)$

Weak relationship between a Sfb meet:  $c(a, b) \geq C^-$  and  $d(a, b) \leq C^-$  and  $c(a, b) \geq c(b, a)$ .

#### 11. In descending order.

The concrete steps: (1) Definition a set A for all project set; (2) Defines a set F contains all schemes which are worse than other; (3) Defines a set F' as the scheme sets which are better than other in set F; (4) Selecting F', and eliminating F' from A. Repeating the steps (2)–(4) to remaining scheme, until all scheme was selected, classification, formation in descending order.

#### 12. In ascending order

The concrete steps: (1) Definition a set A for all project set; (2) Defines a set G contains all schemes which are worse than other; (3) Defines a set G' as the scheme sets which are better than other in set G; (4) Selecting G', and eliminating G' from A. Repeating the steps (2)–(4) to remaining scheme, until all scheme was selected, classification, formation in descending order.

#### 13. Comprehensive ranking.

With the cross synthesis method, build the final ordering relation. Comprehensive ranking principle: (1) If scheme is better than scheme b in the two sort program, it remain preference relation in the comprehensive ranking (2) If scheme a is better than scheme b in a sort program, and the same in another sort program, then scheme a is better than scheme b in comprehensive ranking, (3) If scheme a is better than scheme b in a sort program, but worse in another sort program, then scheme a is not comparable to scheme b in comprehensive ranking.

## 42.5 Conclusion

Electre II methods considering the cognitive features of human decision-making, structure the two preference relation, achieve full ranking of the multiple attribute decision-making scheme, and has great application value. This chapter analyzes basic problems of construction project management mode selection, and put forward the basic steps of the application of Electre II in the construction project management mode select.

## References

1. Tam CM, Thomas KLT, Chiu CW, Ivan WHF (2002) Non-structural fuzzy decision support system for evaluation of construction safety management system. *Int J Project Manage* 20(4):303–313
2. Pan N-F (2008) Fuzzy AHP approach for selecting the suitable bridge construction method. *Autom Constr* 17(8):958–965

3. Baniass G, Achillas C, Christos V, Moussiopoulos N, Tarsenis S (2010) Assessing multiple criteria for the optimal location of a construction and demolition waste management facility. *Build Environ* 45(10):2317–2326
4. Marques G, Gourc D, Laurus M (2011) Multi-criteria performance analysis for decision-making in project management. *Int J Project Manage* 29(8):1057–1069
5. Duckstein L, Gershon M (1983) Multicriterion analysis of a vegetation management problem using Electre II. *Appl Math Model* 7(4):254–261
6. Hokkanen J, Salminen P, Rossi E, Ettala M (1995) The choice of a solid waste management system using the Electre II decision-aid method. *Waste Manage Res* 13(2):175–191

# Chapter 43

## Marketing Strategy Analyse Based on 4P Theories

**Xu-Chao Song and Jian-Zhong Cui**

**Abstract** To meet people's increasing material and culture demands day by day, state and business hold various of festival activities continuously. Along with beer consume quantity enlarging year by year and consumer hobby degree enhancing, in 2011, Beijing held The first Beijing international beer festival. This paper considers beer festival as a kind of experience marketing activity, according to traditional 4 P marketing theories, analyses the product strategy, price strategy, place strategy and promotion strategy of the Beijing international beer festival, and carried on an initial study about the related problems.

**Keywords** The beer festival • Marketing strategy • Analyse

### 43.1 4 P Marketing Strategic and Basic Theories

#### 43.1.1 4 P Marketing Theories Outline

Jerome McCarthy first summarized at his Basic Marketing in 1960 that the marketing stuff of business was the constituent of four basic factors, namely famous "4 P" theories. Product, Price, Place, Promotion, all the English word heads of these four phrases is P, So the theories name is "4 P" theories. In 1967, Philip Kotler ulteriorly notarized this marketing mix method which took 4 P theories as Core in his best-seller book Analysis, planning and control (version 1).

#### 43.1.2 4 P Marketing Theories Develop History

The first stage, before 30s in 20th century, the research was carried out in the angle of enterprise marketing functions [1]. Arch Shaw submitted the thought of functions

---

X.-C. Song (✉) · J.-Z. Cui  
Qingong College, Hebei United University, Tangshan 063000, Hebei, China  
e-mail: 1714064990@qq.com

in *Quarterly Journal of Economics* first time in 1912, he attributed the middleman's function in sales activities to five aspects: the risk share; commodity transshipment; Fund raising [2, 3]; Communicate and sell; Assemble, classification and transshipment. Wakefield also carried on a research to marketing functions in 1917, he proposed: assemble, storage, the risk assume, rearrange, sell and transport etc. Before 1935, Franklin Ryan had written to point out 52 kinds of different marketing functions.

Second stage, the research was carried out in the angle of the marketing mix strategy [4, 5]. Neil Borden submitted "marketing mix strategy" in 1950, he attributed the marketing activities to 12 aspects, included: product, brand, baling, pricing, investigation analysis, distribution channel, personal selling, advertisement, sale promotion, the store show, after service and logistical etc.; and then Foley attributed these factors to "the basic factors" about provide content and "the tool factors" about sales activities, after that some marketing scholars put forward the marketing strategy different combinations. Until 1960, Jerome McCarthy submitted famous "4 P" marketing theories.

### ***43.1.3 How 4 P Theories Put Forward and the Relationship with 4 C Theories***

Lautrang proposed new points in Advertising Age top in 1990, corresponded to the traditional 4 P: "4 C theories of Marketing". He emphasized customer satisfaction should be the first place pursuit by business, the product must satisfy shopper's requirement and reduce cost at the same time, Products and services should fully consider the purchasing power of the customer in research, and pay full attention to the convenience in customers shopping process, Finally business should implement the effective marketing communication taking consumers as the center. The 4 C theories are: Customer's needs and wants; Cost and Value to satisfy consumer's needs and wants; Convenience to buy; Communication with consumer.

After 4 C theories submitted, some scholars thought that 4 P theories should be replaced with 4 C. But many scholars still considered that 4 C just further defined the basic premise of enterprise marketing strategy and the guiding principle, From the operation, people must operate through the 4 P as a representative of the marketing activities. So 4 C just deepened 4 P, and cannot replaced 4 P. So far, 4 P are still the simplest and direct theories to clearly annotation the marketing mix strategy.

Table 43.1 shows the relationship between 4 P and 4 C.

### ***43.1.4 The Connotation of 4 P Marketing Theories***

4 P marketing theories actually research the market marketing problems from the Angle of management decisions. 4 P think that the various factors influence



**Table 43.1** The relationship between 4 P and 4 C

4 P		4 C		
Concrete import	Product	Service scope, stipulation, service product positioning and service brand, etc.	Customer	Study the customer's desire for needs, and provide correspond product or service
	Price	Basic price, payment way, a discount or commission, etc.	Cost	Considering the price that the client would like to pay, and how much is the cost
	Place	Direct channel and indirect channel	Convenience	Make the client enjoy facilitation brought by third-party logistic
	Promotion	Advertisement, the personnel promote, business promotion and public relation, etc.	Communication	Communicate with client actively, look for the approbation feeling about a win-win
Time	20th century	The mid 60s (McCarthy)	20th century	The early part of 90s (Lautrang)

enterprise marketing activities (variable) can be classified into two categories: One is the enterprise uncontrollable factors, that is not the marketers themselves can control: marketing environment, including the microcosmic environment and the macro environment; the other is controllable factor, that is, marketers can control, for example, product, trademark, brand, price, advertising, channel, and so on, and 4 P are induction about all sorts of controlled factor:

Product strategic, mainly means that business achieves its marketing target by providing consumer all kinds of tangible and intangible product for the target market, including controllable factors combination and use, such as product variety, style, specification, quality, packaging, characteristic, trademark, brand and various service related with the same product.

Price strategic, mainly means that the business achieves the marketing goal by establishing and changing the price in accordance with market rules, including the basic price, discount price, allowances, terms of payment and commercial credit and various pricing methods and pricing skills controllable factors.

Place strategy, mainly means business achieves its marketing goal by selecting reasonable distribution channels and organizing the product circulation, including the channels of distribution coverage, commodity circulation link, middleman, outlets setting and storage transportation.

Promotion strategy, mainly means business achieve marketing goal by using all kinds of information communicating means to boost consumer purchasing desire to promote the product sales, including advertising, marketing, business promotion, public relations (PR), etc.

## **43.2 2011 The First Beijing International Beer Festival Marketing Strategy**

The first Beijing international beer festival was the key contracted project in Beijing tourism industry project recommend meeting, was 2011 Beijing municipal key tourism project, also was the Chaoyang district government supported and promoted key project. The purpose of the beer festival was to promote the cultural exchange between China and Germany, flourishing Beijing modern agriculture, promoting Beijing tourism industry development, at the same time, it was an examine to test whether XieDao Beijing Group experience marketing strategy succeeded or not. This paper tries to start from traditional marketing strategy of 4 P theories, analysis the marketing strategy of 2011 the first Beijing international beer festival One by one.

### ***43.2.1 Festival Product Strategy (Product)***

The product strategy is the base of 4 P theories, embodies the value of consumer spending. Marketing's original purpose is to improve the influence of products and marketing department through a series of measures, sell more products, drive additional worth of the products. The products of the first Beijing international beer festival were divided into main products-beer, the catering and dining theme service, etc. Organizers, XieDao group President-FuXiuPing said: The first Beijing international beer festival had three core characteristic: Pure German beer brewing now, authentic traditional German food, the original Bavarian amorous feelings.

#### **43.2.1.1 About Beer Product Strategy**

The main products in the first Beijing international beer festival were pure German beer brewing now. This was different from the product strategy of the other cities the beer festival held. Such as Qingdao, Harbin where launched the local brands of beer, Dalian and other cities launched the famous domestic brands of beer. Beijing international beer festival built eight covers an area of 10,000 square meters of beer canopy, introduced special beer production line from Germany, all used Germany authentic formula and technology, could brew 150 tons beer every day,

could hold 100,000 people to drink. Tourists could see the beer production process standing behind the transparent glass wall. And each canopy produced one variety, so consumer could fully experience pure German beer.

#### **43.2.1.2 About Catering Product Strategy**

Another different from the other cities, which provided barbecue, seafood, peanuts soybean, characteristic starch only in the beer festival, was the Beijing international beer festival catering strategy was only provided authentic traditional German food, such as 8 doughnut, livestock, characteristic dessert, etc. The highlight of the propaganda was: although food is simple, but authentic taste pure. A shed had a main course, roast chicken, roast pigs, grilled fish, grilled beef, a shed a characteristic, visitor chose his own like to eat, reflected pure German food culture.

#### **43.2.1.3 About Holiday Theme Strategy**

The theme strategy of Beijing beer festival was propaganda Bavarian amorous feelings, let consumers experience oktoberfest beer festival atmosphere in Beijing. In order to fully reflect the theme, supposedly, in addition to build and decorate eight Bavarian national style glass beer awning, in beer festival, the organizers still employed eight European style of acting teams, 500 blond German wine ladies, newly built 17 large carnival rides, and specially absorbing service team was the German wine ladies. The alleged the wine ladies were not only beautiful, but also capable, each wine lady could carry 4,000 drafts beer every day, with her hands could carry four drafts beer above six drafts, take 10 drafts beer from the bar to the guest table every time. Some wine ladies could also put 15 bowls of rice, their working enthusiasm were very high. Moreover, hearing music they would dance, seeing the guests would dance with guests, then they could develop friendly relations with guest quickly, and make the guests relax.

### ***43.2.2 Festival Price Strategy (Price)***

Price strategy is an important content of the 4 P theories, reflects the consumer costs. Whether the price strategy is reasonable will directly affect Whether the product marketing success or not.

#### **43.2.2.1 About Pricing Ideas**

The slogan of the Beijing international beer festival wais: “move the oktoberfest in Munich, Germany to Beijing”, tried to achieve the results that people could experience

a German beer carnival in Beijing. Therefore, the price strategy was adopted on high quality, a high price, due consideration to local consumption concepts.

#### **43.2.2.2 About Comprehensive Pricing Strategy**

According to the pricing ideas, the comprehensive pricing strategy was: strive to the beer and catering has pure taste, food quality achieves high level, the price also reached a high level. At the same time, provide consumers some high value-added services. Such as German-styled dining environment, the German wine ladies characteristic service, live music accompaniment, free parking, free ticket, 20 point-to-point free bus line etc.

#### **43.2.2.3 The Price of Specific Products**

Each German draft beer brewing now was 60 yuan, the German catering and staple food was 50 yuan. The rest of the food, accommodation, amusement project prices referred to other Beijing festival consumption price.

### ***43.2.3 Festival Site Strategy (Place)***

Site strategy (Place) embodies the convenience level for consumer, and will directly affect the marketing effect, also it is one of the important factors of 4 P theories.

#### **43.2.3.1 The Site Selection and Marketing**

The organizers of the beer festival was XieDao group, and the place held beer festival is in XieDao Holiday Eco-farm that located in the northeast of Chaoyang district, near the Capital Airport side road, Jinzhan village. The whole resort covers an area of 3,300 mu, a “former store backyard” type of management pattern. Home area was in the resort, a total area of 270,000 m<sup>2</sup>. The site was so open and independent that it was suitable for beer festival held and unified management. Relying on the beer festival, the awareness of XieDao group and XieDao travel resort enhanced greatly.

#### **43.2.3.2 Supporting Facilities, Service and Marketing**

In view of the actual situation of the site, the organizers formulated the facilities and service strategy. Mainly included the amorous feelings dance, the theme

performance; the entertainment carnival outside; commodity sales pavilion, medical center, security operation command center, free items custody, ATM, park broadcasting system and foreign language service window, specially, provides 20 free bus and driving assistance after drinking. In a word, it provided comprehensive service for consumers.

### ***43.2.4 Festival Promotion Strategy (Promotion)***

Promotion strategy (Promotion) refers to the sales channel and the way, a marketing behavior effectively communicate with consumer. Promotion strategy will directly affect the product marketing result.

#### **43.2.4.1 About the Public Relations Strategy**

The organizers Launched many publicity before and after the beer festival. Such as they propagandized that the beer festival was sponsored by Chinese People's Association for Friendship with Foreign Countries, and the city, district leaders inspected the work, made the beer festival has strong official color, greatly improved the reliability and consumers participation enthusiasm; As another example, the beer festival was undertaken by Beijing XieDao Group and German Schottenhamel company, there were both local enterprise and foreign enterprise, and have great of match of Chinese and western effect. Moreover, The organizers publicize energetically the pure German Munich "pedigree", 100,000 people carnival, 800 million yuan exclusive investment, green ecological ingredients and so on, all these PR strategy powerful boosted the beer festival.

#### **43.2.4.2 About Channel Strategy**

The organizers implemented all-round marketing strategy in Beijing beer festival. Whether the media or the report and consumers's by word of mouth were all comprehensively launched. China Daily, PRC, Beijing evening news, capital times, each big network media and the TV news media reported on a large scale. Tried best to create pure, natural and hot Bavarian amorous feelings and grand, carnival, joyful festival atmosphere which attracted a lot of Beijing Residents and other Chinese and foreign tourists.

#### **43.2.4.3 About Staff Promotion Strategy**

The organizers, XieDao group, propagandaed the beer festival was exclusive investment, no subcontract lease. This was a very unique festival marketing

strategy, was clearly different with other cities beer festivals. All goods were unified pricing and settlement also promoted the whole class of the international the beer. And a highlight was the manner of personnel promotion adopted completely the mode of oktoberfest in Munich, Germany. Salesman, waiter, wine lady are sale terminal. In beer sales link, 500 blond German wine ladies provided service for consumers directly, the wine ladies daily bought beer and food tokens with lower than the amount of selling price in the cashier system, guests would directly buy beer or dishes from wine ladies, the price difference was the wine ladies or services salaries, this strategy not only avoided the cashier system confusion, but also boosted sales performance.

#### **43.2.4.4 About Business Promotion Strategy**

In order to improve the awareness of the beer festival and ensure success, the organizers had a lot of business promotion activities. Such as they held photography contest named “together Beijing, Cheers XieDao” first Beijing international beer festival, held beer contest each day during beer festival, invited the Tang Dynasty Band and the western European style performing arts team for live dance performance, invited singer SuoNanZha XiYing to create the theme song “XieDao cheers”, provided 20 free bus and driving assistance after drinking, equipped with Europe type cabin and camping tent, and so on. These strategies made Beijing beer festival a popularity.

### **43.3 The Main Problems of the Marketing Strategy in the First Beijing International Beer Festival**

#### ***43.3.1 The Gaps Between the Marketing Strategy Positioning and National Traditional Consumer Psychology***

In China, it was the first time to entirely replant oktoberfest beer festival. Beijing relevant departments and enterprises made helpful attempts. But compare with the traditional Chinese festivals marketing methods and consumption content, the marketing strategy unfit to Chinese national conditions. To our consumers, beer must be fresh, food must be delicious. During the hot summer, drinking to one’s heart’s contenting with a few good friends in lively stall, eating peanuts, soybean and cucumber, there are mutton strings stall, tofu, baked seafood and steamed bread, If possible people can enjoy the sea breeze, look at the rising fireworks by the sea... This is the ideal beer festival. Qingdao, Dalian and Harbin where the beer festival lasts long, take the ordinary consumers consumption psychology. Although Beijing beer festival was very characteristic, but the variety of beer did not so conform to the mass consumer tastes, and the catering was simple, in eight hall provided only one

brand beer and staple food every hall, Just imagine, who was willing to change eight somewhere to eat? It was impossible that the consumer drank to his heart's contenting like in the lively stall, what most people could do was just feeling the German amorous feelings, tasting the German-style food only.

### ***43.3.2 The Gap Between Product Pricing and Consumers' Psychological Price***

To ordinary consumer, the price of beer has been very stable. Such as the draft beer is a few yuan a sheaf, according to brand, bottled beer is Up to 10 yuan, the best better draft beers also in 20 yuan. And different from liquor, With the purpose of care-free, Quantity unit of drinking beer is the sheaf, bottle, not liang (50 g), moreover. Staple food must be delicious, what the people pay more attention to was the taste, not the price and pure. The Beijing beer festival provided Germany now making draft beers, each sheaf 60 yuan, and 50 yuan each single staple food. By contrast, although the level of Beijing beer festival was higher than other beer festival, but there was a gap between cost performance and consumer's psychology anticipated. So most consumer just had a tasting experiences, the repeat guests were not much.

### ***43.3.3 The Different in Site Selection with Beijing Traditional Festival Custom***

As the ancient capital of the Six Dynasties, Beijing has many folk festivals, and formed unique festival culture. People's festival consumption psychology and spending habits has been come into being. For instance, they are willing to listen folk art on overpasses, watch the play at Chang'an Grand Theater, go to the temple of heaven and DiTan Temple Fair, and so on. After work people prefer "to busy place to join in the fun." The site of Beijing beer festival was XieDao green ecological resort, that located in the northeast of Beijing outside 5th Ring Road, the position was remote. Although the organizers opened 20 point-to-point free bus line, set up 5,800 parking lot, but Beijing city is so sweeping that brings consumer inconvenience. So in addition to the weekend, people preferred to be on some other recreational activities.

## **43.4 Countermeasure and Suggestion**

Holding beer festival is an important experience marketing way, it can not only improve the awareness of merchants and products, but also enrich the national amateur life. The article holds that the organizers should improve from the

following three respects in order to make the Beijing international beer festival hold more successfully in the future.

#### ***43.4.1 Inrich Product Marketing Varieties***

Change product strategy that all implanted oktoberfest beer festival, and improve for Chinese consumer habits. According to the different consumer groups, implement different product marketing strategy. For instance, set up two German high-grade beer experience area, according to the oktoberfest beer festival operation idea, provide consumers with high-end consumer experience environment. For most consumers, set up the Chinese consumer area. Provide various kinds of domestic beer and Chinese food, operate and supervise according to the Chinese traditional consumption concept. Or by the famous beer brand respectively division, such as points German beer area, Qingdao beer area, Yanjing beer area, Snow beer area, every area provides local characteristic beer and food, operate and supervise respectively. So it can reflect the characteristic and level, also it can let the Beijing residents, Chinese and foreign tourists experience the customs and fun better. As for the merchant, they will achieve their purpose attending beer festival.

#### ***43.4.2 Take the Grading Pricing Strategy***

According to the different consumer groups and consumption psychology, the goods should be priced separately. For instance, in pure German beer amorous feelings experience area, the level of service can be higher, the product quality can be more pure, the price also can be adjusted higher. And for the situation of Chinese style area, the product should be abundant, and the price should be moderate. This is the most suitable price strategy. Even can adopt low-cost sales, raflesales of the prize to bring true happiness and benefits to consumers.

#### ***43.4.3 Take Measures to Weaken Site Disadvantage***

According to the site disadvantage of Beijing international beer festival, the organizers may take all kinds of other measures. First, they may provide more convenient transportation service, such as rich free bus line, reimburse a certain amount of expense or limited mileage costs, a consumer integrating system, etc.; the second, they may adopt a elastic price, that is, implement different price on holidays and working days to attract more customers. Such as Monday to Thursday, take discounted strategy, weekend and holiday return the original price, etc.; the third, take advantage of XieDao unique resource to attract more customers. Such as



during beer festival carry out activities of coupons, and the coupons can be use in XieDao resort after beer festival, this can also gather part popularity.

### 43.5 Conclusion

In recent years, the marketing practice activities payed more attention to create fine feeling, promote the customers delivered value to achieve marketing purpose. In some particular industries like tourism, catering, entertainment, theory and practice blend mutually and promote mutually in the experience marketing. Beijing international beer festival was an example of Combining marketing theory with practice. But, due to the different of national economic development level and consumer consumption psychology, There is still a certain gap between completely copying western marketing strategy and our national conditions. So when we organize experience marketing activities in festival, if we formulate more carefully and practically marketing strategy, the results will be better.

### References

1. E.McCarthy of Jerome (1960) Basic marketing
2. Kotler P (1967) Analysis, planning and control, version 1
3. Lautrang (1990) Advertising age
4. Information on <http://news.xinhuanet.com>
5. Information on <http://www.6eat.com>

# Chapter 44

## Distribution of Mn, Pb and Zn Microelements in Agricultural Soil

Ming Hu

**Abstract** Weinan area collecting Agricultural soil samples, using laboratory analysis methods, systematic study the contents and spatial distribution characteristics of manganese, Pb and zinc in soil of the Weinan region. Weinan average soil manganese content is 412.41 ppm. From the Northeast to the Midwest or from the Southeast to the Midwest, the content of manganese in Weinan soil showed increasing trend; Weinan average content of Pb in soil is around 59.24 ppm, distribution of the southeastern is the highest content of the Ministry of counties, Tongguan County average content of Pb in soil is up to 110 ppm; from the south-east of Tongguan, Huaxian reduced to other counties. Soil contents of zinc in Weinan change little in both counties around 50 ppm.

**Keywords** Weinan • Agricultural soil • Microelements

### 44.1 Regional Situation

Weinan city between east longitude 108°50'–110°38' and latitude 34°13'–35°52', is located in the east of weihe river [1]. North and south long, 182.3 km, things wide and 149.7 km, is located in the warm temperate zone semi-humid semi-arid climates, natural conditions and transitional characteristics of multi-types, each region into soil factors become complicated [2]. The actual farming land area of 608982.4 hm<sup>2</sup>, accounted for 48.51 % of the area of the soil.

---

M. Hu (✉)  
Weinan Teachers University, Weinan, China  
e-mail: hm5109@163.com

## 44.2 Research Methods

### 44.2.1 Sampling Principle

Sampling is agricultural soil.

It is six county, each county all has 20 sampling points.

To the surface soil sampling depth to 40 cm.

Sampling time for September 2010.

### 44.2.2 Sample Measuring Instruments and the Processing Method

Measuring instrument: AS-4,000.

Instrument technology index: test the strength of light source, 10–40 kV, 10–50 uA.

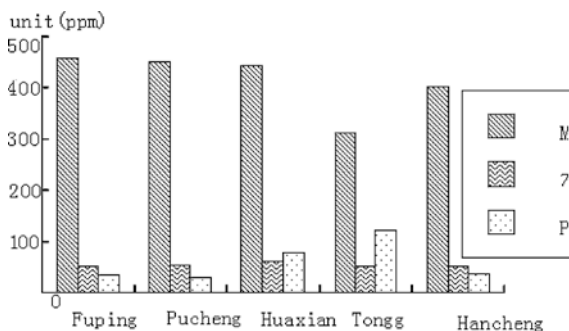
Detector working temperature range: –10–50 °C.

## 44.3 Results and the Analysis

### 44.3.1 Weinan Soil Mn Distribution and Characteristics

The average content of Mn in the earth's crust is about 900–1,000 ppm, while China's soil Mn are all lower than the world average [3]. China Zhejiang red soil manganese for 5.6–260 ppm, northeast of China and Inner Mongolia soil types of forest soil brown upper soil Mn content in the most for 840 ppm. FuPing county soil content Mn an average of 456.85 ppm, a maximum of 644 ppm, the minimum 302 ppm; Pucheng county soil content Mn an average of 450.9 ppm, a maximum of 510 ppm, the minimum 353 ppm; Huaxian county soil content Mn an average of 442 ppm, a maximum of 557 ppm, the minimum 265 ppm; Tongguan county soil content Mn an average of 310.3 ppm, a maximum of 387 ppm, the minimum 231 ppm; Hancheng county soil content Mn lower an average of 402 ppm, a maximum of 591 ppm. Therefore, in Weinan soil Mn content in the midwest is roughly Weinan close to 450 ppm, and low in the east and south. Weinan area northeast to the midwest or soil Mn from southeast to the increasing trend in the Midwest. As shown in Fig. 44.1 (Table 44.1).

**Fig. 44.1** The distribution of Mn, Pb and Zn in the soil of Weinan



### 44.3.2 Weinan Soil Pb Distribution and Characteristics

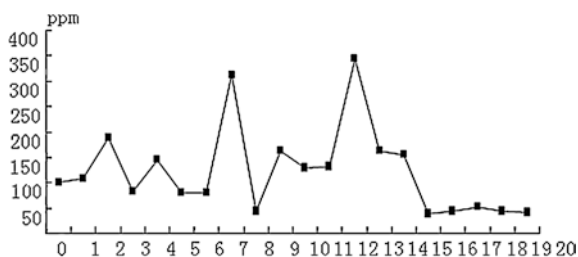
Fuping county soil content Pb lower an average of 34.57 ppm, a maximum of 51 ppm; Pucheng county soil content Pb lower an average of 26.65 ppm, a maximum of 36 ppm, the minimum 17 ppm; Huaxian county soil content Pb an average of 77.1 ppm, a maximum of 221 ppm; Tongguan county soil content Pb an average of 122.1 ppm, a maximum of 343 ppm, the minimum 38 ppm; Hancheng county soil content Pb lower an average of 36.45 ppm. The world is concerned, different types of found in soil lead Pb from trace to 1,200 ppm, on average, average 15–25 ppm [4, 5], in comparison, most of the counties in Weinan soil lead is higher than the world average. In the temperate zone and colder climates in the content of soil lead often higher than average, Weinan and area is under the warm temperate zone, then most areas of higher than the world average soil lead is reasonable. But the changes of soil of the lead in the county average content reaches as high as 110 ppm, the region should pay attention to high levels of lead because the soil, and plant on the harmful material enrichment amplification and endanger the human and livestock production safety or food [6–8], such as shown in Table 44.2. In Weinan soil lead distribution rule of southeastern is highest in counties; from the southeast to the other HuaXian tongguan, reduce the counties (Fig. 44.2).

**Table 44.1** The content of manganese plumbum and zinc in soil of Weinan

Element site	Mn (ppm)	Zn (ppm)	Pb (ppm)
Fuping	456.85	49.00	34.00
Pucheng	450.90	50.95	26.65
Huaxian	442.00	59.40	77.00
Tongguan	310.30	48.80	122.10
Hancheng	402.00	48.75	36.45
Average	412.41	51.38	59.24

**Table 44.2** The contents of plumbum in the soil of Tongguan county

Serial number	Longitude	Latitude	Pb	
			ppm	±
1	110°13'658"	34°31'844"	101	12
2	110°13'703"	34°31'839"	109	9
3	110°13'655"	34°31'889"	188	12
4	110°21'615"	34°34'996"	83	8
5	110°31'663"	34°35'487"	144	10
6	110°20'835"	34°35'601"	81	8
7	110°17'867"	34°32'480"	80	9
8	110°16'205"	34°30'055"	311	22
9	110°16'118"	34°30'063"	45	6
10	110°16'225"	34°30'160"	162	10
11	110°18'986"	34°31'687"	130	9
12	110°18'995"	34°31'694"	131	10
13	110°18'994"	34°31'713"	343	21
14	110°18'998"	34°31'710"	162	11
15	110°18'996"	34°31'739"	155	13
16	110°14'276"	34°33'645"	38	6
17	110°14'715"	34°33'570"	43	7
18	110°14'615"	34°33'937"	51	8
19	110°14'623"	34°33'937"	44	7
20	110°14'631"	34°33'936"	41	6
Average			122	10

**Fig. 44.2** The contents and distribution of plumbum in the soil of Tongguan county

### 44.3.3 Weinan Soil Zn Distribution and Characteristics

The world of soil zinc content changes a lot, its limit range from trace to 900 ppm. The average level of 50–100 ppm [9]. Fuping county soil content Zn lower an average of 49 ppm, a maximum of 61 ppm; Pucheng county soil content Zn an average of 50.95 ppm, a maximum of 67 ppm, the minimum 33 ppm; Huaxian county soil content Zn an average of 59.4 ppm, a maximum of 93 ppm, the minimum 31 ppm; Tongguan county soil content Zn an average of 48.8 ppm, a maximum of 92 ppm, the minimum 24 ppm; Hancheng county soil content Zn lower an average of 48.75 ppm. In Weinan soil of zinc content big changes in the

counties, all is 50 ppm or so. Our country is the soil zinc 3–790 ppm, an average of 100 ppm. In Weinan soil containing zinc in our country is on average less than average.

#### 44.4 Conclusion

- (1) China's soil Mn is all lower than the world average. In Weinan, manganese content for soil average 412.41 ppm, Weinan is roughly the Midwest close to 450 ppm, and low in the east and south. In Weinan soil from northeastern China manganese to the Midwest or from southeast to the increasing trend in the Midwest.
- (2) In Weinan soil lead the average contents of about 59.24 ppm, most of the counties in the soil lead are higher than the world average. In Weinan soil lead distribution rule of southeastern is highest in counties, the changes of soil of the lead in the county average content reaches as high as 110 ppm; From the southeast to the other HuaXian and tongguan, reduce the counties.
- (3) In Weinan soil of zinc content little change for all the counties around 50 ppm. Our country is the soil Zn 3–790 ppm, an average of 100 ppm. The content of zinc in Weinan, less than the average amount in soil containing zinc.

#### References

1. Xing G, Zhu JM (2003) Chemistry of rare-earth elements and soil trace element. *Sci Press* 30:160–166
2. Wang C, Shi Z, Yang J (2009) An assessment of lead content in soils and the factors influencing its accumulation in Chongqing. *J guangxi agric sci* 12:1172
3. Ao BEH, Pan TMM (1982) Trace elements in the soils. *Sci Press* 10:4–12
4. Duan Y, Zang N (2003) Distribution and affecting factors of manganese in soils of Shanxi. *J Chin J Soil Sci* 23:338–339
5. Wang Q, Cui Z, Wang G (2005) The Actuality and prospect of studies on soil manganese. *J heilongjiang bayi agric univ* 11:41–47
6. Ao Bei Er H, Pan Ta MM (1982) Trace elements in the soils. *Sci Press* 1:38–42
7. Ao Bei Er H, Pan Ta MM (1982) Trace elements in the soils. *Sci Press* 1:43–47
8. Lujun W, Enping Z (2008) The study of heavy metals distribution character in soil about lead-zinc smelt mill in Qinling J. *J Baoji Univ Arts Sci (Natural Science Edition)* 120:150–152
9. Ao Bei Er H, Pan Ta MM (1982) Trace elements in the soils. *Sci Press* 3:471–475

# Chapter 45

## Research on Economy Increasing Based on Terraced Fields Development

Ming Hu

**Abstract** The paper applies the statistical software to analyze the impact of terraced fields on the macroeconomic growth and income of residents during the past two decades (1985–2004) in Ansai County. The results show that before 1996 terraced fields developed rapidly and rose 95.57 % in one decade while the annual average growth of terraced fields is 1.5576 ten-thousand-mus. And it played an important role for local growth of agriculture economy, grain output and residents' income which had rose up to 1,126 yuan from 187.65 yuan. Because of oil production, after 1996 the economy changed greatly. In 2003 the total industrial production rose 975.4 % comparing with the one in 1995 while the oil production raised 27.65 ten-thousand-tons which had a very important role for local economy. But the construction of terrace became stable, and its impact on local economy and residents' income was relatively weaker.

**Keywords** Ansai • Water and soil conservation • Terrace

### 45.1 Preface

Terrace agriculture as change basic condition of effective measures to increase in food production and the soil and water conservation plays an irreplaceable role. Slope farmland—especially mild slope farmland reconstruction of soil erosion is to control soil erosion terraces hill, raise the food production, realizing hilly agricultural sustainable development of economy in one of the key technical measures [1]. Practice has proved, in applying for soil decertification can not only for substantially improve land utilization, the land productivity and labor productivity to create conditions, And forestry development forestry and timber and diversified management premise and foundation, it is the masses to solve poverty and hunger of the road of breakthrough [2].

---

M. Hu (✉)  
Weinan Teachers University, Weinan, China  
e-mail: hm5109@163.com

## 45.2 The Study Area General

The Ansai County of the loess plateau hinterland, located in northwestern Shaanxi province, geographical position for E108°51'44"–109°26'18", N 36°30'45"–37°19'31". Total land area for 2950.2 km<sup>2</sup>, Land various types [3].

## 45.3 The Research Method and Data

This chapter is the county economic output and per capita income Angle, using the mathematical statistic method to analyze the nearly 20 years (1985–2004) to Ansai soil and water conservation construction terrace construction and economic development the interaction relationship. The data is adopted by the objectives of shaanxi province statistics bureau, soil and water conservation bureau offers.

## 45.4 Results and the Analysis

### 45.4.1 Terrace Construction Situation Analysis in Ansai County

From 1985 to 2004, nearly 20 years of terrace construction condition is shown in Figs. 45.1 and 45.2 shows: Since the 1980s, at the national policy of strengthening agriculture and soil and water conservation work under the guidance of the positive role of macro-control, the Yellow River terraces rise of constructing new climax. Terrace construction in this period mainly divided into two stages in Ansai County, from 16.2981 million of mu to 31.8738 million of mu in 1985–1996, Growth 95.57 %, average annual increase 1.5576 million of mu.

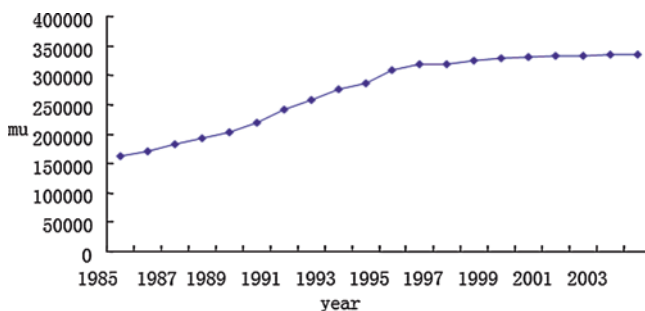


Fig. 45.1 Terrace area of variations



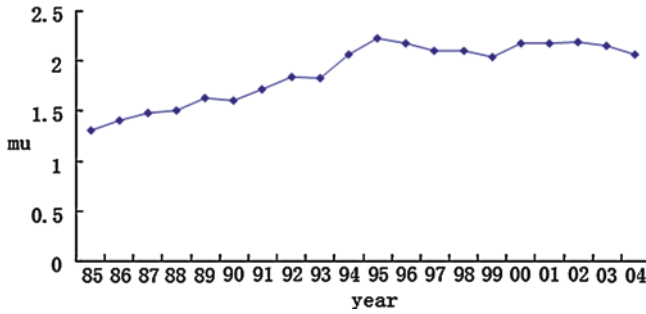


Fig. 45.2 Per capita terrace area of variations

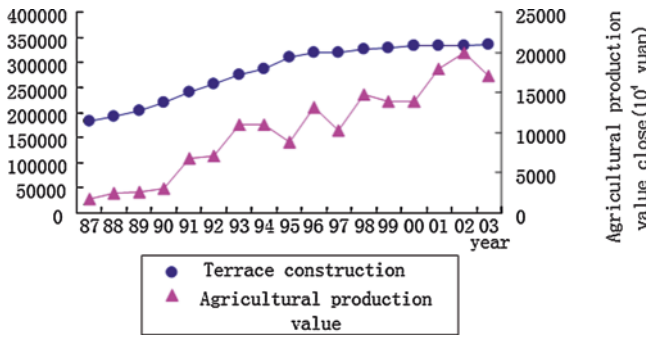


Fig. 45.3 Terrace construction and agricultural production value relation graph

From 1996 to 2004, terrace construction basic stability, 2004 terrace construction area is only 5.09 % growth than 1996, terrace area keep on 32.898 million mu around. According to the water and soil conservation plans requirements, per capita basic farmland to reach 2 mu can satisfy basically local demand for food. From the Fig. 45.2 can see, 1985 the Ansai County per capita has terrace area only to 1.3 mu, along with the development of the terrace construction, 1994 reach 2.06 mu. Within the next 10 years, the per capita terrace area basic stability in 2.1 mu around.

From the above analysis visible, the objectives of terrace construction in the mid 1990s produced a turn, before because of food shortages reasons, to build terraced, and when the per capita terraced meeting demand for food, terrace construction slowdown, be more stable.

### 45.4.2 Terrace Construction and Economic Development Relationship Anal

From the Fig. 45.3 analysis, it shows that from 1987 to 1996 period, Along with the rapid development of terrace construction, agricultural production value has

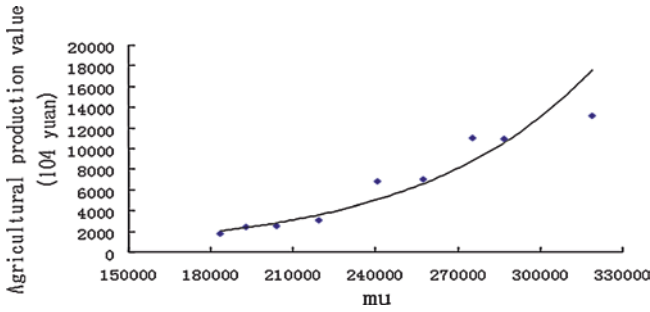


Fig. 45.4 Terrace and agricultural production value relation graph (1987–1996)

Table 45.1 Terrace-agricultural production value relation model

Model	Regression equation	r-squared figures (R <sup>2</sup> )	Significant test
	$Y = 108.71e^{2E-05x}$	0.9397	Yes

Equation scope  $X \in [183512-286708]$

also been increasing year by year, both development trends are similar. From the Fig. 45.4 can see terrace construction and the correlation between the agricultural production value. As the prevailing productivity level is not high, agricultural income mainly by the crop, thus improve cultivated land area became the dominant factors of agricultural output value. Terrace construction from 1987 to 1996 increase 73.69 %; Agricultural production value increased 11,399 yuan, growth 633.6 % (Table 45.1).

In 95–97 years the Ansai agricultural production value appear larger fluctuation, appear landslides. According to the census bureau data shows, 95–97 years the county-wide severe drought, the frost damage, three years accumulative total disaster, inundated area amounted to 189.6 thousand hectares, only 97 years for disaster economic loss of 6540 million yuan. Therefore in Fig. 45.4 in 1995 abandoned the data points so that more accurately reflect the terrace and agricultural production value of relationship curves. But since 1996, agricultural production value after the change and terrace construction and development of relations is not obvious. After 1999 agricultural production value increase gradually, but the terrace construction area is stable. Some scholars study shows that, in the 1990s, due to the use of chemical fertilizers and mechanical power of promotion, make food per has been greatly improved, and terrace construction of agricultural economic influence declined, the period of chemical fertilizer use and mechanical power become influence Ansai agricultural production value of the important factor [4].

From the Fig. 45.5 can see, from 1988 to 1996 Ansai terrace construction development trends and the per capita net income growth consistent. From the Fig. 45.6, which can be seen Ansai 88–96, terrace construction and local per capita net income

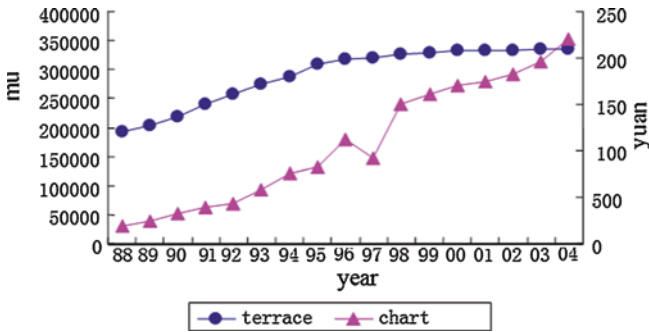


Fig. 45.5 Terrace construction and per capita income relationship chart

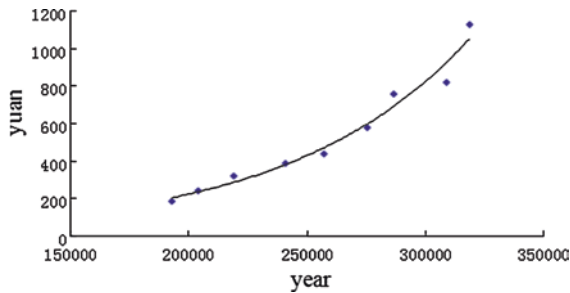


Fig. 45.6 Terrace and per capita income relationship chart (1988–1996)

Table 45.2 Terrace-per capita income relationship model

Model	Regression equation	r-squared figures (R <sup>2</sup> )	Significant test
	$Y = 16.472e^{1E-05x}$	0.9813	Yes

Equation scope  $X \in [192784-318738]$

has close relationship. Along with the increase of terrace construction, per capita net income will increase gradually. That time agricultural output value accounted for about to the county-wide economic output value of 79–85 %, according to the dominant position. And other industries, such as industry and commerce, transportation, services relatively backward. Therefore, the main source of revenue in rural residents vulnerable to farming is given priority to, and the influence on the quality of cultivated land area is bigger. Per capita net income grew 500.05 % during this period. Since 1996, Ansai terrace construction moderate growth is not obvious. But per capita income (except in 1997 outside) increase year by year, during this period, terrace construction of per capita net income of influence weakens (Table 45.2).

As shown in Fig. 45.7 showed that in 1994 years ago, engaged in industry and commerce construction labor the proportion of total workforce has been less than

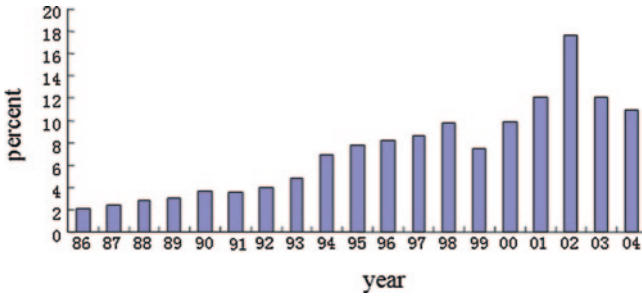


Fig. 45.7 Industry and commerce construction industry labor to total force ratio variation

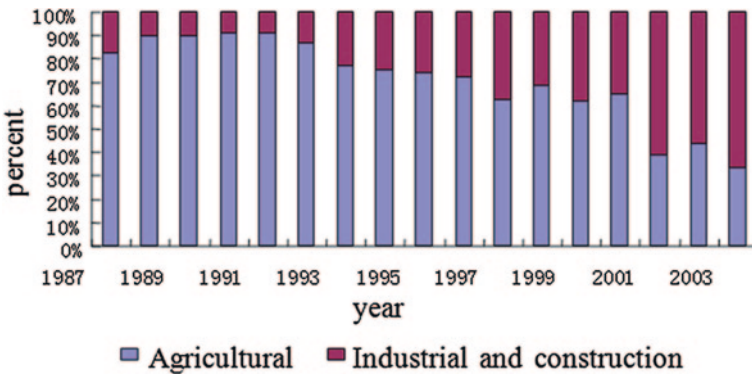


Fig. 45.8 Industrial and agricultural production value change trend chart

5 %, labor income main agriculture to give priority to, along with the industry and commerce construction industries rise (especially the rapid development of petroleum industry, 1996) after a lot of Labour gradually turn to industry and commerce building etc., make per capita income by industry and commerce building industry development influence is bigger. By Fig. 45.8 showed that Ansai economic structure in 1996 happened after the apparent change. Before 1996, Ansai agricultural production value in industrial and agricultural production value has been accounted for 70 % above, but after nearly a decade, the proportion fell rapidly to 2003, agricultural production value in industrial and agricultural production value accounts for only 33.7 %.

Therefore, 1996 later terrace construction has been basically stable, Ansai economic simulative effect reduced. But by the agricultural economy has from for the leading industries of economic patterns gradually to industry and agriculture jointly direct economic model. And, as oil such as the rapid development of industry and commerce of the objectives of promoting economic construction played an important role.

## 45.5 Conclusion

- (1) Ansai County terrace construction in 1985–1996 during rapid development, In 10 years, the average annual growth of the 95.57 % co-using terrace 1.5576 million mu. But since 1996, terrace construction slows down, be more stable. At this time the per capita terrace area has reached food supply demand of standard, the basic needs of local food supply demand.
- (2) Ansai County Terrace construction of local agricultural economy development is influenced mainly displays before in 1996. Before 1996, Ansai economy mainly agricultural production is given priority to, because at that time productivity level is not high, cultivated area is to improve the agricultural output value is the main factor, so terrace construction largely promotes the development of agriculture. After 1996, Terrace construction remained stable. The use of fertilizers and mechanical power construction to make terrace agricultural production value influence reduced. And, due to the rise of commerce construction industries, especially oil industry development, economic structure changes in agricultural and industrial, agricultural production value proportion of GDP than before 1996 down nearly 30 %. Therefore, in 1996, after the objectives of economic development in terrace construction process, the role of reduced significantly.

## References

1. Chen L (2004) Research on the supervision to technic construction and maintenance of soft ridge terrace in loess hilly-gully region. *J Res Soil Water Conserv* 1:41–44
2. Wang C (1994) Applying the masses desertification soil is the development diversified management foundation. *J Soil Water Conserv Sci Technol Shanxi* 3:23–24
3. Wan-mao W (1993) Concerning land ecological economics and land ecological economic system. *J Submitted Regional Res dev* 22(3):53–55
4. Chenxia H, Bo jie F, Chen L (2005) Gray dynamic analysis of agriculture development in loess hilly and gully area—a case study in Ansai Country. *J Res Agric Modernization* 13:282–286

**Part III**  
**Financial Management and Applications**

# Chapter 46

## Measurement of Liquidity Risk of Listed Commercial Banks

Fang Hu, Wenyi Xia and Zongfa Wu

**Abstract** Liquidity, profitability and safety are three principles of commercial bank's operation and management. With the bankruptcy of many financial institutions and the closure of commercial banks during the U.S. subprime mortgage crisis since 2007, liquidity risk has become the most fundamental and fatal risk. As Basel Committee issued Basel III in 2010 and China Banking Regulatory Commission issued The Management Measures on Commercial Bank Liquidity Risk in 2011, liquidity risk regulation of banking industry is strengthened. This paper uses 16 China's listed commercial banks as research objects and employs some indicators to measure the liquidity risk. The paper also studies the relationship between liquidity and profitability of commercial banks, and raises suggestions for strengthening liquidity risk management.

**Keywords** Liquidity risk • Commercial bank • Risk management

### 46.1 Introduction

In 2007, the large-scale subprime mortgage of the U.S. banking industry led to liquidity crisis, which resulted in a number of bank failures and financial crisis extending to the whole world. For a long time, the Chinese public is always having a concept that China's commercial banks, especially the four state-owned commercial banks, are backed by the national credit [1]. With the changes of economic and financial situations in home and abroad, the Chinese government has introduced a series of policies to deal with the international financial crisis influences and stimulate the economic development [2]. Weak awareness of liquidity risk and lagging management methods of some banks are fully exposed. Therefore,

---

F. Hu (✉) · W. Xia · Z. Wu

School of Management and Economics, Tongji University, Shanghai, China  
e-mail: fanglwdn@yahoo.com.cn

W. Xia

e-mail: xiawenyi88626@126.com

Z. Wu

e-mail: gjwzf@263.net

strengthening the management of commercial bank's liquidity risk is significant to the stability of banking system and the safety of financial market [3].

The paper aims to: (1) Establish the comprehensive indicator system to evaluate liquidity risk of China's listed commercial banks. (2) Study the relationship of bank's liquidity and profitability. (3) Give suggestions on risk management [4].

## 46.2 Theoretical Backgrounds

Liquidity includes the liquidity of assets and the liquidity of liabilities. The liquidity of assets means the assets can be quickly turned into cash without causing additional losses, while the liquidity of liabilities means the banks timely get the needed funds at the low cost. Mora proposes that banks may not be able to provide liquidity in a bank-centered crisis because a bank-centered crisis may lead investors to question the safety of bank deposits, even with deposit insurance [5].

Liquidity risk can be defined as the possibility of loss when the banks do not have enough cash to pay off debts or satisfy the customer's demands of withdrawing deposits and getting loans. There are many factors accounting for bank's liquidity risk [5]. Yao considers that the superficial reason is the irregularity and uncertainty of fund source and usage and the deep reason is the contradiction between profitability and liquidity. Li thinks that the mismatching of liquidity supply and liquidity demand is the fundamental reason for bank's liquidity risk. Anson thinks that liquidity risk arises from investing in an asset that cannot be sold in a timely manner, or can only be sold at a large discount [6].

Liquidity is of great importance to commercial banks, some scholars and regulatory institutions put forward the methods of measuring liquidity risk [7]. Xu and Liu put forward several indicators to measure liquidity risk: liquidity ratio, deposit-credit ratio, cash in hand-asset ratio, borrowing fund-deposit ratio, lending fund-deposit ratio, borrowing fund-asset ratio, cash reserve ratio and debt paying ability. The Basel Committee proposed to use liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) to measuring commercial bank's liquidity risk all over the world in 2010. China Banking Regulatory Commission issued The Management Measures on Commercial Bank Liquidity Risk in 2011, pointing out that the regulatory indicators of commercial bank's liquidity risk includes liquidity coverage ratio, net stable funding ratio, deposit-credit ratio and liquidity ratio [8].

## 46.3 Empirical Research

The paper selects 16 China's listed commercial banks as research objects and uses the financial data of 2010 to do empirical research [9].



**Table 46.1** Six indicators to measure liquidity risk

No.	Indicator	Calculation formula	Effect
1	Risk-free asset ratio	(Cash in hand + interbank deposits + government bonds)/total assets	Positive
2	Provision coverage ratio	Loan loss reserve/ not-performing loans	Positive
3	Changes of deposit ratio	(Deposits in the end of period-deposits in the beginning of period)/deposits in the end of period	Negative
4	Borrowing fund-deposit ratio	Funds borrowed from other banks/deposits	Negative
5	Liquidity ratio	Liquidity assets/liability	Positive
6	Deposit-credit ratio	Credits/deposits	Negative

### 46.3.1 Indicator Selection

Due to the information availability of China’s listed commercial bank and the computability of indicators, we select six indicators to measure liquidity risk. Some of them are positive indicators while some negative indicators. Positive indicator means the greater the value of indicator is, the better the bank’s liquidity is. That is to say, liquidity risk is smaller. The six indicators can be seen in Table 46.1.

### 46.3.2 Weight Calculation

Record the indicators of each bank involved in the measurement of liquidity risk by vector and write down the original matrix X as (46.2). The values of indicators of banks can be seen in Table 46.2.

$$x_i = (x_{i1}, x_{i2}, \dots, x_{im}), i = 1, 2, \dots, n \tag{46.1}$$

$$X = (x_{ij})_{n \times m} \tag{46.2}$$

**Table 46.2** Entropy values, difference coefficient and weights of six indicators

Item	Entropy value $e_j$	Difference coefficient $g_j$	Weight $w_j$
Indicator 1	0.970096	0.029904	0.6395
Indicator 2	0.990447	0.009553	0.2043
Indicator 3	0.999972	0.000028	0.0006
Indicator 4	0.999997	0.000003	0.0001
Indicator 5	0.992794	0.007206	0.1541
Indicator 6	0.999935	0.000065	0.0014

Select the maximum and the minimum from the original matrix and deal with positive indicators as (46.4) and negative indicators as (46.5) on the basis of the objective optimization formula. Thus, write down the evaluation matrix Y as (46.6).

$$x_j^* = \max \{x_{ij}\}, \quad x_j^0 = \min \{x_{ij}\} \tag{46.3}$$

$$y_{ij} = \frac{x_{ij} - x_j^0}{x_j^* - x_j^0}, \quad 1 \leq i \leq n, \quad 1 \leq j \leq m \tag{46.4}$$

$$y_{ij} = \frac{x_j^* - x_{ij}}{x_j^* - x_j^0}, \quad 1 \leq i \leq n, \quad 1 \leq j \leq m \frac{1}{2} \tag{46.5}$$

$$Y_{ij} = (y_{ij})_{n \times m} \tag{46.6}$$

Calculate the proportion of  $y_{ij}$  and record the features proportion matrix P as (46.7).

$$P_{ij} = \frac{y_{ij}}{\sum_{i=1}^n y_{ij}}, \quad 1 \leq i \leq n, \quad 1 \leq j \leq m \tag{46.7}$$

Calculate each indicator's entropy value as (46.8) and difference coefficient as (46.9) respectively and they are shown in Table 46.3.

$$e_j = -k \sum_{i=1}^n p_{ij} \ln p_{ij}, \quad k = 1/\ln n \tag{46.8}$$

$$g_j = 1 - e_j \tag{46.9}$$

**Table 46.3** Comprehensive measuring values of China's listed commercial banks in 2010

No.	Name	Vi
1	Bank of Beijing	0.7700
2	Industrial and commercial bank of China	0.5599
3	China ever bright bank	0.7569
4	Huaxia bank	0.5231
5	China construction bank	0.5893
6	Bank of communications	0.4776
7	China Minsheng bank	0.6954
8	Bank of Nanjing	0.6146
9	Bank of Ningbo	0.5284
10	Agricultural bank of China	0.4868
11	Shenzhen development bank	0.6618
12	Industrial bank	0.7644
13	China merchants bank	0.7045
14	China bank	0.5588
15	China citic bank	0.5651
16	SPD bank	0.8815

Compute the weight of each indicator. See Table 46.3.

$$E_e = \sum_{j=1}^m e_j \quad (46.10)$$

$$w_j = \frac{1}{n - E_e} g_j = \frac{g_j}{\sum_{j=1}^m g_j} \quad (46.11)$$

### 46.3.3 Liquidity Risk Measurement

The liquidity risk of every bank can be calculated as (46.12).  $V$  is the comprehensive measuring value, standing for the bank's liquidity and the greater the value of  $V$  is, the smaller the liquidity risk is. The results are presented in Table 46.3.

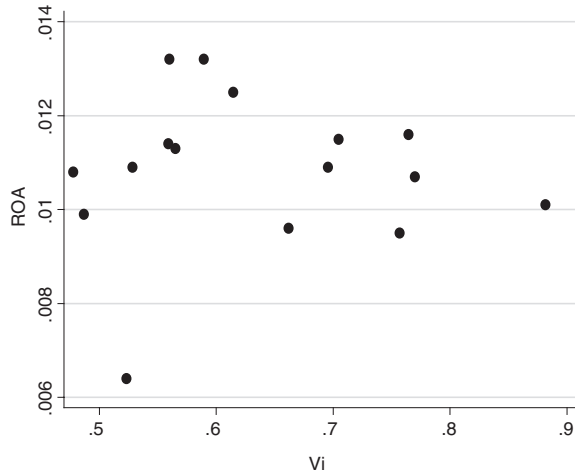
$$V_i = \sum_{j=1}^m p_{ij} w_j, \quad i = 1, 2, \dots, n \quad (46.12)$$

### 46.3.4 Further Study

Liquidity, profitability and safety are three principles of commercial bank's operation and management. Gaining profits is a prerequisite for the development of business. To survive and develop in the competitive industry, commercial bank is inclined to reduce the cash assets, decrease the cash reserves to a minimum and attract deposits as many as possible so that it can use these funds on loans and investments that are more profitable. Maintaining liquidity is the premise for commercial banks of continually gaining substantial funds to keep the normal credit operations. Actually, the ultimate reason for liquidity risk is the contradictory relationship of profitability and liquidity of assets and liabilities. If the assets are all cash assets or assets that can be easily turned into cash, liquidity risk will not happen. However, oriented to profit-maximization, commercial banks will not give up profits to avoid liquidity risk. What they will do is to maximize profits at the cost of bearing small liquidity risk.

In general, liquidity and profitability are often contradictory. When liquidity is good, profitability is generally low. When profitability of the assets is high, liquidity is bad and liquidity risk is big. So we will further study the relationship of profitability and liquidity. We adopt the indicator of ROA (return on assets, the value of net profits divided by total assets) to measure profitability and calculate ROAs of China's listed commercial banks in 2010. Regression analysis of  $V$  and ROA will be used. First, we drop the observed value of Huaxia Bank ( $V = 0.5231$ ,  $ROA = 0.0064$ ) which greatly diverge from other observations that can be seen in Fig. 46.1. Then we test whether the coefficient is significant or not. The results are presented in Table 46.4, showing that there is a bit negative correlation between  $V$  and ROA but the coefficient is not significant in 95 % confidence interval.

**Fig. 46.1** The relationship of Vi and ROA



**Table 46.4** The results of regression analysis

ROA	Coefficient	Standard error	t	P >  t	[95 % Con. Interval]
Vi	-.0027098	.0026146	-1.04	0.319	-.0083583 .0029388
_cons	.012877	.0017024	7.56	0.000	.0091991 .0165549
Number of obs = 15		F(1,13) = 1.07	Pro > F = 0.3189		R-squared = 0.0763

### 46.4 Liquidity Risk Management

Keeping liquidity is the most fundamental condition for normal operation of commercial banks, so liquidity risk management is of great significance.

What the regulatory institutions should do:

Build a more reliable and early-warning system. The establishment of early-warning system of liquidity risk, which includes reliable indicators to measure liquidity risk, the effective transmission of indicators and the timely reflect mechanism, is an important part of pre-regulation that improves the ability of risk prevention. Adverse trends can be identified through this system so that the bank’s management can give rational evaluation of risk and timely response.

Strengthen the effective supervision of liquidity. Regulatory institutions require banks to provide information about the risk exposure and risk analysis reports and at the same time they should observe and assess the measures for risk prevention to ensure the timeliness and effectiveness.

What the commercial banks should do:

Raise the awareness of liquidity risk management. Compared with the credit risk and operational risk, China’s commercial banks are lacking in the cognition for liquidity risk crisis. To achieve the goal of stable operation, commercial banks should establish a scientific system for liquidity risk management and strengthen executive force for the system.

Strengthen management of liquidity forecasting and liquidity gap. One of the important responsibilities for commercial banks is to maintain adequate funds to

meet liquidity demands. Too much liquid assets will result in underutilization of funds, while too little access will reduce the level of profitability. So commercial banks should forecast the potential liquidity supply and liquidity demand by collecting information on fund changes.

Draw up an all-around contingency plan. Commercial banks can make a contingency plan on the basis of their business size, risk level and organizational framework and analyze the potential liquidity risk in line with business conditions and cash flow. Contingency plans should be timely assessed and revised to ensure the planned measures smoothly implemented in case of emergency.

Improve the level of fund utilization. Under the circumstances that new risks won't be caused, commercial banks can improve the usage of funds by financial innovation, which can enrich the financing channels, decentralize risks and improve liquidity risk management.

Establish the mechanism of reputation risk management and coordination [9]. Crisis of confidence is an important factor to accelerate the deterioration of liquidity risk. The ability of banks to maintain liquidity depends on the cultivation of long-term and stable relationships, the management of reputation risk and the establishment of coordination mechanism.

## 46.5 Conclusion

First, we construct an indicator system to measure the commercial bank's liquidity risk. By reflecting the asset liquidity, liability liquidity and asset-liability liquidity, the six indicators effectively measure liquidity risk.

Second, liquidity of 16 China's listed commercial banks is well on the whole, but banks should still put emphasis on risk management.

Third, the study of the relationship between liquidity and profitability shows that negative correlation is not significant.

## References

1. Mora N (2010) Can banks provide liquidity in a financial crisis? *Econ Rev* 95(3):39–44
2. Yao CH (1998) Commercial bank must guard against liquidity risk. *Finan Dig* 1:98–104
3. Li QC (2002) The causes, measurement and control of liquidity risk. *Mod Inf* 8:02–10
4. Anson M (2010) Measuring a premium for liquidity risk. *J Private Equity* 13(20):77–82
5. Xu CZ, Liu XM (2002) On the financial risk early warning system of our country's commercial banks. *Econ Probl* 2:3–11
6. Liu Y, Gong CL (2010) Liquidity risk rating for commercial banks and its empirical study. *Syst Eng* 28(12):10–17
7. Chai QY (2011) Future development of China's regulation on liquidity risk from Basel III. *J Chifeng Univ* 5:16–24
8. Liu L (2011) The existing problems of liquidity risk management of China's commercial banks and its suggestions. *Inf Econ Technol* 11:36–43
9. Li RH (2011) The international experiences on liquidity risk management and the suggestions for China. *Investment Res* 4:11–18

# Chapter 47

## Study on Safety Accounting Theoretical System

**Xiangjun Zhang**

**Abstract** In this paper, from the development of accounting and nature of accounting, combined with China's current production is more severe safety situation from different aspects discussed the accounting involved in safety management is necessary. And initial construction of a new security system of accounting theory and, preliminary study the basic theory of accounting system. Proposed the secure accounting value system that more suitable for China's current status, and made disclosure of information pattern that more matches with the security accounting system.

**Keywords** Security accounting • Theoretical system • Basic accounting • Security accounting information • Disclosure mode

### 47.1 Introduction

Safety is an important symbol both social civilization and progress, but also an important part of sustainable development. Safety is related to people's fundamental interests, but also to China's reform, development and stability, economic development should be between man and nature, the harmony between safety and production; to create a safe, harmonious, civilized production and living environment. To achieve this purpose it is necessary from every point of view, participation by the various disciplines to study the safety issues, and safety issues in accounting research has its objective necessity. Safe accounting research is now in the infancy stage, the theory of security accounting system has not been perfect, the value of the accounting system is not perfect, the disclosure of accounting information security mechanisms are not fully formed, Therefore, this paper will build and application of the security accounting theory to do some preliminary study. Build a complete security framework of accounting theory and the accounting resources information disclosure system security is must.

---

X. Zhang (✉)  
Business Management Branch, Jilin Business and Technology College,  
Changchun 130061, China  
e-mail: dxd0303@163.com

## 47.2 Necessity of Safety Accounting

The accounting an important part as Economic management activities in promoting economic development of the huge role is irreplaceable. After a long history of development and evolution process, the nature, role and content of the accounting have taken place many changes. The accounting from the original simple accounting, record behavioral development to the computer as the main network accounting information age, its development and evolution of each the accounting period, accounting for each to achieve technological progress, not only with a certain period of social and economic development have a direct link, but also by a certain period of social relations of the constraints [1].

### 47.2.1 *The Characteristics of Modern Accounting Study*

Twentieth century, the rapid expansion of global economies of scale and a high concentration of various types of capital to promote modern accounting theory in the new economic environment gradually developed, the main features of modern accounting research evolved as follows:

1. Professional Researchers Appear.

Engaged in accounting research team, in addition to many the accounting scholars doing a lot of new accounting theory, a number of research groups in the accounting profession is also vigorously promoting the accounting theory research.

2. The Standardization of Research Methods.

Modern the accounting research has focused on the description of the accounting theory to normative accounting theory; induction replaced by deduction; also stressed than accounting practice accounting theory, the accounting theory and practice of guiding role.

3. Note that the Functions of Social Responsibility.

The accounting researchers generally accepted social values and economic interests of the concepts into the accounting theory research areas, research began to focus on the social responsibility level, to include price changes accounting, environmental accounting and social responsibility accounting, including many of the new accounting area has been expanded. Enrich the connotation of the accounting research.

4. Continue to Refine the Functional.

Computer technology has been gradually extended to the field of accounting research, and have caused accounting processes complete revolution, the traditional the accounting and gradually formed two relatively independent branch—financial accounting and management accounting, this pattern makes the functions

of the accounting provided information has been basic division of labor, to make it more timely and effective manner to meet the different needs of users of accounting information [2].

### ***47.2.2 Significance of Safety Accounting Study***

#### **1. The Input Mechanism to Promote the Improvement of Security Force.**

Business driven by profit, often to minimize production inputs, reduce security costs to pursue more cost-effective, regardless of social benefits, when one-sided pursuit of within economic neglect the external economy, the contradiction between economic and social benefits will be more obvious, even sharp. To solve this problem, we must establish an effective security force input mechanism. Investment in high-risk industries and enterprises is the lack of security resources China's security situation is still grim one of the main formation of such a lack of investment in enterprise security is a major cause of the lack of effective regulatory measures. Some high-risk industries and high-risk industries small businesses (such as some small coal mines, small chemical) are often only focus on short-term economic interests, ignoring the safety investment. Frequent accidents caused by production, personnel, property losses. Therefore, the security of accounting building will make mandatory input mechanism and related security information disclosure system more perfect, for the prevention of industrial lack of investment in enterprise security accidents caused by the occurrence of great importance [3].

#### **2. Meet the Social needs of Accounting Information for Security.**

Establish an effective security force input mechanism is necessary, to establish a corresponding establish an effective security force input mechanism is necessary, to establish a corresponding mechanism for the disclosure of accounting information is necessary. Security force input mechanism and the disclosure mechanism of accounting information related to the stakeholders to understand business is an important window in safety, security into the performance area. Safety-related accounting disclosures safety information to help assess the safety engineering and safety protection measures of economic rationality, guide enterprises to correctly secure input, to improve the input-output efficiency, increase security degrees.

#### **3. Promote the Development of China's Foreign Trade.**

After China joined the World Trade Organization, China's enterprises are facing more international competition, security issues are often directly affect the image of the product in international trade, exports of domestic enterprises often due to security concerns in the international competition in the market at a disadvantage. With security accounting system to help Chinese enterprises to adequately reflect the production of safe invest operating procedures, and timely and objectively measure and verify the safety cost of exported products, the companies security pay included in the actual cost to fully reflect all the export products the cost of the project, and for the enterprise should provide strong evidence-dumping proceedings.



## **47.3 Formation of Safety Accounting Theoretical System**

Security system of accounting theory the starting point is the security of accounting as a professional accounting to conduct studies. Security accounting to reflect and control of the positioning of objects in a safe stock and flow of resources, but also the accounting point of view in space within an enterprise to discuss the issue, will be related to assets, liabilities, equity, revenues, costs, expenses, income and other basic elements of accounting, as well as accounting objectives, accounting assumptions, accounting principles, basic accounting concepts accounting measurement description of the problem. Thus, there is the theoretical study on the safety of accounting to some extent also based on the basic theory of financial accounting research system as its foundation. Security system of accounting theory research topics are related to accounting security accounting basic theory, and mainly from a involved in the production range of secure enterprise space to study the issue.

### ***47.3.1 Theoretical Foundation of Safety Accounting***

Security accounting as Accounting in the security resource management and accounting field a new branch, research is mainly to prevent industrial accidents, consumption and compensation issues, mainly to resolve the incidents reflect and control the production process and results and to the sustainable socio-economic and social development and the improvement of the premise, must have its own independent characteristics, which reflect the characteristics of the theoretical foundation of this discipline, Thus, the theoretical basis of the establishment should have its own characteristics. The theoretical basis of security accounting issues is to solve the security theory of the formation of the accounting discipline anchor to determine the basic direction of its research questions.

### ***47.3.2 Basic Content of Safety Accounting***

Security accounting content mainly related to the following areas:

1. Accounting object of accounting security.

Accounting objects refers to accounting to be contents of accounting and monitoring; Specifically, the accounting object refers to the enterprises and institutions in their daily business activities or business activities in the movement of funds shown that “the movement of funds form the oversight of accounting and accounting content” [4]. Although the content of the accounting object has a different understanding, in general accounting scholars that “the object of accounting is a social process of expanded reproduction of capital movement.” [5]

## 2. The accounting objective of Safety accounting.

Accounting system to run the starting point and ending point is the common sense of the main content of accounting objectives, the performance of accounting activities should achieve the intended purpose, it is the nature of accounting and accounting in which the macro socio-economic environment of the decision. The goal of safety accounting is to secure accounting system purpose of running, which provides accounting information used in decision making. However, safety accounting to meet the general financial accounting of the goals, also has two additional features: First, to meet the relevant safety information users decision-making needs of safe behavior, should be provided is correct, available on the safety accident prevention, control and other aspects of a variety of accounting information; Second, by accounting supervision, evaluation and other management activities implemented to promote safe investment resources effective use, and thus promote the improvement of safe production conditions and production environmental conditions, and prevent security incidents and the resulting economic losses, thereby enhancing the direct economic effective and comprehensive social benefits.

## **47.4 Bookkeeping Foundation of Safety Accounting**

Business activities may occur the complex economic activities at any time, these activities involve a large number of enterprise business, To confirm whether these companies business are scope of accounting and supervision, the process and results whether should be within the scope of accounting reports, they must use some accounting profession method to solve, which often accounting appraisal belong to accounting recognition.

### ***47.4.1 Base of Accounting Recognition***

In Modern study of accounting theory, accounting recognized as an important foundation the theoretical problem is the accounting recognition issue. Accounting recognition is defined as: "Accounting Recognition refers to certain accounting matters as an asset, liability, business income, expenses and other accounting elements formally included in the business process of financial statements. One has been over recognized the accounting project should also be recorded in words and figures, and the amount included in the total amount among the statements [6].

### ***47.4.2 Measurement of Safety Accounting***

Security accounting of specific measurement method is safe accounting system constitutes the core content. It is based on the quantitative perspective to resolve the by which scale, how much and in what manner the amount of records will

enable the economic and security-related business activities into the security system of accounting and reporting issues in order to “generate different meanings and characteristics of accounting information”[7].

### ***47.4.3 Formation of Methods of Safety Accounting***

Safety accounting method is for the of accounting and oversight of the security accounting object to complete its goal to take a basic accounting methods. Security accounting object complexity, uncertainty and security accounting information of users requirements of the specificity, have determined the basic method of accounting system security should be consist by the next parts:

#### 1. Security Accounting Methods.

One basis way of the secure accounting is the accounting account method; because the security accounting is separate special accounting areas from the corporate financial accounting.

#### 2. Management Method of Security Accounting.

Security system of accounting which one of the main components is safety management accounting method, which involves what specific ways to use security resources investment, consumption, compensation process and the results of monitoring, evaluation and control issues. Security accounting management methods including the specific work methods predict methods, decision-making methods, test methods and analysis methods.

#### 3. Performance Evaluation Method of Safety Accounting.

Safety accounting performance evaluation method is designed to secure resources for investment and compensation for the loss of security incidents performance assessment of the specific ways.

## **47.5 Mode of Safety Accounting Information Disclosure**

Security accounting information carrier specific forms is different, the choice of what mode to disclose security accounting information, which to based on security accounting and requirements to decide. The main body of safety accounting information disclosure is involves or may involve safety risks exist for all operating entities of the problem. In this paper, from the micro-level of disclosure of accounting information to provide a safe mode is to preliminary analysis.

### ***47.5.1 Main Statements of Safety Accounting***

According to the existing accounting standards, corporate accounting in accordance with the assets, liabilities, equity, including the three elements

of the specific economic content to provide detailed accounting information, Security accounting. Which assets section contains the specific items of assets is largest, assets part of the assets can be broken down into current assets and long-term assets, in the safe production plays an important role in the security arrangements of assets are not alone for disclosure, but mixed in all kinds of other assets to be vague disclosure, making the need for such security accounting users or government of information is difficult to analyze regulatory capital of the enterprise security resources to be just how large-scale, What form of specific assets, such secure assets how to play its unique role and so on, thereby affecting their related decision making. From this point of view, security assets is a special form of assets, in asset composition should be possession of a separate place, it can not be obliterated. Therefore, in the assets form of disclosure, security asset should be included in a separate disclosure. There Safety resources disclosure form should be the amount of the cost of changes in enterprise security, enterprise security changes in assets, income statement and balance sheet and so on.

### ***47.5.2 Instructions of Safety Accounting Information Disclosure***

#### 1. Description of the Financial Situation.

Corporate in addition to disclosure the safety of the monetary measures of accounting information in the financial statements, should By the text description supplement the security in the form of investment, security, efficiency and other non-monetary form of security content of accounting information.

#### 2. Safety Report.

The preparation separate security Report is to facilitate information users to enterprise security information resource use, safe work practices and safety precautions comprehensive understanding. Safety report can be voluntary or mandatory when conditions are ripe to be disclosed in a way' Preparation of safety reports can also use tables, text, graphics and other methods. Meanwhile, the safety report need to be reviewed by the safety authorities to verified, ensure the security accounting information disclosure objectivity and credibility.

## **47.6 Summary**

In recent years China has made achievements remarkable development in economic, but rapidly expanding economies of scale also led to more industrial accidents, this paper, the accounting was involved in safety issues research. This paper describes the basic theory of accounting security.

## References

1. Li E, Zhu X, Wang Y (2008) Basic theory building analysis of safety accounting. *Econ Manag* 12:49–53
2. Wang S (2008) Secure accounting study. *Friends Acc* 6:32–33
3. Dong G (2008) Study of secure accounting. *Mod Commer Ind* 1:208–210
4. Dai D (1994) Reflect and control to the accounting in advance, Dongbei University Press 5:330–337
5. Yu Y (1994) Advanced accounting guide. vol 46. Liaoning People's Press, Shenyang, pp 29–36
6. Lou E translation (1993) On the financial accounting concepts, 1st edn, vol 21. China Financial and Economic Publishing House, Beijing, pp 236–245
7. Li X (1996) Modern accounting theory. vol 5. Shanghai Jiaotong University Press, Shanghai, pp 100–150

# Chapter 48

## Research on Dependence and Coupling Relationship Between China and America Under Institutional Building

Guohua Jing

**Abstract** The relations between China and the United States institutional building is the cooperation mechanism, the establishment and development of the perfect dynamic process, promote the development of China-us relations, but there are also many limitations: for the interests of the state decided to pursue the “selfish nature,” national strength of different decided their “balance”, mechanism of complex changes and not mandatory decided their “uncertainty”, “contact and containment” U.S. policy toward China decided to its “no sufficient”. This article through to the relations between China and the United States cooperation conflict the chain of events of the simulation analysis and validate the cooperation of the prediction iteration to work. At the same time thereafter puts forward some constructive policies and Suggestions.

**Keywords** Relations between China and the United States • Limitations • Cooperation degree • Iterative model

### 48.1 Introduction

The current international society, the interests of the state is still countries for maintenance and the pursuit of the first content, as Kenneth wal-mart, this said [1], “we face as the common income and the potential for co-operation, but in the country is on how to distribute the feel unsafe, they are not asked, ‘we have to?’, but ask ‘who gains more’”. Between the two states in the field, building up of how what mechanism to uphold their national interests have a choice, in the interests of the two countries different or even conflict, this selective more outstanding. Based on the national interests, and both congress to reach an agreement on a particular area for consultations and cooperation, but also is based on the interests, between the two countries in some areas of dialogue can’t agree or even reach an agreement is also

---

G. Jing (✉)

Zhejiang Business Technology Institute, Ningbo 315012, China

e-mail: Guohua\_Jing@yeah.net

hard to obtain actual effect. This is the U.S.-China economic fields of cooperation mechanism is rich, have made great achievements, but the political, military and other areas of the effectiveness of the communication mechanism relatively poor and development is not perfect reason [2].

Mainstream phenomenon to achieve some common goal, some members form groups and effectively resources, characters or idea input and combination, but with the group cooperation because some rules in the operation of each member of the actual income distribution and the member in the group of the expected earnings before produce deviation, some members of the cooperative behavior may change when the actual income lower than the base the benefit some members will lower their cooperation intention to choose the cooperation of strategic this will destroy the existing cooperation pattern [3]. On the other hand, in the reality group of practical operation is not simply to conform to repeat, and each members often has the distinct personality characteristics, such as different values, decision habits, and faith, and to the extent of the historical information for cooperation, and so on; These factors and the changes will affect the cooperation of attitude adjustment [4]. Besides the reality of group is often not directly in the equilibrium platform operation, but after a very long-term dynamic evolution process. But there is a lack of can overcome the shortages and reveals group cooperation prediction model of the dynamic evolution, as the timely control or adjust the members of the operation of the willingness to work can be effective evidence in this respect it is necessary to make some useful exploration [5].

## 48.2 Research Methods

This paper puts forward the concepts of degree of willingness to work, on the basis of analysis and to predict in advance after the combination of ideas, construct the description group cooperation evolution to iterative model of cooperation. The model relative objectively reflect the group members, the personality characteristics of historical information and the game theory, and, to some extent, from some side reveals the group members to achieve stable equilibrium of the game before adjustment, the interaction process [6]. At the same time for verification of the iterative model willingness to work for our prediction function relations between China and the United States cooperation conflict chain simulation analysis. And in the simulation results are given based on the analysis of some of the ways to improve relations between China and the United States and policy Suggestions.

### 48.2.1 Cooperation Membership

Members of the strategic space I set for, Pareto strategy, the members of the earnings of  $P_i(s)$ ,  $S_i$   $S_i$  ( $I = 1, 2, L, n$ ) is [7].

$$s_i^c = \{s_i \in S_i \mid s_i \in \arg \max \sum p_i(s)\}, s = (s_1 s_2 \cdots s_m) \tag{48.1}$$

The members of the cooperative strategy I for space  $S_i \setminus S_i^c = S_i^N$  so

$$s_i = s_i^c Y s_i^N. \tag{48.2}$$

Group members choose between cooperation and the cooperation between the state of the strategic distribution strategy in, we say belongs to the extent of the cooperation for I membership, notes for; obviously the cooperation membership is affiliated to the degree.

### 48.2.2 Cooperation Willingness Degree

Cooperation with the membership degree of cooperation membership for poor willingness to work for cooperation intend to spend. In fact is group members take strategic cooperation with the cooperation of the strategic internal power force [8].

Five kinds of typical state: dog in the ego, Roman holiday, no cooperation, negative cooperation, active cooperation intend to degrees corresponding  $-1, a, 0, b, 1$  here  $-1 \ll 0, 0 < a < 1$  b. A common goal with the cooperation of each member will and must be cooperation benchmark walked into the operation of the group, in turn, groups and will influence the results of two factors.

### 48.2.3 Benchmark Returns

In the group or groups before each phase of the operation, members are all expected return standard, it is to measure whether the result is satisfactory reference to cooperation, we call it a benchmark returns, notes for (t stage is the number 1 0). In every game after the actual return benchmark returns with the deviation will affect the behavior of the members through psychological and adjust their willingness to work degree, will definitely affect the next cooperation.

The strategic selection of the actual income and group gains  $\sum_{i=1}^n P_i(s)$  [9].

## 48.3 Model Establishment

On one hand the people is not simply a case of a direct response their reaction is based on past experience as the basis of the formation of the hypothesis. On the other hand as R.L Ewin psychological field theory that the current and recent environmental impact is the determining factor of behavior here environment of living space is the interaction of the group member state.



Members of the first group set I willingness to work for degrees, game  $t + 1$  times willingness to work not only by members of the personality characteristics of influence; And is based on the historical information before cooperation. That is, through two different historical memory and adjust the current period of the integration of willingness to work to adjust to the purpose of the degree of cooperation, namely

$$\begin{aligned} \alpha_i^0 & \text{-----} \alpha_i^{t+1} \\ \alpha_i^t & \text{-----} \alpha_i^{t+1} \end{aligned} \tag{48.3}$$

That is for subjective cognitive and environment restriction  $g_h$  the result of joint action.

Different cultural mode and values will also affect to the members of the other group members interests, attitude, decision of the target choice behavior and cooperation of the state of cognition; And this influence throughout the group members will be between each game will affect them in the cooperative competition conflicts group behavior orientation; This is the so-called path dependence some research shows that comes from the members of the collective socialist culture than from members of the individual culture more tend to present cooperation behaviors. And general east culture belongs to the collective cultural western culture of individual culture.

General but think willingness to work by prior cooperation intention and degree of cooperation will adjust two components; For simplicity's sake get weighted average namely [10].

$$\alpha_i^{t+1} = zh_i^t + (1 - z)g_i^t \tag{48.4}$$

Here was a conservative  $z$  stubborn factor, or called cognitive factor it is the members of groups prior cooperation intend to preferences. Show that a game willingness to work is the degree of cooperation and prior to members of the history of the game information to compromise.

Iterative model shows willingness to work based on individuality characteristic and the game theory are members of the dynamic evolution history information group of psychological essence, as long as know each member's benchmark income variation rules and the willingness to work for adjustment model, it can predict the members of the group cooperation, every member will degrees per issue proceeds, and the change of the overall effectiveness of groups; Cooperation mechanism for setting and correction of the game rules provide important support.

Pay attention to: the model is a complex structure as well as many parameters of the nonlinear dynamic system; it is difficult to make the general research. If a given parameters, can use computer forecast and research cooperation and all kinds of benefits, etc. will degrees of the direction of the rail line and other complexity state; At the same time can by comparing the partial and the whole deviation PI to judge the stability of the group cooperation. Iterative system evolution may exist convergence, steady, divergent, oscillation such status among the members of the group game may ultimately evolution to three kinds of result

(cooperation, not fully cooperation, low level of cooperation, and collapse). Therefore we should iterative model and its dynamic state of the channels for control, in particular, for specific examples can find out specific control mechanism. It mainly involves the orbit of the power system control (including chaos control stability with a high level of stability and control). On the other hand, due to the iterative model of cooperation with general and for different groups may have different parameters and adjustment mode. So, for specific group can simulate different types of members of the state and predict the game evolution and control each member's willingness to work degrees. Here in this paper using iterative model of cooperation intend to study in the relations between China and the United States both in some significant political security incident is present in cooperation intend to problems.

## 48.4 Conclusion

This paper puts forward the group member behavior reflect the concept of psychological willingness to work. The institutional building to the relations between China and the United States how willing to degree analysis, to solve the problems between the two countries for specific problems, to the exchange between our two countries and understanding, the development of the relationship between national and international mechanism consummation plays an important and positive role. At the same time institutional building relations between China and the United States, there are also many limitations, and these limitations factors may not eliminate in the short term, but improve sino-us cooperation mechanism, promoting the effectiveness of the relations between China and the United States institutional building efforts should not give up, the need of international environment improvement, the positive effective cooperation between China and the United States and the corresponding system security. As for China, and it can fully using the mechanism, including the power of the international mechanism for himself in the international system development adjustment to keep a relative to a better position, to strengthen the international mechanism of research and utilization, become active participants in the international mechanism and decision makers.

## References

1. Honghua M (2001) The international mechanism and China's strategic choice. *China Soc Sci* 2:37-44
2. Jie L (2003) The theory and practice of Chinese participate in international mechanism. *Theor Res MAO Zedong Deng Xiaoping* (4):128-134
3. Honghua M (2001) International mechanism and the limitation of the effectiveness. *Am Res* 4:36-39
4. Robert H (2001) After hegemony. Shanghai people's publishing house, Shanghai, pp 22-28

5. Changhe S (2000) Analysis on the global public problems and international cooperation-a kind of system. Shanghai people's publishing house, Shanghai, pp 391–399
6. Jie W (2002) On international mechanism, vol 02. The Falmer Press, Beijing, pp 44–49
7. Xiaojun L (2008) The effectiveness and limitations of international mechanism. *J Shanghai Adm Inst* 1:08–17
8. Wenjing Y (2004) China into the international mechanism and the factors. *Mod Int Relat* 10:36–42
9. Ting L, Pengzhu Z (2010) The research promote cooperation game model of Luo Lei. *J Peking Univ* 8:3–9
10. Longbiao Z (2010) The adjustments of Obama government's national security strategy and the effect of their relations between China and the United States. *Int Stud* 4:19–23

# Chapter 49

## Rural Financial System Reform and Practice in Western China

**Youbi Mao**

**Abstract** Rural financial system reform is a key area of focus for the development of the “countryside, agriculture and farmers” problem in China. According to some surveys, Western regions in China have achieved outstanding results in speeding up the innovation of rural financial institutions, financial systems and products. In the process, good experiences have been summarized, and the development of rural economy has been promoted. At the same time, the narrow scope of financial business in the countryside, high risk of agricultural loans, difficulties in mortgage loan securities, unsound credit system and other factors have also restricted the development of rural finance. Therefore, in the process of rural financial system reform in western regions in China, it is still necessary to broaden the scope of financial services, intensify the innovation of product, develop agricultural insurance and sound risk control mechanisms, promote rural financial ecological environment, and to improve the external areas such as a financial supervision system to seek new breakthroughs.

**Keywords** Western regions in China • Rural financial system • Rural financial reform

### 49.1 Introduction

The rural financial system reform entails a series of rural development allocation of financial resources, thereby affecting the rules of the distribution of famers’ income, including services in the rural economy of the financing system, organizational

---

Y. Mao (✉)

Guizhou College of Finance and Economics, No.276, Luchongguan Road, Yunyan District, Guiyang 550002, Guizhou, China  
e-mail: maoyoubi@126.com

structure, products, markets and other financial forms and their corresponding internal operation mechanisms [1]. Development of the rural economy cannot be done without the effective support of the rural financial system. There exists a mutual promotion and restriction relationship between rural financial system and rural economy. In fact, a significant leap in the agricultural yield and rural economy will bring a big reform to the rural financial system. At the same time, the rural financial system reform also greatly affects rural economic development processes.

In Western China rural areas, because local farmers' incomes arise from a single source, and economic strength is weak, so it is very difficult to provide regular financial mortgage-backed conditions. Furthermore, the necessary loans cannot be obtained from formal financial channels, and the local agencies are unable to effectively meet the needs of the local economy. Therefore, the levels of economic development and financial development lag behind the pattern of mutual influence. Private finance, as an vital financial form, could theoretically acted as the role of "shortage make-up" for the rural economic development which the formal financial is unable to account for. However, due to the lack of proper guidance and regulation of rural folk financial development, many problems are still existed, including some hidden problems, such that the comprehensive sense of rural financial organization system has not yet be brought into fruition. In fact, the reasons those lead to the problem of "three dimensional rural issues" (i.e. problems about agriculture, rural areas and peasantry) could be various. Currently, it has been approached the consensus that the main reason are focused on: the urban-rural dual structure system, fiscal support for rural financial suppression and suppression, and so on. Among those institutional factors, an important one is the fact that the present rural financial system cannot meet the financing needs of rural economic subjects, thereby adversely affects the structural adjustment and upgrade of rural industry [2]. Therefore, it's particularly important to reform the rural financial system to adapt and promote the development of rural economy.

## **49.2 Reform Practice of Rural Financial System in Western China**

Financial innovation is created to obtain the potential profits of the existing financial system by modifying the existing financial system and adding new financial instruments. It is a necessary but slow and continuous development process. At present, the financial system reform in China's Western region is primarily reflected in the rural financial institutions on three main aspects: the rural financial reform and innovation, the innovation of product, and the enforcement of rural financial policies.

### ***49.2.1 Reform and Innovation of Rural Financial Institutions***

Firstly, the rural credit cooperatives are effective. Some business sites have already been established in multiple districts within the township, town and village in western China, acted as the mainstay of rural financial services by providing loan business in most part of districts. Secondly, postal saving banks is the critical one that needs to be focused on for rural financial development due to the particular popular advantage that other financial institutes cannot provide. Thirdly, because there be lack of financial services for farmers and small and medium-sized enterprises (SMEs) in western China, so multi-forms rural financial institutes should be established based on the current rural financial environment that with characteristics of service shortage [3]. Therefore, relevant departments have approved the establishment of a variety of financial organizations. These include microfinance companies, town banks, construction investment companies, guarantees, etc., which become an important supplement of the rural financial market.

### ***49.2.2 Reform and Innovation of Rural Financial Products***

The first method is to reform the original way of mortgage guarantee. According to different customer demands for funds, some mortgage financial products have been developed, such as “three to five households guarantee”, “1 + 1 support”, and “company + peasant household”.

The second way is to innovate the way of mortgage guarantee—“three capital conversions”, namely, by evaluating the property rights, transfer farmers’ resources which contain the property rights, land management rights, forest rights and land attachments into assets, then by innovating mortgage guarantee assets, such as rural forest rights, land use rights, property rights and other mortgage-backed assets, one can effectively solve the problem of uncertainty of bank’s credit guarantee and farmers’ financing demand.

Thirdly, it is necessary to issue credit loans and credit projects. Interest rates should be able to fluctuate based on individual cases; for instance, a group loan should have lower interest rates than that of an individual. Additionally, it is not always necessary to use collateral in loans, especially in cases which pass evaluation of the party taking out the loan.

The fourth way is issuing “orders” of farmer loans. Agricultural industrialization leading enterprises can serve as the carrier. By expanding lines of credit for high quality leading enterprises, simplifying examination and approval procedures, lower loans rate and various other methods, leading enterprises can be guided to provide mortgage guarantee within the scale of farmers’ loan equity. The Fifth one is the development of agricultural insurance. The pilots of agricultural insurance should be undertaken, and use the livestock insurance and crop insurance as a

breakthrough that both can help to perfect the insurance system, gradually expand insurance coverage, and strengthening the agricultural anti-risk ability.

### ***49.2.3 Policy Protection and Innovation***

Firstly, establish the development of “credit culture”, and create a sound financial ecological environment. Financial institutions should depend on the small credit loan for farmers, and strengthen the propaganda, to transform the farmers’ traditional ideas. They should recognize that credit is not only a kind of honor, but also a kind of resource. They can take the credit construction mode of “farmers keep + credit evaluation + microcredit loans” to establish and perfect the farmers’ economy credit files. Secondly, implement efficient policies on new rural financial institutions, such as financial discount and tax deductions, to guide financial institutions to increase agricultural and rural credit investment. Exempt business tax and income tax for the credit loans to farmers that is less than fifty thousand Yuan. For qualified financial institutions, lower deposit reserve rate, and allowed them to retake the loan application to central bank. Thirdly, the financial reform in the rural areas should become a government project. Establish leading financial groups to spearhead the financial work coordination. Local governments should integrate the rural financial reform work to their goals and tasks, and sign relevant responsibility files to guarantee the smooth undertaken of rural financial reform.

## **49.3 Some Problems in Practice in Rural Financial System Reform in Western China**

In the rural financial system, it is important to deepen the reform of financial innovation service—“three dimensional rural issues”. Simultaneously, there exist some problems of innovation of rural financial system reform in western China.

### ***49.3.1 The Situation of Development of Rural Financial Organization***

Due to the limited breadth and depth of financial services, small rural financial organization can only provide four simple services, such as absorbing deposits, issuing loans, dealing with domestic settlements, and interbank leading. Furthermore, there are no subsidiaries established below the county level, nor do they have access to substantial small payments system or credit system. That situation seriously restricts the deposit and withdrawal functions and the customer credit management in town banks. Microfinance companies are also faced with many problems, such as follow-up financing source insufficiency, heavier

tax burden, and risky non-standard operations, etc. Particularly, from the current situation of the services in established microfinance companies, one can see that the service for “three dimensional rural issues” is still highly deficient; therefore, it defeats the purpose for which the microfinance company was founded.

### ***49.3.2 The Current Situation of Rural Financial Services***

Because of the substantial rural capital outflows, there are insufficient financial services available to meet those needs. The purpose of financial institutions is profitability, and the capital outflow is always yielding to high profit industry and developed area. However, the rural economic industry is relatively backward, so the ability to attract capital is limited. Currently, in the western region of China, the agricultural loans are mostly provided by rural credit cooperatives (RCC), and other financial institutions still reside in urban areas, so the rural capital backflow rate is very low. Meanwhile, there exists a notable trend that some rural financial organizations, such as village banks and microfinance companies, have inclined to develop business in urban areas. Most financial institutions are trying to preempt large economic business, and gathering capital and services at the same time. However, the rural financial services, especially those involving farmers and small and medium-sized enterprises, still lack financial suppliers.

### ***49.3.3 Mortgage Guarantee and Credit Approval are Difficult in Practice***

Because several constraints of evaluation, confirmation, registration and management in mortgages and guarantees of product resource, which contain rural forest rights, land contract transform, and farmers' lands, farmers' found it was hard to have mortgage guarantee. Except rural credit cooperatives, loan approval authority of financial institutions is concentrated in provincial and municipal branch, while there is no autonomy or decision-making authority in the county side. The loan examination and approval procedures are stiff, and multilayered system was chose. Those factors seriously limited financial services of financial institutions.

### ***49.3.4 Rural Credit Reporting System is Highly Recommended in Western China***

Because credit systems are not perfect, so it is difficult for peasants, farmers, rural enterprises to get loans; this is mainly because of the credit information asymmetry. China's western region has not yet established a perfect rural credit



reporting system. Large financial institution has to review each loan credit evaluation of building the credit files. Agriculture banks and postal saving banks are developing the establishments of credit files which called “credit county, credit village, credit farmers”, resulting in substantial amounts of duplicate work and resource waste.

### ***49.3.5 The Risk Sharing Compensation Mechanism is not Perfect***

Because financial institutions and “three dimensional rural issues” did not establish corresponding loan risk sharing and compensation mechanisms, once they encounter natural risks and policy risk factors, financial institutions and farmers will suffer larger losses.

## **49.4 Proposed Reforms in Response to Deficiencies in the Rural Financial System of Western China**

### ***49.4.1 The New Type of Rural Financial Institution***

The new type of rural financial institution should expand the business scope, strengthen risk control, and enhance its overall strength. On the one hand, it is necessary to promote the main business content, scope and field of financial institutions, let rural residents be more aware of its specific functions and innovative management process. The internal operating procedures and service processes should be standardized, and an external unified image of the logo should be established. On the other hand, the loan risk control should be strengthened to ensure the safety of funds. To accomplish that, it is necessary to establish and perfect the loan management system, clarify processes of former investigation, subprime loans after examination and loan business process, and standardize operation of the inspection. Furthermore, it is also important to implement loan management responsibilities and reduce credit risks, and establish loan risk monitoring warning mechanisms. To get timely feedback of loan quality deterioration, and minimize loan risk of existing loans, effective measures should be taken; to effectively prevent, control and dissolve business risk, and to enhance the ability of reserve loans to offset risks, provision reserves should be provided to measure doubtful loans. At the same time, it is crucial to terminate any corporate loans which contain suspicious factors, and do not add additional loans to those corporations. In such situation, it requires innovation of mortgage guarantee to reduce the default risks.

#### ***49.4.2 Strengthen Supportive of Rural Financial Policy and Taxation Policy, and Establish Fund Backflow Incentive Mechanisms***

On the one hand, it's necessary to increase the level of tax reduction or tax exemption properly for financial institutions, and to encourage financial institutions to provide service for "three dimensional rural issues" policy by moderately increasing tax reduction and giving rewards according to the service quality of rural financial institutions. On the other hand, the supportive of innovative rural financial institutions should be enhanced, combined with the real local situation. The innovative rural financial organization act as a burgeoning source of rural finance, and it cannot compare with large mature financial institutions, so the risk control and preventative are still weak. The local government could use the income taxes and business taxes of innovative rural financial institutions which have contribution to the "three dimensional rural issues" policy as implementing financial organizations' risk compensation fund. For rural financial organizations which have tax pose difficulties, the local government which have already approved by the tax authority should permit tax reductions and grant exemptions. Therefore, it is easier to have the positive incentive effect by implementing flexible preferential tax policies, and it also encourages the sustainable development of financial institutions. Meanwhile, some incentive measures of financial institutions credit assessment could be considered to encourage and guide the use of financial organizations' funds into local rural construction and development.

#### ***49.4.3 Enhance Financial Innovation and Build a Multi-element Rural Financial Service System***

Due to the institutional mechanism, national finance branches generally utilize big companies and projects for their own purposes while rejecting small and medium enterprises, resulting in inadequate financial services for these enterprises. Small and medium-sized enterprises are the majority, and the vast majority is at an early stage of growth. Furthermore, the external financing channel is narrow, so in order for enterprises to develop smoothly, a diversified financial system corresponding to different growth stages of financing requirements is needed [3]. Therefore, to increase financial support for economic development, local financial institutions must be strengthened and new financing platforms should be established. Thus, in order to further explore the financial innovation mode, four ways can be taken: firstly, encourage the establishments of rural financial organizations and all kinds of mutual cooperatives; secondly, encourage state-controlled large banks and commercial banks to provide services for rural financing and attend competition in rural financial market; thirdly, encourage and develop diversified ownership financial organizations in rural area, and apply for special state policies; fourthly, take

the key role of rural credit cooperatives as the main force of rural finance, and intensify reform in rural development by identifying key fields and weak links, vigorously developing the credit support system for agricultural development, and facilitating land scale sorting and rural infrastructure construction for long-term credit businesses. It is important to encourage rural financial organization to strengthen innovation of credit product on its own characteristics, develop diversified microfinance products, and make efforts to meet diversified farmers' credit demands. Finally, continue the innovation of the credit management model, simplified loan procedures, improve service quality, and form the core competition advantage with its own credit characteristics.

### **49.5 Promote Financial Environment Construction and Improve Environment of Rural Financial Development**

On the one side, it is important to strengthen the construction of rural financial legislation. Firstly, because as the new rural financial institutions, microfinance companies and town banks still need to improve relevant laws and regulation systems which are not perfect, and that requires society to create a good legal environment to facilitate development. Country should strengthen legislation and perfect relevant laws and supporting legal measures, to regulate the access, termination, interest rate management and supervision of rural financial organizations, for example, the microfinance companies, therefore, provide supportive and guarantee on the law level. Meanwhile, through the improvement and implement of laws and regulations, malicious credit fraud and debt evasion can be effectively controlled, credits of rural financial organizations can be protected, and rural financial operation systems can be improved fundamentally. On the other side, it is critical to establish coverage of all farmers' and the rural enterprise's credit systems, improve the rural lending on both sides of the asymmetric information situation, and protect the lawful rights and interests of the principal transactions. The government should develop the creation of credit system which contains farmers, peasants, and agricultural enterprises. At the same time, the government should promote "credit" and integrate the construction of town, village, enterprises and farmers into the culture, to establish a sound credit atmosphere to promote the establishment of rural credit project, and optimize the rural financial environment.

### **49.6 Establish Compensation System for Agricultural Loan Risk, and Develop Agricultural Insurance**

The rural economic is undeveloped in Western China, and the agriculture influenced by lots of factors including natural resources, so the economic development is uncertainly, leading to a higher agricultural loan credit. It is helpful to

improve rural credit loans liquidity for financial institutions by setting effective risk compensation system. It is highly suggested that agriculture loan risk compensation fund should be established with financially appropriate proportion, so it can be used to compensate for credit losses which caused by natural agricultural risks and market risks. Meanwhile, the government should support agricultural industry and projects, and provide agricultural subsidies to farmers and enterprises. The development of agricultural economy must ultimately address the industrialization of agriculture, and only through safeguarding the sale of agricultural products in market, can agricultural economic development be promoted.

At the same time, the agricultural insurance system should be vigorously developed. Due to the characteristic of unique disadvantage and dependency on a seasonal cycle of agriculture, agriculture insurance is particularly important to provide guarantee and supportive for agriculture and functions of policy supportive for agriculture [4]. The development of agriculture insurance in China's western region is relatively underdeveloped, and given the risk factors for natural disasters, it is important to accelerate the policy-oriented agricultural insurance regulations and to explore the establishment of agriculture catastrophe risk reserve system. Government may act as an insurance company to provide agricultural insurance and subsidies. It is critical to encourage and guide the commercial insurance institutions to perfect the network of rural insurance service and sales channel, and implement positive innovation and promotion for all kinds of insurance business that are demanded by "three dimensional rural issues" policy, ultimately attract more farmers to attend to the insurance system.

## References

1. Yunhua G (2009) Coordinated development of rural financial service system of. Chinese Modern Economic Publishing House, Beijing 81:287–294
2. Tiejun Z (2008) Rural prosperity in China's financial choice. China Financial Publishing House, Beijing 08:36–42
3. Xiusheng Z (2008) Theories of modern finance and SME financing. Guangming Daily 5(20):7–12
4. Shuguang W (2008) Rural finance. Peking University Press, Beijing 36:08–20

# Chapter 50

## Research of Bank Internationalization Theory

Xia Liu

**Abstract** The bank globalization is irresistible nowadays. This article will review the two themes focused on bank internationalization theory, namely the general theory of motivation of bank internationalization and the evolution theory of bank internationalization stage. Through the above research review found that, from the bank's international strategy research context, although scholars have studied the behavior of banks increasing international attention, but the overall research in this area is fragmented and not systematic, the relative lack of empirical research, and influenced by the theory of multinational corporations.

**Keywords** Bank • Internationalization • Review

### 50.1 Introduction

The 21st century is the increasing globalization of economic and financial century, with the rapid development of information technology; global banking industry is undergoing tremendous change, banks unstoppable globalization. A large number of foreign scholars from different angles for the international banking issues in depth. In this paper, the literature found that in the past banks international research mainly focused on two main themes: the International Bank of the general theory of motivation and stage of evolution of international banking theory.

### 50.2 Basic Motivations of Banking Business Internationally

Motivation for the banks of the theory of international research, the more common practice is to international banks into the company's internationalization, the theory of the multinational companies in the banking sector related to the application and validation, the following will be described in detail.

---

X. Liu (✉)

School of Business Administration, Shandong University of Finance and Economics, Jinan, Shandong 250014, People's Republic of China  
e-mail: eibj@foxmail.com

### ***50.2.1 Comparative Advantage Theory of International Trade***

Theory of comparative advantage is Aliber (1984) [1] the well-known Heckscher—Ohlin theory in the field of application of international banks, banks operating in different countries analyzed the relative cost or efficiency, and international trade barriers on the impact of bank. The theory for the first time from the bank's motivation in an international study, but the only explanation of how a banking business in international comparative advantage to become a market leader in the field, but did not explore the real source of comparative advantage and how the bank specific achieve comparative advantage, relative to a single perspective.

### ***50.2.2 Related Theory of Foreign Direct Investment***

Internalization theory. The theory by the British economist Buckley & Cassion (1976) proposed. Canadian economist Rugman (1981) [2] will be introduced to the theory of internal cross-border banks, to explain the behavior of multinational banks. Rugman and other scholars on cross-border bank's internal process of discussion, the answer to why the use of bank branches or subsidiaries in the form, rather than the form in the international market agents to carry out financial services business. However, Rugman's theory is not comprehensive: first, his theory does not explain the implementation of internal competitive advantages of the reasons for cross-border banks, which banks cannot answer the same country why different degrees of internationalization. Second, did not adequately explain cross-bank market, rather than choosing a particular cross-border business activities in other markets, the reason; third, internalization theory in the over-emphasis on cost or profit motive in the bank's international importance at the expense of the host factors on the bank's own impact on overseas expansion, only the full combination of the two was more comprehensive and systematic theory.

Trade-off theory. The mainstream theory is the theory of FDI, international action to explain the bank for the same great value. The theory by Dunning (1977, 1981) based on the ownership advantages, internalization advantages and locational advantages on the basis of the three theories. Scholars Gray (1981) and Yannopoulos (1983) applied to the eclectic theory of international banks in, and for the characteristics of multinational banks were elaborated three major advantages. The theory incorporates industrial organization theory, internalization theory, location theory point of view, integrated system to explain the problem of international banking business. As scholars, Williams (1997) discussed in the trade-off theory is very important to the theory of the internationalization of multinational corporations, multinational banks, as a

subset of multinational companies, cross-border actions for the theory provides a theoretical support. However, they did not compromise theory for empirical research.

Defensive expansion theory. Grubel (1977) [3] conducted a defensive expansion theory (also called “follow the clients” motivation) in the bank’s application of international research. He believes that cross-border bank expansion overseas domestic enterprises mainly due to foreign direct investment. Nigh (1986) and many other scholars that the host country’s foreign direct investment and multinational banks in the country, a significant correlation between the number of branches. Blandon (1998) that follow the customers are multinational banks the main motive for overseas expansion, business information can reduce costs and better business in the host country market. Wezel (2004) from an efficiency point of view of defensive expansion motivations that banks set up branches in foreign countries through to follow customers to respond more quickly and more efficient. In addition, Goldberg & Grosse (1994), Niehans (1983), Tschoegl (1997), Yamori (1998), Mutinelli & Piscitello (2001), Merrett (2002), both on the process of internationalization of the banking sector in different countries an empirical study. Defensive expansion theory used to explain the “follow the effect” and oligopoly response theory, but the cost of international banks and the capital’s role in the expansion did not elaborate, making it the explanatory power and influence to be weakened. In addition, Tschoegl (2002) [4] within the United States by foreign banks for the history and operating conditions for foreign direct investment and internationalization are discussed, with the empirical way to tap the foreign bank branch expansion in the U.S. a variety of factors. Petrou (2007) [5], through empirical analysis and comparison of developing and developed countries from international banks (MNBs) the motivation for overseas expansion.

### ***50.2.3 The Bank International of Business Motivation Theory Assessment***

In summary, the motivation for the banking business of the general theory of international banks based theory of international studies, scholars in this field is more in-depth study and the earlier theory. Which, based on the theory of international trade theory of comparative advantage, foreign direct investment related to the theory put forward, are subject follow-up study of international banks to provide a good theoretical guidance and basis? Although most of these theories evolved from the theory of international trade, but as the theory of comparative advantage, customer follow the theory with the global configuration of marketing theory in view of the customer to follow the strategy has a similar, is the prototype of the theory of global marketing strategy.

### **50.3 The Banking Business into the International Stage and Trajectory of the Study**

Clarify the international banking business motivated by the study of international banks on the premise, on this basis, a large number of scholars have begun for a country's banking sector or the banking business in the international market from beginner to advanced dynamic expansion of the evolution were studied.

#### ***50.3.1 The Bank International Stage and the Evolution of Enterprise Theories***

Perlmutter's three-stage-oriented theory. Perlmutter, Professor University of Pennsylvania in 1969 in the "tortuous evolution of the international companies," a paper presented in the three-stage theory of the multinational companies, but also further elaborated the evolution of the bank's international stage theory. He believes that from the domestic to the international banks, the general direction of their home country will experience the host country-oriented, global-oriented three stages of action-oriented. The scholars believe that the only access to "global orientation", the banks can be called true cross-border banks. Perlmutter's three-stage theory is mainly oriented values and behavior from the perspective of the bank's international stage for the international development banks in providing guidance to detect the behavior, but his international stage for the bank's specific business and strategic and other issues not discussed.

Giddy's three-stage theory. Giddy (1982) [6] will be divided into the home country banking internationalization international banking, offshore financial services cross-border banking and the host country in three stages. Divided from the theory of international trade and investment that the banking business with multinational corporations, are based on a monopolistic advantage theory of foreign expansion, as obtained in the international and domestic market competitive advantage.

Dicken's four-stage theory. Shown in Table 50.1, the United Kingdom, Professor Dicken (1988) the bank's international stage development is divided into four stages, namely, domestic banks, international banking, international banking and full-featured full-function banking world, the scholars from the main business object, business scope of foreign market entry mode in overseas markets, clients and other levels of analysis.

In addition, domestic scholars Wu Haihua (1996) will be divided into the bank's international growth—part of the international, internationalized, internationalization and globalization of four stages, and describes how banks to follow the international development of the customer the pace of the construction of an international network, and provides a variety of corresponding services. Dr. Fan Xun (1997) that the bank is the bank's international expansion overseas domestic



**Table 50.1** Bank international development stage table

	The first stage domestic banks	The second stage International Bank	The third stage international full-function bank	The fourth stage full-function banking world
The main business object	Exports and imports	Positive foreign direct investment	Various needs of multinational companies	
Business scope	Mainly trade-related foreign exchange operations, capital operation is short-term	Growing importance of foreign loans and investments in overseas operations in the medium to long term capital	Financial wholesale, retail busi- ness and non-traditional bank- ing business, such as leasing, merchant (investment) banking, advisory, and asset manage- ment industry	
Entry mode	Establish correspondent relationships with foreign banks	Expansion of over- seas branches and offices	Branches in overseas expan- sion, capital participation, the establishment of non-bank subsidiary bodies (financial and non financial), on a global scale to absorb funds, loans and engaged in investment	
Main target	Mainly residents	Mainly residents	Residents and non residents	Residents and non residents

customers as a prerequisite, follow their home country’s foreign direct investment enterprises and gradually developed, and its growth is a passive, incidental to the active and conscious. The process is divided into before the initial stage, the initial stage of international business stage, the international stage and global integration stage, range from the market, all aspects of business activities, banks are highly coordinated in the evolving global integration.

### ***50.3.2 The Process of Internationalization of Banking Enterprises Empirical Research***

Based on the above phase of the study of international banks most simply be deduced from the theory, there are a large number of scholars of the banking process to an international banking business or to study a country’s banks as a whole is given a case study or empirical research.

Riportella & Papis (2001) [7] to Spain’s four major banks, for example under the pressure of competition and in the process of internationalization of Spanish banks have been studied. This paper introduces the service enterprises at different stages of internationalization can take two distinct patterns of behavior, that is “progressive or linear mode” and “opportunistic or contingent model”. The framework for the study of the process of international banks to provide a new

perspective into the international market that is not static, but dynamic and evolving, the banks according to their perceived risk and have the human, capital, organization, etc. selection of resources to determine the incremental or opportunistic entry mode.

ASA (2001) explored the Norges Bank's international expansion, pointing out that the international banks Dnc steps and the process of internationalization of literature consistent with the theory, that is accompanied by a growing enterprise customer and the bank's knowledge and experience and the gradual overseas expansion. Bank of Norway ASA scholar's case studies, theory of the internationalization process for the bank in small state banks provide a basis for the application. Fung & Bain et al. (2002) [8] investigated the Australian Retail Bank (NAB) years of the internationalization process, as the progressive development of retail banking and international evolution and provide support. Lawton & Harrington (2006) studied the Allied Irish Bank (AIB) of the internationalization process, pointing out that AIB gradual internationalization process; the cultural gap plays an important role.

### ***50.3.3 The Bank International Business Stage and Theory of Evolution***

In summary, scholars from different angles on the stage of international banking business and its evolution tracks the theory and practice were studied. This dynamic theory although there are still some limitations, but for us to deeply understand and explain the evolution of international banks to lay a solid foundation for us to think from a dynamic view of the international banking business behavior provides a theoretical support, but also can guide the Commercial Bank of China's gradual implementation of the strategy and development of reference.

## **50.4 Conclusions**

Through the above research review found that, from the bank's international strategy research context, although scholars have studied the behavior of banks increasing international attention, but the overall research in this area is fragmented and not systematic, the relative lack of empirical research, and influenced by the theory of multinational corporations. At the same time, such studies are mostly based on international banks beginner, intermediate phase of the study, for the banks in the study of globalization and high levels of very few. And "the globalization of banking business and its global marketing strategy" of the context of financial globalization as a very important proposition and the global strategy of an important and indispensable part of almost no one involved the topic will become the future academic research an important research direction and content.

## References

1. Aliber RZ (1984) International banking: a survey. *J Money Credit Banking* 16:661–712
2. Rugman AM (1981) *Inside the multinationals: the economics of internal market* vol 11. Columbia University Press, New York, pp 38–45
3. Grubel GH (1977) A theory of multinational banking. *Banco Nazionale del Lavoro: Q Rev* 12:349–363
4. Adrian ET (2002) FDI and internationalization: evidence from US subsidiaries of foreign banks. *J Int Bus Stud* 33:18–23
5. Petrou A (2007) Multinational banks from developing versus developed countries: competing in the same arena? *J Int Manage* 13(3):376–397
6. Giddy IH, Young S (1982) Conventional theory and unconventional multinationals: do new forms of multinational enterprise require new theories. In: Rugman AM (ed) *New theories of multinational enterprise* vol 12. London, pp 78–86
7. Riportella CC, Papis LC (2001) The internationalization process of Spanish banks: a tale of two times. *Int J Bank Mark* 19(2):53–67
8. Fung JG, Bain EA et al (2002) A decade of internationalization: the experience of an Australian retail bank. *J Int Financial Markets* 12:399–417 (Institutions and Money )

# Chapter 51

## Analysis and Recommendations on Status of Banking Profits

Jiyan Xu

**Abstract** In recent years there has been profiteering phenomenon in the banking, the banking profits have far exceeded the profits of industrial enterprises, the per capita net profit of Chinese mainland banks is more 11 times than industrial enterprises, the interest rate between deposit and credit is large, trust, wealth management business and a number of service charges are main reasons of their huge profits. Such huge profits of banking sector are not good for economy, small and medium enterprise, mortgages and depositors, it has increased unfairness of income distribution, and the government should take measures to regulate this profiteering phenomenon. For example, the government could increase deposit rates, strengthen the tax regulation of banking sector, improve the tax rates in the banking sector, vigorously develop the micro-finance institutions and progressively carry out interest rate market.

**Keywords** Banking profits • Profiteering phenomenon • Reasons • Recommendations

### 51.1 Source of Banking Profits

The banking profits are formed by the difference between deposit interest and credit interest. The credit interest is generally higher than the deposit interest, the difference between them constitutes bank profits except the cost of carrying on banking business. Specifically, and the bank profits are formed by following composition:

1. Credit interest and investment income by own capital.
2. The difference between credit interest and deposit interest by borrowed capital.

---

J. Xu (✉)  
College of Mathematics and Information, China West Normal University,  
Nanchong, Sichuan, China  
e-mail: Siny99\_cq@sohu.com

3. The difference between investment income and deposit interest by borrowed capital.
4. Profits by buying and selling securities and foreign exchange.
5. Fee from the intermediate businesses, such as exchange, letter of credit.

We deduct payments of banking business from the total profit of bank, such as stationery, postal fees, staff wages, housing repairs, etc., the rest is net profit of bank.

## 51.2 Current Situation of Banking Profits

Dates showed that, the total net profit of 16 A-share listed banks was 692 billion Yuan (among them, the net interest income accounted for 77.4 %) from January to September in 2011, an increase of 31.86 % over the same period in 2010. Shenzhen Development Bank, Minsheng Bank, Huaxia Bank resulted rapid growth, the net profit year-on-year growth was more than 50 %. Everbright Bank, Shanghai Pudong Development Bank grew quickly also, the net profit year-on-year growth was 41.03 % and 42.02 %. The deposit interest rate is so low, the credit interest rate is so high, and the net interest margin between them is big, so that the bank can not lose [1].

By contrast, the corporate profits declined, the total profit of state-owned enterprises amounted to 2.04156 trillion Yuan from January to November in 2011, an increase of 13.7 % over the same period in 2010, earning growth rate declined consecutively for 5 months. In net profit, from January to November in 2011, the central enterprises realized a total net profit increased by only 3.6 %, down 46.5 % from a year earlier [2].

Deputy Secretary-General of the China International Economic and Exchange Center, Mr. Chan said, the per capita net profit of Chinese mainland banks is more 11 times than industrial enterprises; there has been profiteering phenomenon in the banking. He said that the commercial banks realized a total profit of over 1 trillion Yuan in 2011, the per capita profit was more than 500,000 Yuan, in contrast, the profit of medium-sized industrial enterprises was about 3.7 trillion Yuan in three quarters of 2011. But these enterprises have more than 8,700 million people, the per capita profit is less than 40,000 Yuan, we remove personal income tax from it, the per capita net profit is about 30,000 Yuan. By this calculation, the per capita net profit of Chinese mainland banks is more 11 times than industrial enterprises, the return on capital of banks has not only been higher than industry, but also higher than oil and tobacco businesses. This profiteering phenomenon has caused a great deal of imbalance, it widened the gap between industry profits, it aroused dissatisfaction of community, and it is adverse for development of Chinese economic [3].

Here is the league table on net profit of 16 listed banks in 2010, through the table we can be more intuitive to understand the profit situation of banking sector (Table 51.1).

**Table 51.1** League table on net profit of 16 listed banks in 2010 (Unit: one hundred million Yuan)

Bank	Net profit	Ranking
Industrial and Commercial Bank of China	849.65	1
China Construction Bank	707.79	2
Bank of China	543.75	3
Agricultural Bank of China	458.63	4
Bank of Communications	203.57	5
China Merchants Bank	132.03	6
China CITIC Bank	106.85	7
Shanghai Pudong Development Bank	90.81	8
Minsheng Bank	88.66	9
Industrial Bank	87.64	10
Everbright Bank	68.34	11
Bank of Beijing	39.02	12
Shenzhen Development Bank	30.33	13
Huaxia Bank	30.08	14
Bank of Ningbo	12.63	15
Bank of Nanjing	11.99	16
Total	3461.77	

“According to annual report of each bank”

## 51.3 Profiteering Reasons

### 51.3.1 *The Interest Rate Between Deposit and Credit is Large*

Seventy to eighty percent of the bank's operating income comes from the spread between deposit and credit. Take 1 year deposit interest rate and 1 year credit rate to compare, the interest rate spreads over 3 %, it is much higher than the average level of western countries [4].

Currently Chinese RMB benchmark deposit rates are as follows:

Demand deposit interest rate is 0.50 %; 3 month time deposit interest rate is 3.10 %; 6 month time deposit interest rate is 3.30 %; 1 year time deposit interest rate is 3.50 %; 2 years time deposit interest rate is 4.40 %; 3 years time deposit interest rate is 5.00 %; 5 years time deposit interest rate is 5.50 %;

Currently Chinese RMB benchmark credit rates are as follows:

Six-month credit interest rate is 6.10 %; 1 year credit interest rate is 6.56 %; 1–3 years credit interest rate is 6.65 %; 3–5 years credit interest rate is 6.90 %; more than 5 years credit interest rate is 7.05 %.

(Since July 7, 2011)

### ***51.3.2 Credit Basis is Large***

Chinese credit basis is large, the operating profit is big more. The growth rate of RMB loans was up to 32 % in 2009, the first 9 months of 2010 grew 18.5 %, and they are much higher than the historical average. As of late 2011, the new RMB loans of four major banks were as follows: 818 billion Yuan of the ICBC; Agricultural Bank of China 620 billion Yuan; Bank of China 507 billion Yuan; 727 billion Yuan of China Construction Bank. The new RMB loans of National banks were about 7 trillion [5].

### ***51.3.3 Strong Demand for Credit***

The demand of real economy for Credit is still large, quantitative estimates show that, we make a simple calculation in accordance of 1.2 elasticity of nominal GDP and credit growth, we assume that the real GDP growth is 9 % in 2011, the price growth is 3.5–4 %, this mean that the nominal GDP growth is 12.5–13 % and the needed loans growth is 15–15.6 %.

The follow-up financing needs of projects are large, private investment is further recovering, the investment scale of affordable housing plans substantially expands, they all need the support of banks credit. The financing needs of started projects of real estate developers are mainly medium- and long-term demands for credit, most house buyers are burdened with a heavy mortgage payments in the case of high price, especially the rigid requirements, the credit terms are all over 5 years, some 10 years, some 20 years, and the amount is not small, these cases are very beneficial for commercial banks. Over all, the long-term loans maintained fast growth momentum in 2011.

In addition, the solvency of industrial enterprises is at historically high level, the slight rate increase will not has a significant impact on solvency of enterprises, which ensures interest income from loans.

### ***51.3.4 Rapid Growth of Intermediate Business***

Intermediate business, including payment and settlement business, the bank card business, agency business, trust business, leasing, investment banking, guarantee and commitment to business and financial derivatives trading business. There are four sources of income such as bank card business, merchant settlement fee, annual fee, interest income from bank card with overdraft function, costs of bank card loss, transfer, cash and other activities.

In 2011, the product innovation of commercial banks in China was more active than ever before, the revenue growth of intermediate business maintained a rapid

growth, the income growth rate of banking net fee reached 30 %. There are more and more bank charges, more than 300 kinds only in 2003, but now they are up to 3,000 kinds.

### ***51.3.5 Interest Rate Controls***

Bank competition in the market could have to raise deposit interest rate, but the Central Bank control it, helping the banking industry to drive down deposit interest rate, making a large deposit and loan spread. Benchmark deposit and credit rates are prescribed by the Central Bank, banks generally perform the benchmark interest rate on deposit, banks can not adjust, but the credit rate can be based on the benchmark interest rate to float-adjusted, while the Central Bank provides for adjustment range, which is still in favor of bank loans.

Part of Beijing and Shanghai Banks of China raised the first mortgage interest rates in October 2011, the first mortgage interest rate of a branch of China Construction Bank is more 0.05 times than benchmark credit rate at least in Beijing, if the lenders hope to get the loan as soon as possible, they must accept the interest rate which is more 0.1 times than benchmark credit rate. With this phenomenon, the policy of interest rate controls is good for income of bank business; it also promotes the growth of banking profits.

The funding requirement of enterprise is large, the operating pressure is also large, their profits are so low, but the banking profits are so high, such huge profits of banking sector are not good for economy, small and medium enterprise, mortgages, depositors. It has increased the gap between rich and poor and it has increased the unfairness of income distribution, this would inevitably lead to dissatisfaction of community.

## **51.4 Countermeasures and Recommendations**

Government departments should pay attention to profiteering phenomenon in banking sector, a series of measures should be taken to adjust the profiteering phenomenon, they should coordinate the development of financial sector and real economy, so that the entire socio-economic can develop well.

First, they should take the policy measure of increasing benchmark deposit rates, but the benchmark credit rates are unchanged. It will narrow the deposit and loan spread, thereby reducing the profit of bank. What level is reasonable to increase deposit rate? Our deposit rate should be higher than the inflation rate, at least not lower than inflation rate. So that the deposits of ordinary people could preserve the value, otherwise they are depreciated, at the same time, the deposits of enterprises income also increase.



Second, government departments should strengthen the tax regulation of banking sector and improve the tax rates in the banking sector. Because eighty to ninety percent of banking income comes from its business assets, which mainly include loan business, securities investment business and the business of cash assets. The loan business is the main source of bank income, the interest rate between deposit and credit is large, the credit basis is large, there is strong demand for credit, and these create unique conditions for banking profits, so we have to increase bank taxes.

Third, they should progressively carry out interest rate market. Currently benchmark deposit and credit rates are prescribed by the Central Bank, generally banks perform the benchmark interest rate on deposit, the credit rate can be based on the benchmark interest rate to float-adjusted, banks usually implement benchmark credit interest rate on large enterprises, they increase the credit rate on medium-sized enterprises, they increase the credit rate on small enterprises for several times. If this issue is not resolved, the banking profiteering problem is not fundamentally resolved.

Fourth, they should vigorously develop the micro-finance institutions. Small financial institutions can compete with large banks, not just the credit rate competition, including competition of deposit rate. It helps to increase deposit rate. In addition, the government departments should regulate these situations to avoid vicious competition.

Fifth, the government departments should strengthen supervision of bank's staff on personal income tax, especially senior staff. It can prevent them from tax evasion.

Sixth, banks are required to strengthen services for small and medium enterprises, especially small micro-enterprises. This can reduce the risk of small enterprise for private lending; the endorsement for small enterprise is the most important part of support on real economy.

In short, we should coordinate the development of banking and other businesses, banking profits should be established on the basis of enterprise development, if there is no long-term stable development of enterprise, there will never be long-term stable profits of banks.

## References

1. Liu YG (2010) Listed banks in the ultra-high profits hidden. *China EconWeekly* 35:22–28
2. Zhang S (2010) Problems and countermeasures of intermediate business of modern commercial banks. *J Financ Econ* 18:122–125
3. He Y (2007) Profitability level and capacity of Chinese state-owned commercial banks. *Shanghai Finance University of Technology* 01:83–89
4. Youfa Q (2009) Perfecting the pricing of commercial bank loan in china. *Prod Res* 05:56–61
5. Li D, Yong Y (2005) Chinese commercial bank Profitability analysis. *Nankai Econ Res* 02:11–17

# Chapter 52

## Study on RMB Exchange Rate Transmission Mechanism Based on VAR Model

Yuhua Wang

**Abstract** The transfer effect through import prices index (direct transmission mechanism) is stronger and more obvious than through export prices index (indirect transmission mechanism), which mainly due to the buffer of the international market weaken effect of ERPT through export price. The RMB exchange rate movement has an incomplete transfer to prices. The degree of pass-through of exchange rate shock to different prices indices varies, however, consistently with prediction: the pass-through effect is the largest for import prices, and the smallest on consumer prices.

**Keywords** Exchange rate pass-through • RMB nominal exchange rate • VAR model

### 52.1 Introduction

In general, the exchange rate pass-through (ERPT) effect refers to the degree of impact of the nominal exchange rate changes into a country's import (export) prices of goods and domestic prices [1, 2]. Goldberg and Knetterl (1997) mainly analyze the price pass-through effect of exchange rate movement based on industrial organization theory when they study ERPT effect in the 1980s. Korhonen and Wachtel (2006) study the speed and degree of ERPT of the Commonwealth of Independent States (CIS) and they find that exchange rate movement has a significant impact on the price trends of CIS. Binlin Feng (2006) estimates the RMB ERPT effect and the conclusion is that in our country ERPT effect is not significant and exchange rate movement impact on the producer price index is more significant than on the consumer price index [3–8]. Lu Jian [1] makes a research about RMB exchange rate changes into domestic prices. He finds that

---

Y. Wang (✉)

School of Management Harbin Institute of Technology, Harbin, China

e-mail: zibowangyuhua@163.com

RMB nominal effective exchange rate significantly affects the domestic price level and has adjusted dynamics of self-correction mechanism by the short-to long-run equilibrium.

Viewing from the literatures, many scholars have directly researched exchange rate movement influences the import prices and domestic prices level in order to explain the ERPT effect [9]. However, they don't distinguish the pass-through mechanism in detail and not take into account exchange rate movement leading to changes of the export prices which is a factor to influence the domestic prices. Based on this background, we will further explain the processes and the reasons of ERPT into price level. The contribution of this paper is that we extend transmission process of RMB exchange rate change from import prices to export prices, and we explore respectively exchange rate movement through import prices and export prices affecting on the domestic prices, and compare the effect of ERPT of this two transmission mechanisms [10, 11]. Thus we can have a better understanding of the progress and degree of exchange rate movement into prices.

## 52.2 Rationale and Methodology

McCarthy (1999) uses recursive VAR model to study the relationships of oil price, output gap, exchange rate, import price, industrial producer price and consumer price of industrialized countries. He gives the general equation of ERPT:

$$P_t = \alpha + \delta X_t + \gamma E_t + \beta Z_t + \varepsilon \quad (52.1)$$

where  $P_t$  denotes the price index,  $X_t$  denotes foreign control variables,  $E_t$  denotes the nominal effective exchange rate, and  $Z_t$  denotes internal control variables.

McCarthy has systematically studied ERPT, but his research can't explain the crucial ingredient in the process of ERPT. In this paper, we consider ERPT as two aspects. On the one hand, changes of exchange rate influence domestic prices through imports prices of intermediate goods and final price of consumer goods, which may be named direct Transmission Mechanism. On the other hand, by influencing the relative prices of export products, changes of exchange rate has a impact on the international market demand for the product as a result it makes prices increase or decrease to influence the domestic price level, which may be named indirect Transmission Mechanism. Based on McCarthy' research we will respectively set up two kinds of the VAR models to test the two RMB ERPT.

### 52.2.1 *The Direct Transmission Mechanism*

ERPT takes effects to changes of import goods prices in the first. If the currency appreciation, the domestic currency prices of imports of the goods will decline. At the same time, due to the prices of imported goods changing, the corresponding

price indexes will change, such as the producer price index, retail price index, and consumer price index. This process forms the direct pass-through mechanism of ERPT effort. Thus there is a model such that:

$$PPI_t = \alpha_0 + \alpha_1 NEER_t + \alpha_2 CPI_t + \alpha_3 M_t + \alpha_4 IPI_t + \varepsilon_t \quad (52.2)$$

$$IPI_t = \beta_0 + \beta_1 NEER_t + \beta_2 M_t + \varepsilon_t \quad (52.3)$$

IPI denotes import price index, NEER denotes nominal effective exchange rate of RMB, M denotes the money supply, CPI denotes the consumer price Index, and PPI denotes the producer price index.

### 52.2.2 The Indirect Transmission Mechanism

Specifically, first of all, due to the cost of imported inputs changing, the exporter marginal cost curve may change after exchange rate movement. Secondly, according to the theory of market pricing, there may be strategic pricing behavior for exporter firms, which aims to protect its market share as currency appreciation or expand profits in depreciation. Under this pricing strategy, there will be differences between the export price in local currency and the national market price. As currency appreciation, the companies may reduce export price of goods relative to domestic commodities and undertake part of the cost of exchange rate movements by themselves. This forms the indirect transmission mechanism of ERPT into export prices, the model following is:

$$EXP_t = \gamma_0 + \gamma_1 NEER_t + \gamma_2 PPI_t + \gamma_3 CPI_t + \gamma_4 WPI_t + \varepsilon_t \quad (52.4)$$

EXP denotes the export price index; WPI denotes the world price level.

## 52.3 Empirical Analysis

### 52.3.1 Variables Selection

Referring to the models, selected variables are as follows: IPI denotes the import price index, NEER denotes nominal effective exchange rate of RMB, M denotes the money supply, CPI denotes Consumer Price Index, PPI denotes the producer price index, EXP denotes the export price index, WPI denotes the world price level.

Data description: We select 51 monthly data of August 2005–October 2009 and the August 2005 as the base period. Data of CPI, PPI, M (broad money supply M2) is from China Economic Information Network (CEI Net). NEER comes from the Bank for International Settlements (BIS). World price level

comes from the IMF, and we use the world oil price (average crude price) replace it. Data of IPI comes from IMF. EXP has not been published in China, so we reference paper of Cerra and Saxena. We take all the variables as logarithmic form named LN (NEER), LN (CPI), LN (PPI), LN (IPI), LN (WXP), LN (M), and LN (WPI).

Testing data stationary: ADF test results indicate all of the variables in logarithmic form are not stable, but after taking first-order difference the series are stable.

### 52.3.2 Empirical Process

Cointegration test: Using of Johansen-Juselius cointegration test, we can obtain the following normalized cointegration equations to determine long-term relationship between variables.

In direct transmission mechanisms, we get the equations as follows:

$$LN(PPI) = 0.115981LN(CPI) + 0.020076LN(M) - 0.336148 LN(NEER) - 0.644417LN(IPI) \tag{52.5}$$

$$LN(IPI) - 0.5066LN(NEER) + 0.0482LN(M) \tag{52.6}$$

For indirect transmission mechanisms, we get another equation:

$$LN(EXP) = 0.4154LN(NEER) + 0.81388LN(PPI) + 0.62799 LN(CIP) + 0.635043LN(WPI) \tag{52.7}$$

From (52.5) and (52.6), we can find that in the long run, the nominal effective exchange rate and domestic CPI, PPI, and M are negatively correlated. The import price index, PPI and CPI are very significantly affected by exchange rate changes. While 1 % point of nominal effective exchange rate changes, there is 0.34 % points of PPI changes in the opposite direction. While 1 % point of the domestic

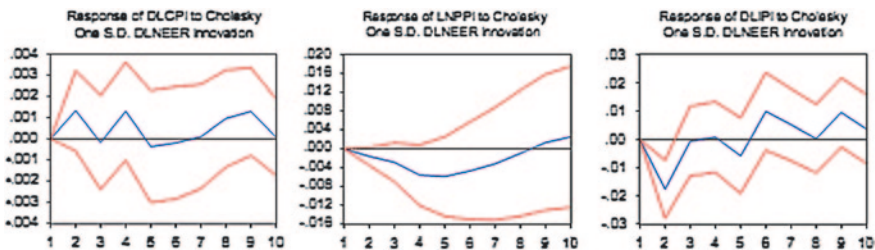


Fig. 52.1 Response of CPI!PPI!IPI to cholesky one s.d.NEER innovation

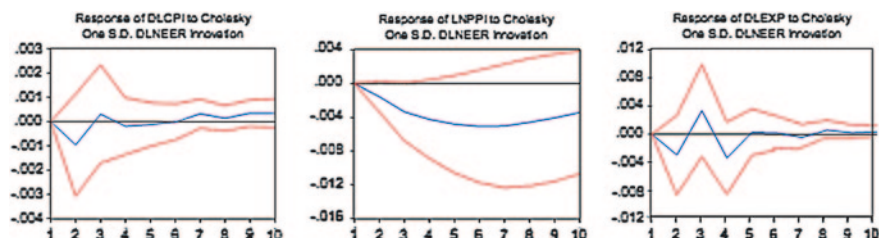


Fig. 52.2 Response of CPI!PPI!EXP to cholesky one s.d.NEER innovation

money supply changes, there is 0.02 % points of PPI changes in the opposite direction. Equation (52.6) shows that, the RMB appreciation 1 % makes import price index drop 0.51 %. Contrast (52.6) and (52.7), we can see that the nominal effective exchange rate increasing 1 %, the export price index will go up 0.42 % points. The world oil price changes by 1 % point then the export price index will change by 0.64 % points.

Impulse response function: Furthermore, we use impulse response function to investigate the exchange rate change of one standard deviation effect on domestic prices and export prices in the short-term.

Figure 52.1 presents the exchange rate changes through the direct transmission mechanism to IPI and PPI has a significant negative effect. In the fourth month the exchange rate of RMB increase 1 %, producer price will decline by 0.06 % and import prices fell 0.15 %. At fifth month, exchange rate of RMB to the import prices gradually change into a positive effect and CPI and exchange rate movements are in the same direction without significant effect, only 0.0012 %. Figure 52.2, in the indirect transmission mechanism the nominal effective exchange rate of RMB has a negative effect on the domestic price level. RMB appreciation will reduce the domestic price level, but the degree of influence is smaller than through the direct transmission mechanism. In the third month, EXP has a opposite direction movement, while in the fourth month EXP declines by 0.03 %.

Variance decomposition: From variance decomposition of two mechanisms for ERPT we can inspect the contribution of each variable leading to price changes. Table 52.1 describes volatility of CPI dues to itself during 10 periods, but also by the impact of industrial prices. For the import price index, in addition to its effects, the impact of the RMB exchange rate movement reaches 26 %, while money supply shocks is not obvious. Another example for Table 52.2, during the 10 periods CPI is affected by the price level of world, reaching 11 %. Except for its own factors the producer price index is affected by the world oil price level which is very significant, reaching 31 % and much stronger than the impact on the CPI. The domestic shocks can well explain Export Price Index changes while the impact of exchange rate and the impact of world price level are weak power of explanatory.

**Table 52.1** Variance decomposition of direct transmission mechanism

Period	Variable	LN(CPI)	LN(PPI)	LN(IPI)	LN(NEER)	LN(M)
2	CPI	78.29568	7.277166	5.183358	4.587739	4.656062
3		74.17759	10.8636	5.093377	4.357122	5.50831
6		57.15388	15.43513	10.73379	5.690115	10.98409
10		48.75697	20.46379	12.12954	8.116794	10.5329
2	PPI	7.153587	84.82404	3.20457	2.039856	2.777951
3		7.658478	79.36233	7.220983	3.63106	2.127147
6		26.28171	56.98712	7.345244	8.771862	0.614059
10		50.69863	38.61949	5.433572	4.779349	0.468966
2	IPI	17.02958	13.96012	39.84845	27.72487	1.436984
3		15.94107	13.13445	37.76726	24.73099	8.426232
6		17.03732	12.66287	36.44114	25.04279	8.815884
10		18.60801	12.52586	34.82461	26.1374	7.904118

**Table 52.2** Variance decomposition of indirect transmission mechanism

Period	Variable	LN(CPI)	LN(PPI)	LN(IPI)	LN(NEER)	LN(M)
2	CPI	80.90778	5.712157	2.586835	1.6649	9.128331
3		81.17531	5.55499	2.548714	1.764014	8.956973
6		77.42925	6.440238	3.740008	1.711976	10.67853
10		72.96747	9.968448	3.569115	2.119783	11.37518
2	PPI	5.737835	91.89694	0.000102	1.731614	0.633512
3		6.471262	83.59087	0.318639	4.051474	5.567756
6		13.15548	58.74957	0.256707	5.7129365	22.11887
10		22.91207	40.43376	0.130804	5.168906	31.35446
2	EXP	15.56391	2.485265	78.65463	1.981657	1.314534
3		17.50301	2.862755	71.20012	3.997302	4.43681
6		17.37406	3.178284	68.06212	5.977789	5.407747
10		17.28394	3.874291	67.29054	6.024608	5.526617

## 52.4 Conclusion

We consider two transmission mechanisms to explore the exchange rate movement of RMB impact on import prices, export prices, producer prices and consumer prices. The VAR analysis of ERPT has revealed several new important facts.

## References

1. Lu J (2007) An empirical study of the impact of RMB real exchange rate misalignment on the domestic prices. *Int Finance Res* 2010(8):57–58
2. Goldberg P (1997) Michael knetter I goods prices and exchange rates: what have we learned? *J Econ Lit* 35:1243–1292

3. Dornbusch R (1987) Rudiger1 exchange rate and price. *Am Econ Rev* 77(3):83–106
4. Devereux MB, Engel C, Storgaard PE (2010) Endogenous exchange rate pass 2 through when nominal prices are set in advance. *J Int Econ* 63:23–27
5. Dornbusch R, Krugman P (1976) Flexible exchange rates in the short run brookings papers on economic activity 7(3):53–75
6. McCarthy J (1995) Pass-through of exchange rates and import prices to domestic inflation in some industrialized economies, research department, federal reserve bank of New York staff report. 111:41–45
7. Campa JM, Goldberg LS (2005) Exchange rate pass-through into import prices. *Rev Econ Stat* 87(4):679–690
8. Yu X (2010) The pattern of exchange rate effects on Chinese prices, 1980–2002. *Rev Int Econ* 15(4):683–699
9. Faruqee H (2010) Exchange rate pass-through in the euro area: the role of asymmetric pricing behavior, IMF working paper 6(14):53–56
10. Fuentes M (2007) Pass-through to import prices: evidence from developing countries. Pontificia Universidad Catolica De Chile, Document de Trabajo 35:320–322
11. Korhonen I, Wachtel P (2009) A note on exchange rate pass-through in CIS countries. *Res Int Bus Finance* 573:24–26



# Chapter 53

## Study on Listed Company Accounting Policy Selection

Zhensheng Zhuang

**Abstract** The Company accounting policy selection refers in established range, according to the company production management objectives and characteristics, the formulated accounting policy process after analyzed and compared alternative accounting principles, methods and procedures. Accounting policy selection has two notable features: first, the selection is not the simple collection of individual principles and methods, but an integral optimization. That is the company accounting policies of the component should have inner consistent aim by the unified thought guidance. Second, selection is a dynamic process. The policies of primitively established need to select and the existing policy changes is also a kind of selection.

**Keywords** Accounting policy • Accounting policy selection • Listed company

### 53.1 An Overview on the Accounting Policy and Accounting Policy Selection

As the accounting standards for company's No. 28-accounting policy, accounting estimate changes and error correction (2006) regulated: accounting policy is to show the companies adopted the principle, basis and accounting methods in accounting recognition, measurement and statements. This definition includes two senses: one is that the government should formulate the optional principles, methods, and procedures for companies that are government's accounting policies [1, 2]. The other is that company must according to own actual situation, within the scope of the government's accounting policies, selects the suitable the principles, methods and procedures, that is the companies' accounting policies [3].

---

Z. Zhuang (✉)

Shan Dong Jiaotong University, Shan Dong, China

e-mail: zhuangzhensheng2@163.com

## **53.2 The Principle of Listed Company's Accounting Policy Selection**

### ***53.2.1 Consistency Principle***

Accounting policies selected by companies should maintain consistency and continuity from one period to the other. It should not be modified randomly. Companies should correctly handle the relationship between remain stable and timely adjust. If the accounting information provided by selected accounting policies is no longer relevance and reliability, the company unfavorable uses the accounting policy [4, 5]. It should reselect the most properly reflect a company's financial condition and operating results of the accounting policy, according to the current economic environment and operating conditions. The company accounting policy changes should be marked out in financial statements, making accounting information user can grasp the starting point and particular influence during companies selecting accounting policy, in order to correctly understand the connotation of accounting information.

### ***53.2.2 Applicability Principle***

The applicability of accounting policy is to ensure the accounting policies to be fully exert. When a company select accounting policies it should consider the characteristics of its production and business with financial environment in combination, such as industry characteristic, company production scale, internal management, company business performance, cash flow, solvency etc. This also means that as the production and operation condition of companies and financial environment changes, accounting policy itself should reselect to ensure the applicability of the new environment.

The applicability of accounting policy is to ensure the accounting policies to be fully exert. When a company select accounting policies it should consider the characteristics of its production and business with financial environment in combination, such as industry characteristic, company production scale, internal management, company business performance, cash flow, solvency etc. This also means that as the production and operation condition of companies and financial environment changes, accounting policy itself should reselect to ensure the applicability of the new environment.

### ***53.2.3 Principle of Combining the Costs and Benefits***

The company in the selection of accounting policies should weigh the cost effectiveness of providing accounting information. Based on the quality of basic accounting information be guaranteed, accounting policies of facilitate

understanding and implementation should be selected, and operating costs should be reduced as far as possible. When operating costs is roughly equal, company should preferred select the accounting information provided relevant and reliable accounting policies.

#### ***53.2.4 Principle of Combining the Legitimacy and Relative Independence***

The company accounting policy selection should choose in alternative accounting principles and specific treatment within the standards and regulations, so that we can guarantee comparability and reliability of the provided accounting information. As the accounting policy which is going to use and the state's tax regulations are inconsistency, accounting policy should keep their relative independence and stability, and follow the accounting itself inherent laws. It need not get bogged by the change or adjust of the national tax regulations, rules and policy.

### **53.3 The Problems of Accounting Policy Selection in China Listed Company**

Although our country has initially established a socialist market economic system, it is far from the perfect and developed market economy. It is also far behind American and western developed countries in the study of company accounting policy selection. At present, there mainly exist the following questions of accounting policy selection in our country listed company:

#### ***53.3.1 Using the Accounting Policy Selection as the Main Means to Operate Profit and Whitewashed Statements***

Currently, the listed company adopts non-standard accounting policy selection and use accounting policy selection generally to operate earnings management. This phenomenon frequently happens. In order to achieve the match qualifications, offering and listing and avoid punishment, many listed companies abused the option of accounting policies and adopted various measures, even breakthrough accounting system and accounting rules limit. It caused a relatively serious distortion phenomenon of accounting information and caused great damage to investors and other related. Judging from the recent case, using the accounting policy selection to operate profit and whitewashed statements mainly displays in the following aspects: company randomly change fixed assets depreciation policy, latent losses on account, using the accounting period assumption and

accrual basis, through confirmed ahead the loss of bad possible happen in later period of accrued items, to make profits transfer in different accounting period, abusing interest capitalized, randomly change “eight ready to” plan, etc.

### ***53.3.2 The not Correct Goal of Accounting Policy Selection can't Really Reflect the Original Intention***

In domestic listed company of accounting policy formulation and execution, company management authorities has larger selection space. Companies' future is uncertain, because a given set of accounting policy could not be all-inclusive. From the perspective of policy making, the purpose of making company have more professional judgment is to make company have more freedom in judging its own economic situation; to select the most reflected the economic substance of accounting policies. And our country company in the selection inclination of accounting policy, stresses some purposes as circumvented market supervision, recessive share out bonus, get tax benefits and debt contract, etc. In order to reach these aims, many companies try their best to make bill performance for losses, thus to avoid or postpone pay taxes. Or whitewash statements in favor of applying for a loan and evading market regulation. The result is that the phenomenon of listed company manipulating earnings through using accounting policy selection become seriously, abused accounting policy selection right, even breakthrough criterion and system limit, caused the serious distortion of accounting information and heavy loss to investors, stakeholder, etc.

### ***53.3.3 Accountants' Practicing Judgment Ability is Low; the Company Accounting Policy Selection is Unreasonable***

At present, from the accounting policy selection effect point of view, the company really implementing the accounting policy selection is still few. Most company can't achieve integral optimization purposes. Some companies had no unified guidelines and scientific selection processing in process of policy, thus offsetting part of policy selection function. Large random selection of accounting policies results that some of the accounting information can not really reflect the financial condition, operating results and cash flow. So, the policy effectiveness could not be evaluated. For example, the Ombudsman in Hunan of Ministry of Finance sent the headquarters did a special inspection to the quality of accounting information in 2006 of Data huayin Electric Co.'s subordinate 11 home and subsidiaries, in 2007. Under inspection, the company adopted various means to control profit in the accounting. It mainly involved fundamental accounting work, the information disclosure, accounting, taxation management, etc. Above behavior of the company, in addition to through the accounting policy selection to control the profit, it does not exclude low practicing judgment ability of accounts actually engaged in accounting business, the unreasonable company accounting policy selection and other reasons.

### ***53.3.4 The Implementation of the New Accounting Standards Increased the Subjectivity of Accounting Policy Selection in Some Ways***

On February 15, 2006, China's Ministry of Finance issued the new Companies Accounting Standards made of 1 basic accounting standard and 38 specific accounting standards. It first was implemented in the listed company from January 1, 2007. Encouraging companies to carry out in advance, it tried to soon cover the large and medium-sized companies in China. New accounting standards once again adopted "fair-value" measurement attributes again. It is conducive to achieving convergence with international accounting standards. New accounting standards provided a more detailed guide on the measurement of impairment the recoverable amount, made practical operation convenient, and avoided the listed company random provision and return for long caused by without provision for impairment loss. However, asset information, the price market mechanism in china is not sound. It is a certain degree difficult on the measurement of fair value and recoverable amount. In addition, the discount rate determined when the present value of future cash flows was expected with a great Subjective. It mainly relies on subjective judgments of accounts. All these would cause some difficulty in accounting policy selection.

## **53.4 The Way to Optimize Accounting Policy Selection Behavior of the Listed Company**

Optimization of accounting policies, the key is to prevent excessive abuse, minimize induced abuse motives, narrowing the accounting policy selection space, and optimize their selection behavior. According to accounting environment in China, we must improve the accounting standards for companies and other related standards; improve corporate governance mechanism, through optimizing operator behavior etc. to realize optimization of accounting policy selection.

### ***53.4.1 Optimize Restriction Mechanism, Perfect the Relevant System, and Reduce Using Accounting Policy Selection to Manipulate Surplus***

Clear restriction mechanism of accounting policy selection, and make it normalization and efficient, in order to achieve the optimal combination of accounting policies. This will be conducive to effectively configuration of social resources and stable development of company, thereby enhancing the effectiveness of the

whole society. From the perspective of the accounting policy selection motives, some motives of manipulation surplus can eliminate or ease through improving relevant system. For example, the problems of applying for listing, match, suspension and delisting qualification about listed companies, has been taken equity reached a certain level as the only financial control parameter. Whether matches qualification system or delisting system, it obviously is insufficient using single financial indicators for control parameters. The single index is likely to cause surplus manipulations. Net assets or profits are not a only index to comprehensively evaluate its financial condition, operating results and cash flows for the sole indicator. Corporate profits and the rate of net capital on this basis are closely related to method of valuation of assets, income, costs and the principle. Profits under the accrual basis are a product of subjective judgments. The level of corporate profits does not mean the abundant degree of its cash flow. Asset pricing model measured with historical cost as the leading property, made the net assets of net assets income rate can not reflect the current value of assets. Therefore, capital market regulation measures should be reformed. The listed company earnings quality indicators should be reset. Multiple accounting and the unaccounting index system should be used on listed company's market regulation, to increase the difficulty of the listed company to operate profit and escape market regulation by using the accounting policy.

### ***53.4.2 Perfect Accounting Standards and Other Related Specifications; Reduce the Space of Using Accounting Policy Selection***

As a result of separation of ownership and management, information asymmetric between the company and contractor and incompleteness of companies agreement, the company management authorities must possess companies' surplus control right, and the accounting policy selection is just a reflection of it. The characteristics of accounting contract and limitations of accounting standards, made selection space objectively exist. This is the important premise that company use accounting policies to manipulate financial report. Since we can't completely eliminate the phenomenon of accounting policy selection in reality economic life, all we can do is to control accounting policy selection in acceptable range of company stakeholders through regulating and perfecting the company contract and social contract, and through strengthening the supervision.

After years of accounting theory's accumulation and practice, the accounting standards of listed companies in China have initially established a relatively perfect system including accounting laws, corporate accounting standards, internal accounting system of listed companies, etc. However, the existing Accounting Law should be modified and added according the actual situation. And Implementing Regulations should be formulated to ensure it real implementation.

### ***53.4.3 Further Improve the Information Disclosure System, Strengthen Supervision***

Impeccable information disclosure system is the prerequisite for companies to realize efficient governance. Powerful information disclosure system is typical characteristic to monitor the company, is the key to exercise their voting rights for shareholders, is a powerful tool to influence corporate behaviors and protect investor's interests. Other stakeholders also need to use company's disclosure information especially the accounting information make the corresponding decisions. The key to strengthen information disclosure is to strengthen establishment and consummation of the internal and external auditing system. The more financial information is public, the greater effectiveness of extrinsic restraint mechanism of CPA, justice and government and other external persons and institutions. First, the deterrent and punishment are mechanism of laws and regulations. If the accounting policy selection violates relevant laws and regulations, the company would be subject to corresponding sanctions. Second, the CPA as the external auditors having more knowledge and skills, not only audit legitimacy and consistency, but also the reasonableness and the adequacy disclosure of accounting policy selection.

### ***53.4.4 Improve Accountants' Professional Ethics and Professional Qualities***

First, professional ethics education to accounts should be strengthened, prompting them regulate their professional behaviors, made them honest, credible, objective and fair, not make false account. And a social evaluation mechanism should be established taking social public opinion and credit archives system as the basic form. Second, the ability of accounts' professional judgment must be strengthened to ensure the rationality of companies' accounting policy selection. Due to changing accounting environment and the increasing complexity of accounting objects, accounts have the more and more space of using professional judgment. To improve accountants' professional judgment ability, has become the important guarantee to correctly select accounting policies. Accounts should take the initiative to adapt to the new accounting requirements and continuously improve the accuracy of professional judgments. Meanwhile, the financial sector should cope with the accounts to continue education, multi-level and comprehensively train accounts, explain difficult problems of accounting standards and systems, the content and methods needing professional judgment, to improve their theoretical level and professional judgment ability.

## **References**

1. Ruisheng L, Li Z (2005) Research on the accounting policy selection of modern enterprise. *Acc Res* 452(8):56-57
2. Luo L (2010) Accounting standards for business enterprises. *Ministry Finance* 24:62-66

3. Yang Chengwen (2006) Research on accounting policy selection of listed company, vol 62. Lixin Accounting Publishing House, pp 345–346
4. Yuan N (2010) Discussion about enterprise accounting policy. Securities Futures China 53(6):35–37
5. Wang W (2004) A study of the problems in the listed companies and countermeasures. J Jiangsu Polytech Univ 5(3):65–68



# Chapter 54

## Research on Effect of Banks Risk Weighted Assets

Weiguo Xiao and Yurui Huang

**Abstract** Risk weighted assets are an important element of risk-based capital ratios. Indeed, banks can increase their capital adequacy ratios in two ways: (1) by increasing the amount of regulatory capital held, which boosts the numerator of the ratio, or (2) by decreasing risk-weighted assets, which is the denominator of the regulatory ratio. We study how investors account for the riskiness of banks' risk-weighted assets (RWA) by examining the determinants of stock returns and market measures of risk. We find that banks with lower RWA performed better during the US and European crises. This relationship is weaker in Europe where banks can use Basel II internal risk models. RWA do not, in general, predict market measures of risk although there is evidence of a positive relationship before the US crisis which becomes negative afterwards.

**Keywords** RWA • CAPM • Financial crisis

### 54.1 Introduction

The financial crisis that began in 2007 has exposed a number of important weaknesses in banking regulation. A key challenge is how to appropriately determine the riskiness of banks' assets [1]. The principle that regulatory capital requirements should be tied to the risks taken by banks was accepted internationally and formalized with the Basel I accord in 1988, and the definition of capital and measurement of risks have undergone several revisions since that time [2]. The second Basel accord, published in 2004, recommended banks hold total regulatory capital equal to at least 8 % of their risk-weighted assets (RWA). The recently updated Basel III guidelines emphasize higher quality forms of capital, but makes limited strides in the measurement of risks. Instead, Basel III proposes as a complementary measure, a non-risk weighted leverage ratio [3].

---

W. Xiao (✉) · Y. Huang  
Economics and Management School, Department of Finance, Wuhan University,  
Wuhan, Hubei, China  
e-mail: wgxiao@whu.edu.cn

Y. Huang  
e-mail: hyr817@gmail.com

Risk weighted assets are an important element of risk-based capital ratios. Indeed, banks can increase their capital adequacy ratios in two ways: (1) by increasing the amount of regulatory capital held, which boosts the numerator of the ratio, or (2) by decreasing risk-weighted assets, which is the denominator of the regulatory ratio. A key concern about current methods of determining risk-weighted assets is that they leave room for individual banks to “optimize” capital requirements by underestimating their risks and thus being permitted to hold lower capital [4].

In this paper, we study whether equity investors find banks’ reported risk-weighted assets to be a credible measure of risk [5]. Our paper studies whether markets price bank risk as measured by RWA, to inform the debate on how best to measure the risks embedded in banks’ portfolios. Addressing the first question, we find that banks with higher RWA performed worse during the severe phase of the crisis, from July 2007 to September 2008, suggesting that equity investors did look at RWA as a determinant of banks’ stock returns in this period. This relationship is weaker in Europe where banks can use Basel II internal risk models.

Regarding the relationship between RWA and stock market measures of bank risk, we find that RWA do not, in general, predict market measures of banks’ riskiness [6]. There is evidence, however, of a positive relationship between RWA and market risk in the three years prior to the crisis, from 2004 to 2006, and this relationship becomes negative after the crisis. This could result from the large increase in market measures of risk, which reflect the volatility of a bank’s stock price, since the crisis, while banks have not adjusted their RWA to account for increased risk [7].

## 54.2 Data and Methodology

The sample consists of 808 publicly-listed deposit-taking institutions in 35 countries, spanning North America, Europe, Asia, and Australia. The balance-sheet and income statement data are from the Bank scope database, which has good coverage from 2004 onwards, and the stock return data is from DataStream. We discard obvious mistakes in the data as well as outliers at the 1 and 99 % levels [8].

The average bank stock return from June 30, 2007 to September 30, 2008, the phase of the financial crisis before the beginning of government capital purchase programs, was a poor  $-31\%$  with a large standard deviation of  $27\%$ . The stock return during the recent Euro zone debt crisis is also low, at  $-13\%$ , with a similarly large standard deviation of  $20\%$  (see Table 54.1).

**Table 54.1** Descriptive statistics—stock returns over periods of crisis

	June 2007 to Sep 2008 (770 obs)	June 2011 to Sep 2011 (808 obs)
Mean	-31.37	-13.10
Std. Dev.	26.55	19.60
Min	-99.97	-75.28
Max	78.49	192.36

Our first hypothesis is that banks with higher risk-weighted assets will perform worse during a period of crisis.

### ***54.2.1 Banks with Lower RWA Will Perform Better During the Crisis***

Second, we expect a positive relationship between capital and stock returns, since capital functions as a buffer against adverse shocks by providing loss absorbency beyond provisions and other expected-loss buffers [9]. A higher share of customer deposits in funding decreases the susceptibility of banks to runs, so we expect banks with more stable funding to perform better during periods of crisis. There may also be a trade-off between these two factors, in that banks with higher capital are better able to withstand liquidity problems [10].

### ***54.2.2 Banks with Higher Capital Ratios Will Have Higher Stock Returns During the Crisis and Banks with More Stable Funding Will Have Higher Stock Returns During the Crisis***

#### **54.2.2.1 Banks with More Stable Funding Will Not Receive as High a Reward for Higher Capital, Compared to Banks with Less Stable Funding**

Third, if RWA are a good measure of asset-risk, we expect they will be positively related to market-based measures of risk. The relationship between the two, if found, could change in either direction after the crisis. The onset of the crisis could render RWA less credible to investors, or the increase in risk-aversion associated with crisis could result in increased sensitivity to any available information on asset-risk.

### ***54.2.3 Market Measures of Bank Risk Will be Positively Correlated with RWA***

#### **54.2.3.1 This Relationship may Change After the Financial Crisis**

To test these hypotheses we estimate two models. In the first, we study the effects of risk weighted assets and capital adequacy on the cross-section of banks' stock returns, while controlling for other balance-sheet measures of risk

exposure. We perform least squares dummy variable (LSDV) estimation, with country fixed effects, on the model:

$$r_i = \theta_0 + \theta_1(RWA/TA)_{i,t-1} + \theta_2(Capital/TA)_{i,t-1} + X_{i,t-1}\gamma_1 + \eta_i \quad (54.1)$$

where the dependent variable  $r_i$  is the real stock return in US dollars from June 30, 2007 to September 30, 2008 for bank  $i$ . The end date is chosen to precede the beginning of the Troubled Assets Relief Program, established in October 2008, in which the U.S. Department of the Treasury, infused capital into qualifying financial institutions. We also study stock returns over the three-month period from June 30, 2011 to September 30, 2011 to contrast market reactions in the recent European sovereign debt crisis to the first phase of the global financial crisis. In both cases, all of the explanatory variables are lagged by 1 year. Table 54.2 reports descriptive statistics for the explanatory variables in 2006 and 2010.

The main explanatory variables of interest are the ratio of risk-weighted assets to tangible assets and the capital ratio.

The other explanatory variables, in  $X_{i,t-1}$  are:

1. Stability of funding, measured as the share of customer deposits in total deposits and short-term funding
2. The ratio of securities to assets, as a proxy for the liquidity of assets
3. The share of non-performing loans
4. Return on average assets, a measure of the bank profitability
5. The log of assets, to proxy for bank size
6. Country dummies, to control for differences in the institutional and regulatory environments across countries
7. Dummy variables to control for the specialization of the bank.

Table 54.3 shows descriptive statistics for the market measures of risk. The explanatory variable is as in model (1) except we now include the squared capital ratio  $(Capital/TA)^2$ , to test the hypothesis of a U-shaped effect of capital on bank risk-taking.

**Table 54.2** Descriptive statistics—explanatory variables

	2006 (770 obs)		2010 (808 obs)	
	Mean	Std. Dev.	Mean	Std. Dev.
TCE/RWA	11.26	8.37	10.73	6.00
Tier 1/RWA	12.73	7.61	13.06	5.03
Total Capital/RWA	14.47	7.37	14.96	4.87
RWA/Assets	42.40	31.47	66.60	14.86
CustDeposits	90.56	11.85	91.20	11.22
Securities/Assets	19.92	11.57	22.14	11.88
NPL/Loans	1.66	2.72	4.45	4.83
ROAA	0.87	0.90	0.38	1.18
Log(Assets)	14.92	2.28	15.29	2.34
Beta	0.24	1.07	1.00	1.33

**Table 54.3** Descriptive statistics—market measures of risk

	Vol of monthly stock return	Beta	Idiosyncratic Vol
Mean	9.15	0.63	-1.52E-09
Std. Dev.	7.87	1.27	7.12E-08
Min	0.16	-4.08	-1.75E-06
Max	184.84	5.45	1.12E-06

## 54.3 Estimation Results

### 54.3.1 Market Perceptions of Risk-Weighted Assets

Table 54.4 presents the results of our benchmark estimation of model (1), the determinant of stock returns over 2007–2008 crisis periods.

As expected, we find that stock returns are lower for banks with higher risk-weighted assets. The relationship is statistically quite significant and the effect is such that banks with a 1 % point higher RWA to tangible assets (TA) ratio have a stock return that is 0.06 % points lower. The tangible common equity to TA ratio is positively related to stock returns in the cross-section, but the two broader measures of capital adequacy are not. The signs of the coefficients on the additional explanatory variables are as expected. Higher stock returns are associated with more stable funding, more liquid assets, a lower share of non-performing loans, and a higher accounting return on assets. However, only the liquidity of the assets, measured as the share of securities to assets, and the accounting return on assets have a strong statistical relationship with the stock returns.

### 54.3.2 Is There a Capital-Liquidity Trade-Off

We find a trade-off between capital and liquidity in terms of their positive effects on bank stock returns.

Table 54.5 presents the results of the estimation of model (1) in which an interaction term between capital and funding stability and, subsequently, an interaction term between capital and the liquidity of assets, are included. The negative coefficient on the interaction term in column (2) shows that the more stable a bank's funding, the less positive the effect of higher capital on its stock returns. Similarly, column (3) indicates that the more liquid a bank's assets, the less an increase in capital will increase its stock return.

### 54.3.3 Differences Across Regions

We find some evidence consistent with the regions' hypothesis in Table 54.6.

The estimated coefficient on the interaction term between the indicator for banks in Asia and RWA/TA in column (2) is negative, at  $-0.103$ , indicating that

**Table 54.4** Determinants of returns: do risk-weighted assets affect stock returns

	(1)	(2)	(3)
RWA/TangibleAssets	-0.065*** (0.013)	-0.059*** (0.013)	-0.064*** (0.011)
TCE/TangibleAssets	0.292*** (0.074)		
Tier1capital/TangibleAssets		-0.011 (0.085)	
TotalCapital/TangibleAssets			0.026 (0.089)
CustomerDeposits	0.045 (0.069)	0.056 (0.072)	0.054 (0.070)
Securities/Assets	0.673*** (0.107)	0.688*** (0.103)	0.682*** (0.102)
NPL/Loans	-0.279 (0.183)	-0.293 (0.194)	-0.302 (0.196)
ROAA	5.101*** (0.502)	4.706*** (0.679)	4.755*** (0.600)
Observations	766	760	766
R-squared	0.181	0.178	0.179

\*\*\*indicates significance at the 1 % level

**Table 54.5** Determinants of returns: is there a capital and liquidity trade-off

	(1)	(2)	(3)
TCE/TangibleAssets	0.292*** (0.074)	4.196*** (1.493)	5.604** (2.197)
CustDeposits	0.045 (0.069)	0.319*** (0.085)	0.396*** (0.121)
(TCE/TangibleAssets) *CustDeposits		-0.041*** (0.015)	-0.048** (0.019)
Securities/Assets	0.673*** (0.107)	0.666*** (0.103)	0.983*** (0.314)
(TCE/TangibleAssets) *(Securities/Assets)			-0.034* (0.019)
RWA/TangibleAssets	-0.065*** (0.013)	-0.064*** (0.012)	-0.074*** (0.011)
NPL/Loans	-0.279 (0.183)	-0.262 (0.160)	-0.248* (0.134)
ROAA	5.101*** (0.502)	4.158*** (0.547)	4.517*** (0.469)
Observations	766	766	766
R-squared	0.181	0.186	0.193

\*\*\*indicates significance at the 1 % level

\*\*indicates significance at the 5 % level

banks in Asia with higher RWA have lower stock returns as a result, compared to the banks in other regions. In column (4), the positive coefficient of 0.169 on the interaction coefficient, indicates a positive relationship between RWA/TA and stock returns for banks in Europe, unlike for the rest of the banks in the sample. This indicates that markets are not rewarding European banks for lower RWA, which may suggest a lack of credibility of their RWA. Finally, the relationship between RWA and returns for American banks, in column (3) is in between those for Asia and Europe, as expected. The magnitudes of the estimated interaction coefficients are consistent with the hypothesis that markets do not use RWA in their assessment of banks in regions where banks are more able to “game” the measure, however the differences in the samples are not statistically significant.

**Table 54.6** Determinants of returns: are the effects of RWA different in the United States, Europe, and Asia

	(1) No interactions	(2) X = Asia	(3) X = US	(4) X = Europe
TCE/TangibleAssets	0.292*** (0.074)	0.298*** (0.078)	0.895** (0.424)	0.306*** (0.067)
X*TCE/TangibleAssets		0.263 (0.426)	-0.654 (0.417)	1.009 (1.661)
RWA/TangibleAssets	-0.065*** (0.013)	-0.053*** (0.012)	-0.144 (0.103)	-0.076*** (0.014)
X*RWA/TangibleAssets		-0.103 (0.136)	0.074 (0.102)	0.169 (0.255)
CustDeposits	0.045 (0.069)	-0.008 (0.066)	0.082 (0.093)	0.075 (0.060)
X*CustDeposits		0.204 (0.161)	-0.108 (0.092)	0.026 (0.148)
Securities/Assets	0.673*** (0.107)	0.699*** (0.101)	0.282 (0.169)	0.737*** (0.066)
X*Securities/Assets		-0.103 (0.121)	0.554*** (0.170)	-0.774** (0.343)
NPL/Loans	-0.279 (0.183)	-0.306 (0.224)	-0.199 (0.130)	-0.267 (0.208)
X*NPL/Loans		-0.447 (0.828)	-5.411*** (0.153)	-0.567 (0.722)
ROAA	5.101*** (0.502)	4.828*** (0.366)	3.762 (2.426)	4.943*** (0.452)
X*ROAA		1.820 (2.846)	0.589 (2.429)	-6.771 (5.210)
Observations	766	766	766	766
R-squared	0.181	0.190	0.213	0.190

\*\*\*indicates significance at the 1 % level

\*\*indicates significance at the 5 % level

Other differences in which balance-sheet measures are rewarded with higher stock returns across regions are also apparent. American banks receive a higher reward for holding more securities, and European banks with higher securities are actually penalized with a lower stock return. Market reactions to American banks are also different in that American banks are more heavily penalized for having a higher share of non-performing loans. Column (3) indicates that American banks with a 1 % point higher share of non-performing loans in 2006 had stock returns that were approximately 5.6 % points lower over the crisis.

## 54.4 Conclusions

Regarding banking stock returns, we find a negative relationship between RWA and stock returns over periods of financial crisis, suggesting that investors use RWA as an indicator of bank portfolio risk. Indeed, banks with higher

risk-weighted assets performed worse during the severe phase of the crisis, from July 2007 to September 2008. We find a similar result when we focus on the ongoing crisis in the Europe.

Comparing regions with different regulatory structures, we find, however, that the relationship between stock returns and RWA is weaker in countries where banks have more discretion in the calculation of RWA. Specifically, in countries that had implemented Basel II before the onset of the recent financial crisis, allowing banks to use their own internal models to assess credit risks, investors look to other balance-sheet measures of risk exposure but not RWA.

We confirm results from previous studies that only capital with the greatest loss-absorbing potential matters for stock returns. In addition, we find a trade-off between capital and liquidity in terms of their positive effects on bank stock returns. The more stable a bank's funding, the less positive the effect of higher capital on its stock return; the more liquid a bank's assets, the less an increase in capital will increase its stock return.

When it comes to stock-market measures of risk, we find that RWA do not, in general, predict market measures of bank risk. There is evidence, however, of a break in the relationship between stock market measures of risk and RWA since the start of the crisis. Indeed, we find a positive relationship between RWA and market risk in the 3 years prior to the crisis, from 2004 to 2006, and this relationship becomes negative after the crisis. This could result from the large increase in market measures of risk, which reflect the volatility of a bank's stock price, since the crisis, while banks have not adjusted their RWA to reflect increased risk.

Indeed, the asymmetry of information between banks, supervisors, and market participants regarding how risky RWA are can lead to increased uncertainty about the adequacy of bank capital, which during a financial crisis; can have damaging effects for financial stability.

## References

1. Acharya VV (2011) Ring-fencing is good, but no panacea, the future of banking. In: Thorsten B (ed) *A VoxEU.org eBook*, vol 35. Centre for Economic Policy Research, pp 84–88
2. Aggarwal R, Jacques KT (2001) The impact of FDICIA and prompt corrective action on bank capital and risk: estimates using a simultaneous equations model. *J Banking Finance* 25(6):1139–1160
3. Ashcraft AB (2008) Does the market discipline banks? New evidence from regulatory capital mix. *J Financ Intermediation* 17:543–561
4. Beltratti A, Stulz RM (2011) The credit crisis around the globe: why did some banks perform better? Fisher College of Business WP 2010-03-005
5. Bradley MG, Wambeke CA, Whidbee DA (1991) Risk weights, risk-based capital and deposit insurance. *J Banking Finance* 15:875–893 August
6. Calem P, Rob R (1999) The impact of capital-based regulation on bank risk-taking. *J Financial Intermediation* 8(4):317–352
7. Cordell LR, King KK (1995) A market evaluation of the risk-based capital standards for the U.S. financial system. *J Banking Finance* 19:14–16



8. Demirgüç-Kunt A, Huizinga H (2009) Bank activity and funding strategies: the impact on risk and return, working paper, vol 84. European Banking Center, Tilburg University, Holland, pp 52–55
9. Nicolò D, Dell’Ariccia G, Laeven L, Valencia F (2010) Monetary policy and bank risk taking. IMF Staff Position Note SPN 25:563–566
10. Flannery MJ, Rangan KP (2002) Market forces at work in the banking industry: evidence from the capital buildup of the 1990s. Proceedings, Federal Reserve Bank of Chicago, issue May 46:146–147

# Chapter 55

## Research on the Urban Public Transport Route Accounting System

Zhike Han, Quan Pan and Bowen Yang

**Abstract** Bus route accounting system with basic accounting methods and financial accounting principles of double-entry bookkeeping, the use of passenger daily, real-time billing, supplies, human resources systems to provide real-time data to a single line of commercial vehicles and accounting unit of revenue, costs, costs of collection, and ultimately accurate reflection of Bus routes, the fleet of the company's production operations financial condition.

**Keywords** Bus route accounting • Public transport • Cost-sharing

### 55.1 Introduction

In recent years, while the scale of public transport enterprises, increased traffic, fuel prices, operating costs increased sharply, companies face a severe test; the other hand, government investment in public transport enterprises increased year by year, the government purchase of public goods—public transportation services policy the implementation of public transportation cost supervision and examination system to establish prices are on the bus company's financial accounting of a new and higher requirements. However, bus companies in the first premise of social protection still need to reduce losses, increase economic efficiency. The existing accounting system bus under this new situation cannot meet, hence the need for financial accounting model of innovation, implementation of the bus company management process reengineering. So the bus companies to use “cycle accounting” model to enhance cost management, improving economic efficiency [1].

---

Z. Han (✉) · Q. Pan · B. Yang  
Computer Science and Technology College of Zhejiang University, Hangzhou, China  
e-mail: hanzk@zucc.edu.cn

Q. Pan  
e-mail: pan.quan.zu@gmail.com

B. Yang  
e-mail: ybw\_zju@126.com

Cycling routes for the current accounting system is in major cities public transportation group based on the company internal management needs, through computer-aided calculation cycle and line costs (profits) to provide support for enterprise decision management information systems.

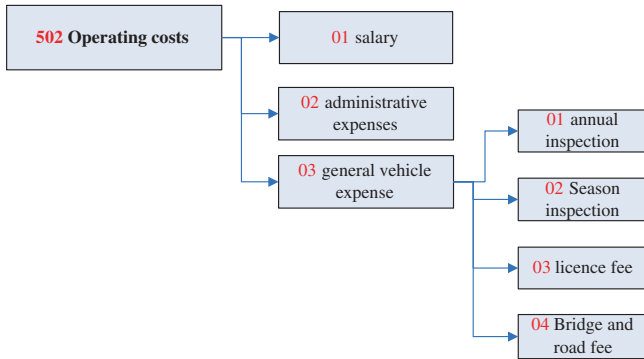
## **55.2 Accounting Principles and Accounting Methods**

Spread of information technology in the enterprise before the accounting concept bike has been produced, when the Bus is mainly accounted for the most traditional accounting based method of accounting, some are carrying on in the chapter. The project has been very involved during the many, very large amount of data to Hangzhou Public Transport Group Co., Ltd., for example, the company is divided into several subsidiaries, affiliates following further divided into teams, and cycling routes, the size of the company now has a very large, involving the wider the line, company-wide about 5,000 buses involved in daily operations. In order to monitor the Group's income and expenditure, vehicles bound to the income and expenditure statistics. The project involved a very long, as the main business revenue, main business cost, so there are ten or so large items, large items is divided in many small projects, there are numerous items related to the hundreds of small. These vehicles and so many more projects together, use the end of the financial accounting into a very heavy work. Moreover, the requirements for accuracy, but also increased the financial burden on staff.

Given that the company has a number of departments or the relevant part of the reality of information management, has been running online daily passenger transport system, real-time billing, supplies, human resources systems, using data provided by these systems, Bus routes can be accounting for such a heavy workload to a system of imputation of work to achieve. Thereby reducing the burden of financial and accounting staff provide more timely and accurate group, company, team, circuit, cycle cost and profit statistics for leadership decision-making faster and more accurate information for the development of strong business support.

### ***55.2.1 Accounting Elements***

Bus route accounting system needs of the business logic is very clear, that is with the aid of basic double-entry accounting methods and financial accounting principles, the use of passenger daily, real-time billing, supplies, human resources systems to provide real-time data to a single commercial vehicles for the accounting unit of revenue, costs, costs of collection, thus completing the cycle, the line, the fleet operating companies, the company's cost accounting and profit comprehensive statistics, and ultimately accurate reflection of Bus routes, the fleet of the company's production operations financial position.



**Fig. 55.1** Sub-project level accounting design

Accounting elements: (1) Information elements: number, line, work number, km; (2) accounting elements: income, costs, expenses, profits; (3) the accounting equation:  $\text{income} - \text{costs} - \text{expenses} = \text{profit}$ .

Project in the accounting system is the basic unit of accounting. Systems involved in the project: Main business revenue, main business cost, operating overhead, support operating expenses, taxes and surcharges, management fees, finance charges, profit. These projects will maintain the tree structure; each accounting for the project will have a set of properties to define its distribution and formulas. Project the same basic financial and accounting subjects, but according to the company’s management requirements will be more refined, some of the projects will also appear on a different level subjects (such as: all kinds of social security funds). Accounting classification project management, system design for the non-class time limits, can be infinitely set lower subjects. Numerical code at all levels of the project; the number of coding bits is no longer required. However, taking into account the possible consistent with the accounts, it is recommended to set the format: (Fig. 55.1).

A subject with 3-digit (with the same accounts), subjects with lower 2-digit, level between the use of “.” Separated, such as: license fee item number is 502.03.03.

### 55.2.2 Accounting Method

In this chapter, the cost position of accounting methods [2]. In this method, the cost accounting of the accounting methods are usually divided into three categories, namely, to answer three questions: (1) What happened costs—cost category accounting; (2) These costs take place—the cost of location accounting; (3) for whom these costs occur—costs borne by accounting. Cycling bicycles based financial accounting for the revenue cycle can not be directly included in the cost, according to standard operating km km-sharing law or off, according to the provisions of the statutory calculation of cost basis and the proportion accounted for. The following major subjects of the cost accounting method to do a brief description:

(1) the main business revenue accounting cycle in a certain accounting period for the actual operating income, the specific breakdown by income category; (2) Business tax and surcharges accounted for cycling in a certain period of actual tax accounting; (3) main business cycle in a certain accounting cost accounting for manufacturing operations that occurred during the actual cost, and thus the occurrence of cost-sharing, the specific breakdown by cost category; (4) accounting for the indirect costs of operating the team occurred during the operation of production management expenses, including station management expenditures incurred. The fee can be charged directly to the Bus should be accounted for, not included in the Bus according to the provisions of the accounting cycle estimation methods are included in the cost-sharing. (5) The statutory basis for the calculation of the cost required to calculate the share and proportion; (taxes, three funds, five insurance payments a fee).

### 55.2.3 Cost-Sharing Method

The need to share the cost of the previous section of the main business costs and operating overhead costs, which algorithm to use has been controversial for sharing the original share point is used in the standard model [3], that is, according to the time scale for cycling cost-sharing, but this way of statistics and to get more difficult, this chapter introduces a kind of standard operating km or km-scale folding Busto visit cost-sharing method. In kilometers below the salaries of personnel costs, for example to illustrate the cost allocation method; the bus companies are generally divided into management levels are generally divided into companies and fleet-level management personnel.

The company management salaries, for example, the accounting project: Indirect operating costs (4,105) \_\_ management staff salaries (01); item codes for the 4,105.01.

Suppose there are n units below a company operating the vehicle (n = 1, 2, 3...), i-th vehicle to share the cost of 4,105.01 is  $\cos t_i$ , Operation of the car mileage for the months  $rang_i$ . The company has m management employees (m = 1, 2, 3...), j-th of management salaries for the is  $salags_j$ .

I-th vehicle is allocated to the cost of 4,105.01  $\cos t_i$  is:

$$\cos t_i = \frac{\sum_{j=1}^m salags_j}{\sum_{i=1}^n rang_i} \times rang_i$$

Similarly for the team management staff sharing algorithm:

$$\cos t_i = \frac{\sum_{j=1}^m salacd_j}{\sum_{i=1}^n rangcd_i} \times rang_i$$

Of which  $\sum_{i=1}^n rangcd_i$  is the operation for the fleet total mileage of the vehicle,  $\sum_{j=1}^m salacd_j$  Management team following the total wages. Similarly other methods of cost allocation will not repeat them.

### 55.2.4 Line Cost-Sharing Method

In the actual situation in which the line and there is no fixed management vehicle management, for example, the temporary secondment of the vehicle, the vehicle will cause changes in affiliation with the vehicle line adjustment of relations. However, due to the introduction of standard operating miles or kilometers off scale for the accounting, cost accounting methods may rely on the vehicle line's daily report of the external data that is attached to the line the next day the vehicle mileage to solve the line costing.

The company management salaries, for example, read from the system daily passenger data can be drawn a single car on the  $i$ -th ( $i = 1, 2, 3 \dots$ ) Lines in the  $j$  ( $j = 1, 2, 3 \dots$ ) Km under the operation  $rang_{(i,j)}$ , The line of total operating mileage of place  $rang_j$ , Then the  $i$ -th vehicle to 4,105.01 of the subject company management pay costs to the  $j$ -line following the  $costxl_{(i,j)}$ , so

$$costxl_{(i,j)} = \frac{rang_{(i,j)}}{rang_j} \times cost_i$$

$J$ -th line of 4,105.01 of the company management wage costs  $costxl_j$  is:

$$costxl_j = \sum_{i=1}^n costxl_{(i,j)}$$

Other subjects are similar.

### 55.2.5 System Building

Here in Hangzhou Public Transport Group's Bus route accounting system, for example, describes the system's business processes, where the budget of the NC system software using the UF system. System consists of three components: (1) The first stage of the cycling part of the budget accounting: NC budget with all kinds of basic file system synchronization, are: departmental files, personnel files, budget items; NC budget items will be introducing the budget targets and import tables to a revenue budget line accounting system to produce budget cycle stage of the line budget costs; (2) The second part of the accounting phase of the cycle accounting: the first branch in the NC system for financial accounting subjects to form aggregate results as a Bus cost accounting basis; to import or read into the passenger Daily, real-time billing, supplies, human resources systems,

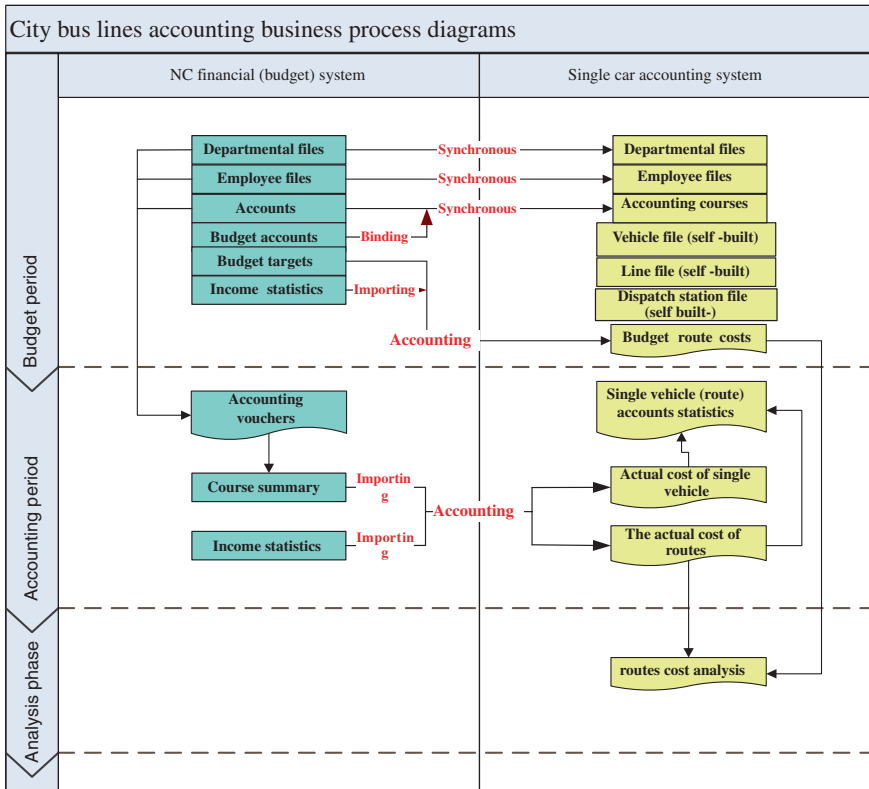


Fig. 55.2 Accounting business processes

these systems provide data; then during the cycle after cycle cost accounting system and the line cost accounting; final accounting resulting from cycling (line) accounting tables; (3) The third part is the analysis phase of the cycle accounting: the budget phase of the line costs and cost accounting phase of the line budget analysis, providing decision support data; the figure is a business flow chart (Fig. 55.2).

### 55.3 System Construction and Application

System uses Struts and Hibernate development model [4]. The various components of Struts, Servlet, JSP Taglib tag library also integrated in the framework of a complete system within which it has the MVC pattern by “the separation of business logic code and presentation logic code” capability. In the Struts framework, the model is generally achieved by the business logic Java Bean or EJB components, the controller comes from the framework of the Action servlet and

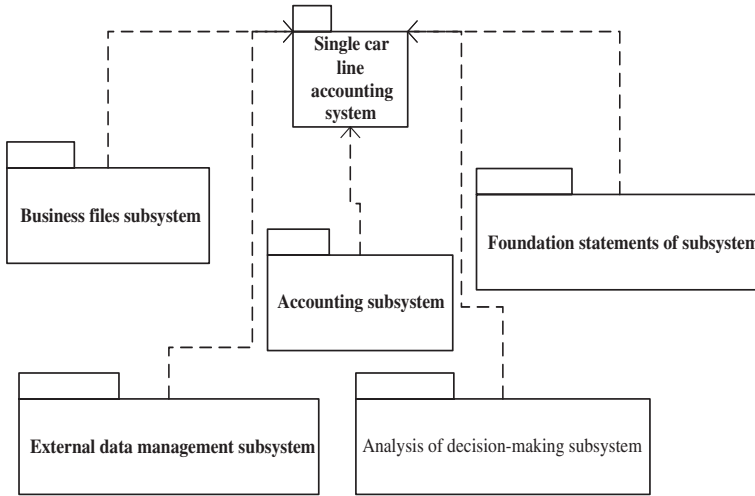


Fig. 55.3 System static map

developers expanded the Action to achieve the general view is constituted by a set of JSP files [5].

Hibernate is an ORM framework is now more processes, with its superior performance has attracted wide developer of all ages. It implements the JDBC for a lightweight package, making the system developers can use the object-oriented thinking to relational database operations to achieve the transparency of the underlying database. Hibernate not only implements the Java class to the mapping between database tables, it also provides data query and access methods, enabling developers to query the database in operation or the difficulty of accessing data greatly reduced.

Figure 55.3 is a system UML static diagram.

### 55.4 Summary

Bus route accounting makes the information integration effective, changes in financial accounting methods. For the income can be broken down, the cost of the project, can be read from the other existing systems, after the establishment of a seamless interface to read, change the existing system cannot be asked to share data, further hand finishing required contradiction. Financial accounting processes have changed, the original is always to the point that regardless of whether the project can be broken down, first check the number and routed to each line, the line's financial situation influenced by the subjective, can be broken down for now project, the total must be divided again, only the sub-right, and the total will be correct. If the original accounts of the operating overhead and operating costs are



in accordance with standard auxiliary vehicle km for sharing, cycling accounted for according to the requirements of this 2 year quarter of the cost of inspection fees and other items specific to the actual amount of cycling, the remaining costs will then no longer be assigned the standard vehicle kilometers.

Cycling is an important project accounting is accounting for warranty costs, maintenance and minor repairs categories of diversity of the frequent maintenance expenses of management as weak, with real-time settlement system, strengthening the process of consumption Bus maintenance control, improve material consumption transparency, the main question of the contract specifications settlement relationship, with clear, repair both sides Zequan Li, reflecting the cost and value of consistency, to eliminate the occurrence of waste, materials, fixed by changing the existing settlement pattern, each maintenance operation project must be confirmed both mechanic and pilot, and description section of the distribution system reform, the pilot of the pilot material savings incentives, and the material has been effectively monitored, making financial accounting segment, management processes and further transformation.

## References

1. Eason G, Noble B, Sneddon IN (1955) On certain integrals of Lipschitz-Hankel type involving products of Bessel functions. *Phil Trans Roy Soc London* 247:529–551
2. Maxwell JC (1892) *A Treatise on electricity and magnetism*, 3rd edn. Clarendon, Oxford, pp 68–73
3. Jacobs IS, Bean CP (1963) Fine particles thin films and exchange anisotropy. In: Rado GT, Suhl H (eds) *Magnetism vol III*, 1st edn. Academic, New York, pp 271–350
4. Elissa K (1998) Title of paper if known. 1:1–3. (Unpublished)
5. Yorozu Y, Hirano M, Oka K, Tagawa Y (1982) Electron spectroscopy studies on magneto-optical media and plastic substrate interface. *IEEE* 2:740–741

# Chapter 56

## Empirical Research on Rural Residential Construction of Financial System

Wei Wang, Hongrui Zhang and Zhenxiang Cui

**Abstract** Based on the annual national data from 1978 to 2010, this thesis applies the EVIEWS5.0 software into the empirical research on how. The research shows that the investments on residential construction in China's rural areas have long-standing and obvious effect on financial system. VEC model suggests that the changes of investment in the first lag are proportional to the stability of finance, while the influence is inverting in the second lag but not prominent, the two are influenced by each other in the short-term Granger causality. Impulse response function indicates that the current investments on China's rural residential construction have inverting effects on financial stability. Variance decomposition displays that currently China's rural financial system mainly depends on financial system itself to maintain it stable; otherwise the residential construction in rural areas has no proper effect.

**Keywords** Financial stability index • VEC model • Impulse response function

### 56.1 Introduction

Classical economic theory believes that the residential building is not only the important response media to promote regional flows of financial resources [1], but also it can decrease the regional financial risks and sustain the regional financial system stable. Based on the theories of Andrew Crockett [2, 3], the thesis try to do the empirical research on the development of China's "New Countryside" in recent years. The main point is that whether China's rural residential construction will really influence the stability of financial system and how the influences are made. If the influences are against the theories, the

---

W. Wang (✉) · H. Zhang · Z. Cui  
College of Economics and Management, Northeast Forestry University, Harbin, China  
e-mail: Hongrui198632@163.com

blocking factors will need to be found to provide the solutions to develop “New Countryside” better.

## **56.2 Analysis of Capital Investment in Rural Housing Construction**

Currently, the rural residents own few liquidity and their most savings are transferred over the rural credit cooperatives, so except influenced by the effective finance under the national policies, China’s rural residential construction is also influenced by the capital supplied by the rural credit cooperatives, that is also a key factors. The survey statistics show that there are 120 million rural residents need housing loan, half of them applied for the loan from the rural credit cooperatives while there are 45 million of them really gain the loan. This fully demonstrates that the functions of rural credit cooperatives in rural finance, especially in the rural housing finance.

## **56.3 Index selection and Data sources**

### ***56.3.1 Selection of Financial System Stability Index***

On the selection of index, lots of economics only use one or two index to reflect the stability of financial system, therefore the results are doubtful. But to deeply study the influences made by the rural residential construction on financial system. This chapter adopts financial stability index to represent the financial stability, written in WD which is composed by 17 sub-indexes [4].

### ***56.3.2 Selection of Rural Residential Construction Index***

According to the features of China’s rural residential construction index and considering the availability index data, this chapter chose the index of investment in rural residential construction to reflect the total funds, written in TZ.

### ***56.3.3 Data Sources***

All data in this article comes from statistical yearbook of China, statistical yearbook on financial of China.

## 56.4 Empirical Analysis

### 56.4.1 Stability Test

Stationary test of time series [5] often refers to unit root test, this chapter mainly applies AOF test, which is completed by three models as follows:

Model 1.1 with constant term and trend term:

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{i=1}^m \beta_i \Delta X_{t-i} + \varepsilon_t \tag{56.1}$$

Model 1.2 with constant term and without trend term:

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{i=1}^m \beta_i \Delta X_{t-i} + \varepsilon_t \tag{56.2}$$

Model 1.3 without constant term and trend term:

$$\Delta X_t = \delta X_{t-1} + \sum_{i=1}^m \beta_i \Delta X_{t-i} + \varepsilon_t \tag{56.3}$$

The order of test is 1, 2 and 3, if it cannot reject the null hypothesis, the steady-state is formed and the time series is no stationary, so the differential must made to the original sequence. Then the above test processes must be repeated until the steady-state is formed. Test results come out as in Table 56.1.

Note: Three terms in the ADF test respectively use to test whether there are constant, lag order and trend items in the equations, o means not existing. Adding *D* before the variable refers to first-order differential and adding *D*<sup>2</sup> refers to the second-order differential.

Seen form the Table 56.1, time series of these two variables LTZ and LWD are both sequence.

### 56.4.2 Analysis of Vector Auto Regression Model

Selection of optimum lag time

This thesis connects AIC principle and Sc principle and chooses 2 as the best lag. The test values are showed in table as follows (Table 56.2):

**Table 56.1** Results from stationary test of time series

Variable	ADF test	T test value	1 % Threshold	5 % Threshold	10 % Threshold	Conclusion
LTZ	(C,T,3)	1.63578	-2.7158	-1.9627	-1.6262	Unsteady
DLTZ	(C,0,4)	-2.02365	-3.9635	-3.0818	-2.6829	Unsteady
D2LTZ	(0,0,2)	-3.77873	-2.7275	-1.9642	-1.6269	Steady
LWD	(C,T,3)	-1.61263	-4.6193	-3.7119	-3.2964	Unsteady
DLWD	(C,0,4)	-1.44887	-3.9635	-3.0818	-2.6829	Unsteady
D2LWD	(0,0,0)	-9.87678	-2.7057	-1.9614	-1.6257	Steady

**Table 56.2** The definite test value of the best lag in VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	30.4561	NA	4.02E-06	-3.2593	-3.0531	-3.3226
1	36.1753	45.7742	1.14E-07	-3.3175	-3.1681 <sup>a</sup>	-4.0056
2	38.1215	50.0858 <sup>a</sup>	1.23E-08	-3.3759 <sup>a</sup>	-3.2274	-4.2005
3	33.8275	41.1640	1.56E-08	-2.9808	-2.6345	-4.3020

Note <sup>a</sup>means the lag order chosen by test value

**Table 56.3** Johansen co integration test results

Null hypothesis	Feature value	Trace statistic	1 % Threshold	5 % Threshold	P value
None <sup>(a)</sup> <sup>b</sup>	0.86454	36.9151	20.04	15.41	0.000
At most 1	0.05047	0.93227	6.65	3.76	0.1042

Note <sup>a</sup>means rejecting the original hypothesis in the 1 % threshold

<sup>b</sup>means rejecting the original hypothesis in the 5 % threshold

### Co integration test

Co integration test is a way to test whether the long-term balance is existed between the variables [6]. In this thesis, the co integration test of LWD and LTZ variable is done with Johansen’s maximum likelihood method, and test results shown in Table 56.3.

This test results indicate that there is only one co integration between LWD and LTZ and they are significant correlated. All these show that China should do great efforts to develop rural housing construction to promote the stability of financial system.

### Vector error correction model (VEC model)

VEC model reflects the short-term interaction of variables, once I (56.2) variables deviate from their equilibrium value, they will automatically return to the equilibrium value. The VEC model is founded based on the co integration Eq. (56.4) as follows:

$$\begin{aligned}
 DLWD_t = & -0.086ECM_{t-1} + 0.086DLTZ_{t-1} - 0.077DLTZ_{t-2} \\
 & -0.2676DLWD_{t-1} + 0.2004DL[-0.99634] [0.74205] [-0.61013] \\
 & [-0.82244] [0.62023]WD_{t-2} + 0.087917 [2.07571]
 \end{aligned}
 \tag{56.4}$$

The values in square brackets in the Eq. (56.4) are t statistics of the coefficient.

The overall fit effect of the equation is good. Equation (56.4) refers to the influence of short term residential investments on stability of financial system. VEC model shows that the changes of investment in the first lag are proportional to the stability of finance, while the influence is inversing in the second lag but not prominent, the financial system also has inverse second lag effect. The coefficient of error term  $ECM_{t-1}$  is  $-0.086$ , indicating weak reverse correction mechanism.

**Table 56.4** Results of short-term Granger causality test

Null hypothesis	P value	Conclusion
DLWD does not Granger Cause DLTZ	0.007	Rejecting null hypothesis
DLTZ does not Granger Cause DLWD	0.097	Rejecting null hypothesis

Granger causality test shows rural residential and financial systems have the bidirectional Granger causality.

### 56.4.3 Granger Causality Test

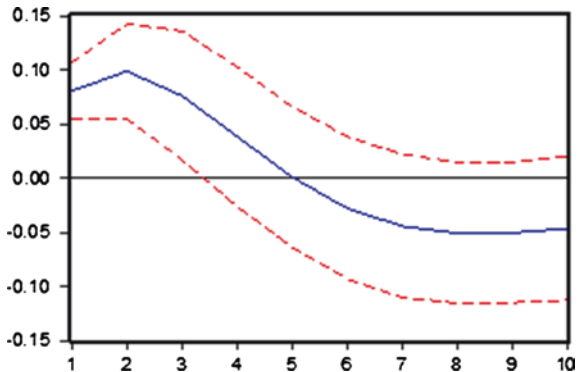
Seen from the Table 56.4, rural residential and financial systems have the bidirectional Granger causality. But the influence of short-term rural residential on financial system is less significant than the influence of financial system on short-term rural residential. This test basically has the same conclusion as co integration and VEC models.

## 56.5 Impulse Response Function

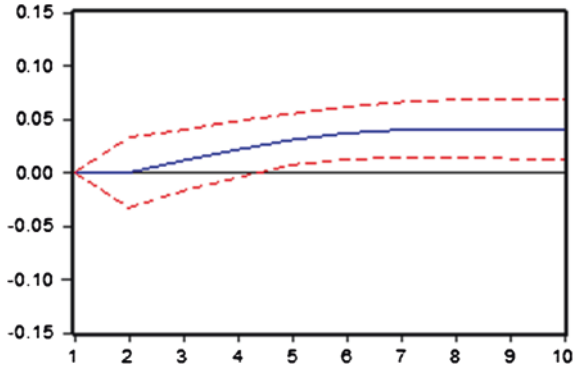
Impulse response function can be more visually depicts the dynamic interactions between variables and effects. Horizontal axis represents the trace phases, the longitudinal axis represents the response of dependent variable to variables and two dashed lines represent the confidence band with twice the standard deviation. See the below Figs. 56.1, 56.2, 56.3, 56.4.

Figures Impulse response function

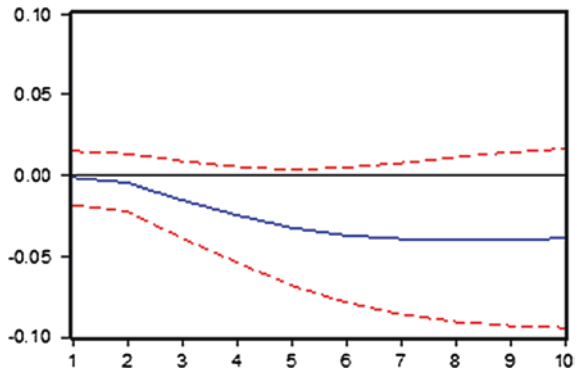
**Fig. 56.1** Response of LTZ to LTZ



**Fig. 56.2** Response of LTZ to LWD



**Fig. 56.3** Response of LWD to LTZ



**Fig. 56.4** Response of LWD to LWD

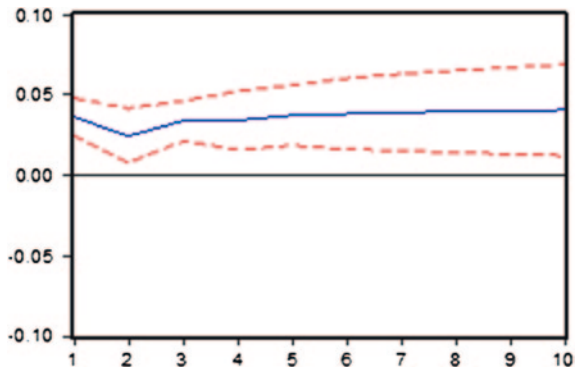


Figure 56.2 shows that the rural financial system stability responds to the impact of a standard deviation of residential investment. An impact is given in the current period and the response begins to improve from the second to the seventh when the maximum positive effect happens, after that the response is stabilized. This shows that China's financial resources have significant impact on rural residential investment.

**Table 56.5** DLWD variance decomposition

Period	S.E.	DLWD	DLTZ
1	0.036150	99.82060	0.179400
2	0.043965	98.85091	1.149092
3	0.057470	92.38307	7.616933
4	0.071170	83.22035	16.77965
5	0.086533	74.77159	25.22841
6	0.101522	68.43488	31.56512
7	0.115665	64.17619	35.82381
8	0.128566	61.43672	38.56328
9	0.140326	59.73038	40.26962
10	0.151157	58.67453	41.32547

Figure 56.3 shows that the rural residential investment responses to the impact of a standard deviation of financial system stability. An impact is given to financial system in the current period and the response begins to decline from the first period, in contrast with Fig. 56.2, in the seventh period there is the greatest negative effect and the lag has stabilized. This is consistent with the actual situation.

## 56.6 Variance Decomposition

Variance decomposition analyses the contribution rate of the rural Residential investment to the stability of financial system. Variance decomposition as shown in Table 56.5.

As can be seen from Table 56.5, in the first period, the stability of the financial system is influenced by itself and by the rural residential investment, and the influence of the latter can be ignored. Beginning from the second period, the influence of itself decreases and stabilizes at around 60 % in the eighth period. With the disturbance of its own financial system decreasing gradually, the disturbance of rural residential investment increased rapidly and basically stabilizes in the eighth period; disturbance factor is about 40 %. This indicates that the rural housing construction still has great room for development under the environment in which China does its utmost efforts to safeguard the financial stability.

## 56.7 Conclusions

Currently, the effects of China's rural residential construction on financial system are disagreeable with theories, which show that there must be some problems in both rural residential finance and financial system. In this chapter, there are the following four block factors:

1. Although policy finance has a large proportion, but rural housing developers do not get the appropriate credit funds;



2. The rural agriculture is not enough developed, the expected economic benefits of farmers are not improved and cooperative finance can not support rural housing construction effectively;
3. Without complete management for long time, the rural credit cooperatives form a large number of bad debts, losses and can not provide for rural residents more residential loans;
4. Private finance is hit and the expansion of policy and commercial finance make some impacts on private finance which have certain impacts on the stability of financial system in rural areas. Therefore, measures should be taken to improve the system timely, to curb the negative effects of the two and to ease the pressure on China's rural financial system.

**Acknowledgments** This work is supported by Northeast Forestry University Graduate Student Technology Innovation Fund, and Supported by the Fundamental Research Funds for the Central Universities (DL09BC01), and supported by the Fundamental Research Funds for the Central Universities (DL11CC12), and supported by Youth Fund of Social Science Planning Project of Heilongjiang Province (10CC002).

## References

1. Crockett A (1997) The theory and practice of financial stability. *Essays Inte Finance* 4:531–568
2. Zhou YF (1996) Comparison of typical models of housing industry development and funding. *China's Residential* 55(8):68–69
3. Sheng R (2003) U.S. rural housing subsidy policy and its enlightenment. *Agricu Econ* 88(12):47–48
4. Cui SZ (2010) Empirical study of China's real estate cycle for financial stability. *Northeast Univ Finance Econ* 45(11):112–133
5. Chen GM, Chen SD (2004) *Walt grisham para moore. Quantitative methods for finance*, vol 54. Shanghai People's Publishing Press, Shanghai, pp 197–211
6. Engel RF, Granger CWJ (1987) Co-integration and error correction: representation, estimation and testing. *Econometrics* 55:25–27

# Chapter 57

## Study on Income Distribution Based on Money Exchange Model

Xiaoye Shang

**Abstract** In this paper, we present the economic characteristics of wealth and income, and demonstrate that the wealth distribution and income distribution are different in essence with the help of money exchange models. Wealth is a stock, which refers to the amount of assets at a certain time point, while income is a flow, which can be defined as revenues from exchange activities over a period of time. Due to different concepts and measurements of wealth and income, the generation mechanisms of them are also different. The purpose of this paper is to make a clear distinction between wealth and income, and demonstrates both wealth and income distribution in money exchange models. By comparing the two distributions we can check the capability of this kind of models for interpreting the distribution of income.

**Keywords** Income distribution • Generation mechanism • Money exchange model

### 57.1 Introduction

Since in 1897 pareto optimal solution, it has been known wealth and income distribution appeared-is normal or gamma distribution log and power law attenuation of the upper limit of the bottom. So far, the research work has covered all the continents of the world, show has worldwide distribution, robust structure of different regions, social [1]. Since the early 1990s began, a group of physicists forayed into this research field and new theory and modeling method and econophysics formed an important branch of [2, 3].

---

X. Shang (✉)

Economics and Management School of Wuhan University, Wuhan, Hubei, China  
e-mail: xiaoyesh3232@126.com

X. Shang

Guizhou University for Nationalities, Guizhou, China

The characteristics of wealth and income are often obscure, and the result shows the two distributions is often together. Therefore, these works produced some economist's criticism [4]. Points out that these work is "a confusion of the basic concepts, in particular concept, model establishment in income these principles, basic characteristics ignore absolute economic reality". These criticisms are so sharp, sparked a debate over the value of the subject in the academic circles econophysics.

Even though the distributions of wealth and income have similar characteristics, the two economic concepts are quite different. The distinction of the is embodied on both definitions and generation mechanisms. Wealth is defined as an accumulation of resources accruing to a person or nation; it is the value of assets owned at a given point of time [2]. While income refers to the quantity of revenue from labor services or from ownership of land and capital measured per unit of time [3]. This means wealth is a stock, but income is a flow. Correspondingly they have different measurements. Only time point information is required when wealth is measured, but periodicity is necessary for income. In the aspect of generation mechanisms, the generation of income is analogous to current, as it is the net flow of wages, dividends, and interest payments over a period of time [5]. While wealth is analogous to a bathtub, there is an accumulation of wages, dividends, and interest payments etc. Income relates to the change in wealth over a period of time, while wealth reflects an effect of the accumulation of income.

## 57.2 Money Exchange Models

The economy is regarded as a kind of multi-agent system, money can exchange in the agency. Continuous deal making money was eventually often distribution agents with certain patterns in. Distribution is the shape of the corresponding exchange rules. These models provide an effective tool to explore the basic mechanism of particle size distribution [2]. The retention of different body design corresponding trading rules gives different fixed distribution. For example, the ideal random exchanged Dragulescu Yakovenko a, fifth, lead to a index distribution; Random exchange and unified savings rate, puts forward and add Chakrabarti, give the gamma distribution; To deposit interest rate model as individual extinguished, leads to a power law distribution. We will carry out our three representative simulation model; show that they died, CC, CCM mold in short [6].

The economic system is made an analogy to the ideal-gas system, where the number of agents is  $N$  and the units of money is  $M$ . Initially, each agent is given the same quantity of money  $M/N$  [7, 8]. During the process, agents exchange their money in sequence. Each time of trade, a pair of agents  $(i, j)$  is chosen randomly, they take out all their money  $(x_{t-1}^i, x_{t-1}^j)$  to exchange. The sum of their money is split in a random way, and reassigns to them. The new amount of money for each one in this trading can be written as follows,

$$x_t^i = \varepsilon_t(x_{t-1}^i + x_{t-1}^j) \quad (57.1)$$

$$x_t^j = (1 - \varepsilon_t)(x_{t-1}^i + x_{t-1}^j) \quad (57.2)$$

where  $\varepsilon_t$  is a random number ( $\varepsilon_t \in [0, 1]$ ). This trading rule guarantees that the total amount of trader's money is conserved, and the money is nonnegative for any agent during the trading process.

As an extension of model DY, model CC argues that agents always keep some money in hand as saving when trading, so an unifying saving rate  $\lambda$  ( $\lambda \in [0, 1]$ ) is introduced. In pair wise trading, agents (i, j) firstly save a proportion of their money ( $\lambda x_{t-1}^i, \lambda x_{t-1}^j$ ), and then take out the other part  $[(1 - \lambda)x_{t-1}^i, (1 - \lambda)x_{t-1}^j]$  to exchange [9]. The transaction rule is described as,

$$x_t^i = \lambda x_{t-1}^i + \varepsilon_t((1 - \lambda)x_{t-1}^i + (1 - \lambda)x_{t-1}^j) \quad (57.3)$$

$$x_t^j = \lambda x_{t-1}^j + (1 - \varepsilon_t)((1 - \lambda)x_{t-1}^i + (1 - \lambda)x_{t-1}^j) \quad (57.4)$$

Money is also conserved in the whole process of trading. The equilibrium probability distribution of money exhibits a gamma function.

In contrast with model CC, the saving rates in CCM are settled as random values  $\lambda^i$  ( $\lambda^i \in [0, 1]$ ) and assigned to agents with a certain distribution. For each pair with specific saving rates ( $\lambda^i, \lambda^j$ ), the transaction between them is expressed as

$$x_t^i = \lambda^i x_{t-1}^i + \varepsilon_t((1 - \lambda^i)x_{t-1}^i + (1 - \lambda^i)x_{t-1}^j) \quad (57.5)$$

$$x_t^j = \lambda^j x_{t-1}^j + (1 - \varepsilon_t)((1 - \lambda^i)x_{t-1}^i + (1 - \lambda^j)x_{t-1}^j) \quad (57.6)$$

In this case, the system eventually falls into a stationary state with a power-law distribution.

### 57.3 Measurement of Wealth and Income

Although, wealth and income are typical in form of currency, the stock of money in this model is more suitable for describing the wealth and income is not. So in our model, the definition of wealth is held by the agent, the amount of money the distribution of wealth and the distribution of the trade pattern of money before work.

As we know, income is a flow; this is a law essential factor. In the real world, usually refers to the income from a month, or a year a season, etc. Therefore, the money must pay for a cyclical. According to the two properties-time period and the generation mechanism of exchange, we define the income of the aggregate money get the deal, in a given number of trades round T exchange model.

According to the trading rules prescribed in previous section, in each time of trade only a pair of agents is chosen to exchange. So we introduced an indicator function  $w_t^i$ , if agent i is chosen to trade in time t,  $w_t^i = 1$ , otherwise  $w_t^i = 0$ . In a certain round t,

the revenue of agent  $i$  can be denoted by  $R_t^i$ . When the money of agent  $i$  has increased, he has achieved money from his partner. So he has a positive value of revenue. Otherwise, he loses money from this trade, and his revenue is zero. If the recording of income starts from one round of exchange  $n$  and it then ends at the round of  $n + T$ . During this period, when agent  $i$  takes part in the trading,  $w_t^i$  at round  $t$  turns to 1, and the revenue will be added up to the income. So his income in this period can be expressed as

$$I^i = \sum_{t=n}^{n+T} R_t^i \cdot w_t^i \tag{57.7}$$

And the expression of the revenue can be written as follows,

$$R_t^i = \begin{cases} x_t^i - x_{t-1}^i, & x_t^i > x_{t-1}^i \\ 0, & x_t^i \leq x_{t-1}^i \end{cases} \tag{57.8}$$

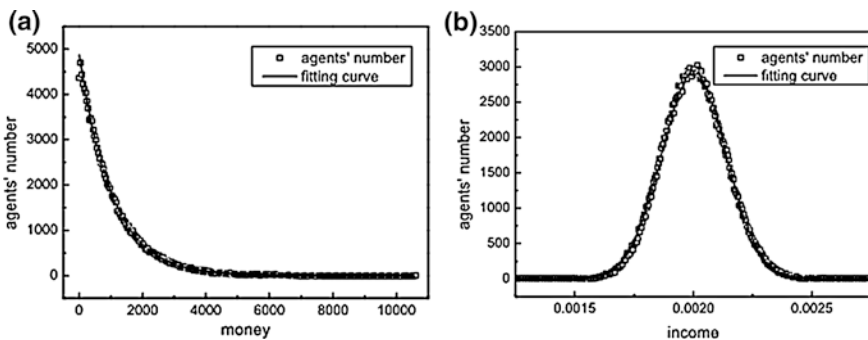
In particular, from a transformation of the formula of income in model CC we have,

$$I^i = (1 - \lambda) \sum_{t=n}^{n+T} \left[ \varepsilon_t (x_{t-1}^i + x_{t-1}^j) - x_{t-1}^i \right] g w_t^i \tag{57.9}$$

This indicates that the level of agents' incomes will be affected by the saving rate  $\lambda$ . The average income in this model is calculated over a time period of 500,000 trading rounds. The dependence of average wealth and income for different saving rates are shown in Fig. 57.1.

### 57.4 Wealth Distribution Versus Income Distribution

In order to look into the characteristics of income with this definition, we perform numerical simulations of income in detail. Comparing with results of wealth in original works, we can see the difference between them.



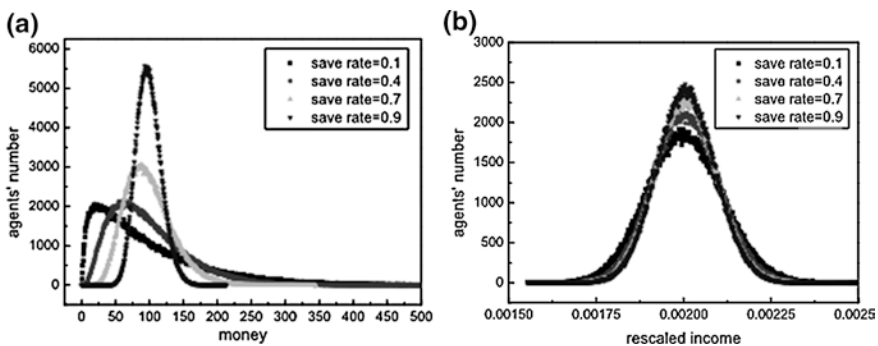
**Fig. 57.1** **a** Stationary distribution of wealth in model DY, the *solid curve* is a fitting of exponential function, **b** stationary distribution of rescaled income in model DY, the *solid line* is the *fitting curve* of the normal function

In DY, there are 500,000 units of money and 500 agents in the system, i.e.  $M = 500,000$ ,  $N = 500$ . Initially, all agents are give an equal amount of money,  $M/N = 1,000$ . After about 5,000 times of trade, the system has gotten an equilibrium state. Then we calculate the frequency of agent’s money and obtain the wealth distribution as shown in Fig. 57.1a. Similar with the original work [3], the probability distribution becomes skewed and presents an exponential function with maximum at  $m = 0$ . Due to the conservation of money and the entropy maximization, the equilibrium distribution must follow a Boltzmann–Gibbs form. So the function of  $f(x) = \exp(x/\langle x \rangle)$  ( $\langle x \rangle$  is the average wealth of agents) is used to fit the simulation data, and has given a good fitting result.

At the same time of the calculation of wealth distribution, we start to record each agent’s income over 250,000 times of trade. The income distribution has been shown in Fig. 57.1b. Different from wealth distribution, income distribution is quite symmetrical. Agents spread equally in both side of the average value, and perform a normal function.

In the process of calculation of income distribution, there are two points should be noted. Firstly, the income has been rescaled by dividing it by the sum of all agents’ income. It is because that the quantity of agent’s income will be equally affected by the amount of money taken out to exchange. Secondly, a unit of time is defined as 250 times of trades, so that during this period every agent can take part in the exchange once in average. Thus the periodicity of 250,000 times of trades is equal to 1,000 units of time.

In CC, there are 50,000 units of money and 500 agents in the system, i.e.  $M = 50,000$ ,  $N = 500$ . At the beginning of the simulation, each agent is given an uniform saving rate  $\lambda$ , and he will save a fraction  $\lambda$  of his money before trading. After 100,000 times of trades, the system attains equilibrium. The distribution of wealth is shown in Fig. 57.2a. According to the derivation in [7], the equilibrium probability distribution of wealth follow a typical gamma function  $f(\xi) = \frac{1}{\Gamma(D_\lambda/2)} \xi^{\frac{D_\lambda}{2}-1} \exp(-\xi)$ ,  $\xi = \frac{1+2\lambda}{1-\lambda} \cdot \frac{x}{\langle x \rangle}$  and  $D_\lambda = \frac{1+2\lambda}{1-\lambda}$ . When  $\lambda$  goes



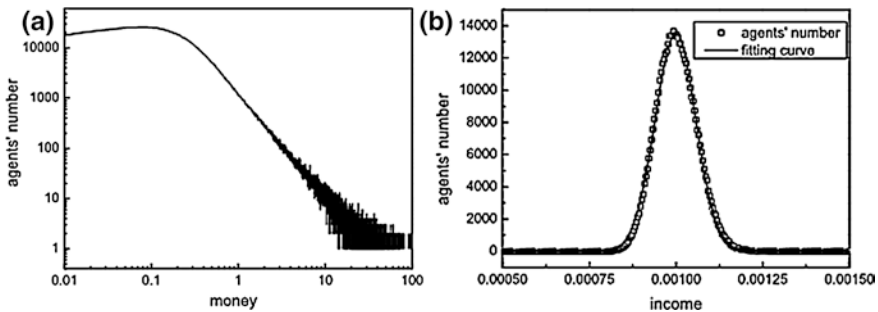
**Fig. 57.2** **a** Gamma distributions of wealth with uniform saving rate in model CC, **b** normal distributions of income with uniform saving rate in model CC

down, the distribution becomes more asymmetric, and finally goes back to the exponential form when  $\lambda = 0$ .

Similarly, we record revenue of agents in the periodicity of 250,000 times of trade after equilibrium, and rescale the income by dividing the income of each agent by that of all agents. We present the probability distribution of rescaled income in Fig. 57.2b. Since the essence of income is a sum of independent random variables, the income distribution in model CC also exhibits a normal function. Moreover, as mentioned in previous section, saving rate only affects the value of income. But the rescaling has already eliminated this effect. So it is as shown in Fig. 57.2b distributions for different saving rates all present a similar profile. Nevertheless, the discrepancies in money distributions in Fig. 57.2a imply that the distributions of  $R_t^i$  for different saving rates should have different profiles. So the variance of  $R_t^i$  are different for different saving rates. According to simulation results, the value of  $\sigma_{0.1}^2, \sigma_{0.4}^2, \sigma_{0.7}^2$ , and  $\sigma_{0.9}^2$  are  $9.74 \times 10^{-3}, 8.47 \times 10^{-3}, 7.77 \times 10^{-3}, 7.46 \times 10^{-3}$ . Therefore, the variance of income distribution is affected slightly as shown in Fig. 57.3b.

In CCM, the initial settings of our simulation is  $M = 1,000, N = 1,000$ , and each agent is given a diverse saving rate  $\lambda^i$ . Agent  $i$  will only take out a fraction of  $((1 - \lambda^i)x^i$  to exchange with others. After equilibrium we calculate the frequency of agent's money to obtain the distribution of wealth, which follows a power-law function in Fig. 57.3a. The system of agents with diverse saving rates can be seemed as a set of small groups with uniform saving rate. In the group with a small  $\lambda^i$ , the individual wealth distribution present a most skewed profile with the maximum at  $m = 0$ . While in the group with  $\lambda^i \rightarrow 1$ , no such infinite maximum is present and the distribution becomes symmetric. So the cumulative effect of such groups exhibits a power-law function.

Following the same procedure of two models above, we calculate the income after equilibrium in the periodicity of 500,000 times of trades, and plot the distribution of rescaled income in Fig. 57.3b. For the same reason mentioned above, there is an additive effects of independent revenue of every trade, so income



**Fig. 57.3** **a** The stationary distribution of money with diverse saving rate in model CCM, **b** the stationary distribution of rescaled income in model CCM

still follows a normal distribution. According to the initial conditions of this model, time scale is  $\tau = 1,000$  and the mean income and variance are  $\mu = 0.001$ ,  $\sigma^2 = 4.24 \times 10^{-3}$ . The solid curve in Fig. 57.3b is the function of  $N(0.001, 4.24 \times 10^{-6})$ .

After investigating the stationary distribution of income in each model, we further look into the dependence of these distributions on timescales. For income is a flow, timescale is an important factor to it. In each model, we change the timescale  $\tau$  with  $\tau = 1,000, 2,000, 5,000, 10,000$ . In respect that large timescale will have multiplier effect on agent's income, so we also rescaled the income by divided it by all agents' income. And according to the central limit theorem, the rescaled income distribution also follows the normal distribution  $N\left(\mu, \frac{\sigma^2}{\tau}\right)$ . It has been observed that the simulation results confirmed this supposition very well. The mean of the normal distribution is practically independent of timescale. It only affects the unevenness index of the distribution. When timescale becomes larger, the standard deviation is smaller and the income distribution is getting steeper. More and more people have income close to the average value, which means that people's incomes become more equality. If we calculate the income with an infinite periodicity, the normal distribution will converge to a vertical line. The other two models have the identical phenomena. In the case of model DY, the simulation results of variance are  $\text{Var}_{1000} = 1.04 \times 10^{-5}$ ,  $\text{Var}_{2000} = 5.18 \times 10^{-6}$ ,  $\text{Var}_{5000} = 2.09 \times 10^{-6}$ , and  $\text{Var}_{10000} = 1.05 \times 10^{-6}$ . Obviously, there is a reciprocal relationship between the variance and timescale.

## 57.5 Conclusion

So the previous works on money exchange model is only applicable to explain the distribution of wealth, not the income distribution. By introducing the income of the measurement of the model, we examine the balance of income distribution system. The simulation results show that, despite the different trading rules may produce different types of the distribution of wealth and income distribution present a consistency almost Gaussian form. Therefore, trading mechanism of random exchange can't provide an explanation of the income distribution of empirical research. Based on these models, further efforts to investigate the distribution of income generation mechanism need us.

## References

1. Montroll EW, Shlesinger MF (1982) On noise and distributions with long tails. *Proc Natl Acad Sci* 79:3380–3383
2. Chatterjee A, Chakrabarti BK (2010) Kinetic exchange models for income and wealth distributions. *Eur Phys J B* 60:135–149



3. Aoyama H et al (2009) Pareto's law for income of individuals and debt of bankrupt companies. *Fractals* 8:293–300
4. Souma W (2009) Universal structure of the personal income distribution. *Fractals* 9:463–470
5. Mandelbrot B (1961) Stable paretian functions and the multiplicative variation of income. *Econometrica* 29:517–543
6. Kleiber C, Kotz S (2010) *Statistical size distributions in economics and actuarial sciences*. Wiley, New Jersey
7. Angle J (1986) The surplus theory of social stratification and the size distribution of personal wealth. *Soc Forces* 65:293–326
8. Gibrat R (2010) *Les inegalites economiques*. Librairie du Recueil Sirey, Paris
9. Steindl J (1972) The distribution of wealth after a model of world and whittle. *Rev Econ Stud* 39:263–279

# Chapter 58

## Study on Long-Effect Mechanism of Securities Investor Education

Yunlei Huo

**Abstract** Investor education is not only one of the most important and fundamental institutional constructions at capital market, but also an important part of the cultural construction of capital market. At the present stage, the long-effect mechanism for investor education is not only a demand of China's securities market on its healthy development, but also an objective reality that China's investor education is necessary to confront with. For these reasons, it is necessary for China to deepen investor education, expand investor education platform, strengthen risk prevention, and take initiative to build up a multi-level investor education system, and ultimately establish and improve a long-effect mechanism for investor education, so as to ensure the stable, harmonious and order development of China's Securities market in futures.

**Keywords** Securities investment • Education • Long-effect mechanism

### 58.1 Introduction

IOSCO thinks that investor education refers to a kind of social activities, which is implemented and oriented at individual investors with explicit goals [1], plans, organizations and systems. It is designed for informing the investors of their due rights and protection approaches and thereby making an enhancement to the quality of the investors through imparting investment knowledge and advocating rational investment ideas. Furthermore, investor education is allowing investors to learn knowledge in finance, developing professional skills in investment, and making an enhancement to the “physical health” of the investors at securities market, and thus building up a good “physical body”. Only in such a way, the self-awareness and self-protection abilities of the investors in legal rights and interests can be continuously improved at securities market, and simultaneously their ability in risk aversion can be increased greatly.

---

Y. Huo (✉)

Jilin Business and Technology College, Changchun, Jilin 130062, China  
e-mail: yunleih212@126.com

However, in China, securities investor education is in its infancy at present. Therefore, in comparison with the capital market's steady development [2], the continuous market expansion and the rapid growth in the number of investors, there is still a great difference between China's securities investor education and overseas mature market investor education in terms of development breadth and depth.

## **58.2 Characteristics of China's Securities Investors**

### ***58.2.1 A High Proportion of New Investors Lacking Awareness of Risk***

In recent years, the number of investors opening new accounts increased very rapidly. From 2012, there are about 100,000 new investors to enter securities market every day at average; the number reached more than 180,000 a day at the maximum. However, the investors newly entering the securities market own educational backgrounds at different levels, and also they come from a variety of industries. What is worse, some new investors do not have fundamental knowledge of financial planning and investment, and also a small part of new investors almost do not think that there is a possibility for them to suffer a loss.

### ***58.2.2 A High Proportion of Low-Income Investors with a Weak Awareness of Rights of Shareholders***

Investigation result from the Securities Association of China shows that in terms of income structure, China's securities investors are groups with an income below 2,000 RMB/month or 2,000–5,000 RMB/month, and these groups take a large proportion, reaching nearly 70 % in total. Therefore, at the present stage, the groups with low and middle incomes are the main part of investors. In general, the ability of these groups to resist risks is very poor. Therefore, they will have no idea about what to do once market quotations go into an unfavorable situation. From investigation, it was found that 63.4 % of individual investors said they did not take part in any proposals at general meeting of stockholders.

### ***58.2.3 A High Proportion of Small and Medium Investors Lacking a Concept of Long-Term Value Investment***

Seen the scale of the capitals entering securities market, it was found that more than half of investors own only a capital of below 300,000 RMB. However, these groups of investors hold an intensive speculation with too little money at capital

market; the average period for more than half of individual investors to hold shares is less than two months. This is because these investors like to pursue share price rising but retire immediately once share price goes down, and will change their shares frequently. At the same time, these groups of investors often pay much attention to the news and analyses of stock analysts, reviewing the information released on some non-formal websites for buying stocks. Therefore, they are in shortage of a rational concept of long-term investment.

## **58.3 Establishing a Long-Effect Mechanism for Investor Education**

### ***58.3.1 Improving the Legal Protection System for Investors and Establishing a Feasible Law Enforcement System***

Over the last decade, a considerable progress has been made on the protection of rights and interests of investors in China.

Through the Law of Cooperation, the legal status and all rights and interests of shareholders of cooperation have been clearly and definitely provisioned. Through the issuing of the Securities Act, an enhancement has been made to the information disclosure system of listed companies, and also how to protect the rights and interests of investors in securities listing, trading, clearing, supervising and other links has been clearly stipulated.

Through the amendment of the Criminal Law, more crimes related to securities are explicitly provided, so as to criminally sanction the behaviors of securities frauds. Besides, China Securities Regulatory Commission shifted the regulatory concepts and work focus from “Serving for the Reform of State-Owned Enterprises” to the protection of the rights and interests of investors, released a series of administrative regulations and rules such as the Rules on the Shareholders’ Assembly of Listed Companies, Several Provisions about Strengthening the Protection of Rights and Interests of Public Shareholders, Administrative Measures for the Protection of Rights and Interests of Administrative Measures for the purpose of protecting the rights and interests of investors, and take the measures such as clearing up debts of listed companies, implementing equity division, reforming payment consideration so as to protect the rights and interests of small and middle investors.

In addition, the Supreme People’s Court issued the Notification on Accepting Tort Cases Caused by False Statement in the Securities Market and other rules and regulations for implementing the judicatory relief system of rights and interests of investors.

Therefore, at present, a complete and effective legal system, which is cored at the law of Law of Cooperation and the Securities Act, supplemented by administrative regulations and normative documents issued by China Securities

Regulatory Commission, and guaranteed by the Law of Civil Procedure, the Criminal Law and the Judicial Interpretations of the Supreme People's Court, is preliminarily formed in China for protecting the rights and interests of securities investors.

At the same time, there has been a multidirectional clues discovery mechanism in the process of enforcing laws, for the purpose of ensuring the unblocked and effective information channels from exchanges, day-to-day regulatory authorities, complaint departments, media and relevant units. A "direct-channel" system for transferring clues is generated between exchanges and the securities supervision and inspection bureaus.

Also, a powerful monitoring system has been established in exchanges for the purpose of carrying out the real-time monitoring and analysis of market transactions, and therefore, the processing ability of exchanges has been greatly improved. It is necessary for inspection bureaus to pay close attention to changes in the market and media reports, and start up all types of investigative procedures in time, give responds to hot markets, make an enhancement to the confidence of investors. In the mean time, it is necessary to actively cope with the developments and changes of behaviors breaking laws and rules, make an exploration on a more effective model of working.

Next, it is necessary to make an improvement to the existing law enforcement system.

In addition, a three-dimensional coordination mechanism comprising of exchanges, agencies and governmental institutions has been established, in which the informal inspection model allowing audit departments to implement interventions in advance is offered, so as to get rid of hidden risks as early as possible, prevent the spreading of risks, and reducing the possibility of damaging the rights and interests of investors as much as possible.

With the purpose of improving the hearing ability, an Administrative Punishment Committee has been established, making the separation of inspections and hearing realized, and increasing the profession, authority and credibility of the administrative penalties.

Thus, the efficiency and quality of the administrative penalties have been significantly enhanced at present. Finally, it is necessary to establish a coordination mechanism for the enforcement of securities law.

### ***58.3.2 Strengthening the Market Supervision Cored at the Protection of Investors***

Through an enhancement to the supervisions on the information disclosure of listed companies, the business behaviors of intermediary organs, as well as behaviors of market transaction, the intensity of punishing the behaviors of breaking laws has been intensified, and simultaneously the behaviors of breaking laws and damaging the legal rights and interests of investors have been prevented and attacked greatly.

It is highly necessary to regard investor education as a fundamental institutional construction at capital market for a long term.

With the purpose of making investors protect their own legal rights and interests, it is necessary to take the right of investors to know at capital market as center and the increases of investor qualities and self-protection awareness as goal.

Also, it is necessary to integrate investor education in all parts of securities business through constructing a multi-level investment education organizational system, an all-aspect investor education protection system, and attaching importance to the real-effect investor education supervision system, and make every effort to innovating investment business and relevantly extending investor education if a new business is started. Knowledge can be continuously imparted to investors with consciousness and activeness; the skills of investors can be developed; the ideas of rational investment can be advocated; the investors can be informed of their legal rights and interests as well as processing approaches.

As a result, investors can become skilled or matured self-protectors of legal rights and interests with a gradual step.

Besides, it is necessary to adhere to four combinations in investor education: (1) the effective combination of investor education and risk education; (2) the combination of long-effect and market stages; (3) the combination of universality and pertinence; (4) the combination of regulatory authorities, self-discipline organizations and social education.

### ***58.3.3 Accelerating the Construction of Integrity and Generating a Social Morals of Protecting Rights and Interests of Investors***

Investigations show that 37.9 % of investors said they never exercised rights.

Therefore, it is necessary to speed up the construction of integrity, establish a well-improved legal system for the integrity at the securities market, an effective integrity incentive and restraint mechanism and a well-improved integrity management system, so as to make social morals (high importance is attached to honesty service, personal integrity, diligence and conscientiousness, and operating business according to laws) of protecting rights and interests of investors cultivated at the securities market.

Therefore, integrity can be practiced by all people with conscientiousness and willingness; high respects can be shown to the rights and interests of investors; the rights and interests of investors are urged to be realized legally in an all-round way.

As a result, a securities culture, which is oriented at protecting the rights and interests of investors to the maximum, can be created at China's securities market.

Besides, it is highly necessary to not only strengthen the construction of the market's fundamental institutions, but also attach the highest importance to the protection of rights and interests of investors in market supervision.

Therefore, a large amount of work has been done in developing the ideas of market stock market, strengthen the constraints of the shareholders on listed companies, guiding listed companies to increase returns of investors, and effectively attacking the behaviors of breaking laws at the securities market, etc.

Under the leadership of China Securities Regulatory Commission, China Securities Investor Protection Corporation makes great efforts to innovating the investor protection working mechanism, is always dedicated to constructing a multi-level and all-aspect investor services system, takes initiative to establish a monitoring system for the capitals of clients of securities companies, carry out the evaluations on the work of listed companies, securities companies and other market participants in the protection of the legal rights and interests of investors, and also make an enhancement to the international exchanges and cooperation of investors.

#### ***58.3.4 Establishing a Multi-Level Investor Education System and Ensuring Investor Education Comprehensive and Effective***

It is necessary to vigorously make an enhancement to the nonprofit investor education. In future, it is necessary to continuously strengthen the nonprofit investor education from four aspects.

First of all, increasingly more funding and manpower supports can be provided for the existing investor education activities of public organizations.

Second, private investor education foundations and public organizations can be advocated and cultivated according to the practices in Europe and America, and also provide them with supports in tax and policy and help them broaden the sources of funding.

Third, high importance is necessary to be attached to investors' risk identification and rational investment, investment information processing, protection and maintenance of rights and interests, etc.

Fourth, it is necessary to make an enhancement to the early investment planning education for young people, and also expand the popularization of investor education in more and more places.

Currently, it is urgent for China to have an investor educational school like the New Oriental School, in which teaching materials are in diversification, consideration is given to the educations of both old and new investors according to the actual conditions, and a proper concept of securities investment should be promoted and popularized.

The establishment of investor educational school will become highly popular among a wide range of investors, because the learning exchanges between investors and securities providers or among investors are effectively promoted when the fundamental knowledge of securities is being popularized.

Therefore, an effective platform is provided for business departments to help clients solve problems in the actual operations in time, give them real-time answers to questions, and remind them of possible risks.

## References

1. Chung NS (2009) Investor education is activated by long-effect mechanism completely. *Shanghai Securities News* 22:3–23
2. Feng Y (2010) Enhancing investor education: creating a healthy investment environment for China's capital market. *Shanghai Securities News* 08:12–24



# Chapter 59

## Study on Influences of Fair Value on Risk Management of Commercial Banks and Coping Strategies

Boyao Wei

**Abstract** One of the characteristics of the New Accounting Standards is the introduction of fair value. However, there are many shortcomings in fair value, and also a great number of problems have emerged in its application to Chinese market. For these reasons, in this paper, how the commercial banks solve these risks and problems is discussed, and simultaneously how to introduce advanced experience from foreign countries is analyzed.

**Keywords** Fair value • Commercial • Banks

### 59.1 Brief Introduction to the Measurement of Fair Value

Since the 1980s, the financial market of China has undergone a great number of earth-shaking changes [1].

However, at the same time, this made the shortcomings of the traditional measurement model exposed, and also promoted Chinese people to pay more attention to and provide more supports to the measurement model of fair value.

First, as the financial control is gradually relaxed and the subsequent too-frequent fluctuation appears in the interest rate, the interest rate risk has changed into the object that China's banking financial institutions and companies focus on.

Second, there have been a great number of enterprise credit crisis occurring in the economic development of China [2].

In addition, the role of China's Banks has undergone a great number of changes within the financial industry.

Just under such a situation, both FASB and IASB were continuously making effort to transforming from the historical cost calculation model to the measurement model of fair value when they are re-making accounting standards.

---

B. Wei (✉)

Certified General Accounting Class 0901, School of Accountancy,  
Zhongnan University of Economics and Law, Wuhan, China  
e-mail: boyaowei11@126.com

In 2006, the financial department of China released several basic standards as well as 38 specific standards, thus generating an accounting standards system including standards of four financial instruments [3].

The release and implementation of these financial standards promote the public to pay more attention to the role of fair value in the risk management of Chinese commercial banks.

Therefore, analysis on the impact and influence of fair value on the risk management of Chinese commercial banks is of practical significance.

## **59.2 Analysis on the Influence of the Measurement Model of Fair Value on the Risk Management of Chinese Commercial Banks**

Since the financial crisis 2008, China's banking sector and all walks of life have paid increasingly more attention to the influence of the measurement model of fair value on the risk management of Chinese commercial banks, and even on the entire financial industry.

So far, there have been several argumentations on this influence of the measurement model of fair value on the risk management of Chinese commercial banks, shown in the following.

### ***59.2.1 Reliability Analysis***

At present, the worries and considerations of many experts and scholars in China on the measurement model of fair value is mainly concentrated in the costs as well as the problems generated from the execution of the measurement model by the clients authorized by Chinese commercial banks.

Because of the requirements on a comprehensive measurement model, fair value is also necessary to be applied in the financial instruments that have no secondary markets.

The reliability of the financial information is the premise of ensuring the accounting information of the clients authorized by Chinese commercial banks to own relevance.

At the present time, the worry from Chinese financial industry on the measurement model of fair value just lies in the doubt on the reliability of such a measurement model.

### ***59.2.2 Control of Self-Credit Risk of Banks***

At present, another worry from Chinese banking industry on fair value mainly involves the processing of the measurement model on the self-credit risk of banks.

First, when banks have changes in credit, the influence of the measurement model of fair value on the measurement of bank liabilities goes against the common sense.

In addition, the calculation of the financial liabilities based on the measurement of fair value conflicts with the requirements of banking supervision unit at present, and also the starting point of banking supervision unit is to protect the interests of the depositors and simultaneously attach high importance to the abilities of banks in undertaking the risks and absorbing the losses.

### ***59.2.3 Economic Periodicity and Capital Regulation***

The investigation result of the author shows that one of the most important advantages to apply the measurement model of fair value is allowing the changes of the external economic situation to be timely reflected in the financial statements.

This advantage is also to help the management personnel of enterprises to get more familiar with enterprise's financial situation and business condition, and thus the economic behavior of enterprise working personnel in concealing their failure of investment or business management can be more effectively prevented.

The standard of fair value, as a sharp tool of preventing the financial risks, had made the Financial Accounting Standards Board in the United States (FASB) and the International Accounting Standards Board (IASB) criticized by the public because of the pro-cyclical effect in the financial crisis of the last few years.

Therefore, from the perspective of maintaining the healthy and orderly development of the financial industry of China, the cost calculated by fair value will help the periodicity grow within Chinese bank credits, and thus it is likely to give rise to a more obvious economic cycle.

## **59.3 Analysis on the Coping Strategies of Commercial Banks for the Application of Fair Value**

As a large number of Chinese commercial banks appear on the market and also have begun to apply the measurement model of fair value, not only new opportunities but also more challenges are emerging in the industry.

For this reason, it is highly necessary for Chinese commercial banks to carry out risk control from the several aspects as follows.

### ***59.3.1 Controlling the Potential Risks***

There will be a large number of potential risks to emerge in the measurement model of fair value when Chinese economic market is under an unstable state.

With the purpose of effectively preventing fair value from exerting an adverse effect on the stability of the financial market in the process of applying fair value option, it is necessary to take relevant measures.

In 2006, a supervisory guideline for banks to use fair value methods according to the international financial reporting standards was made and issued by Basel members. The making of this guideline is to require banks have to possess a reasonable risk management system in the process of applying fair value option, but do not use fair value in the financial instruments that can't be calculated.

### ***59.3.2 Cautiously Applying Fair Value and Establishing an Evaluation System***

In terms of the attitudes of Chinese commercial banks towards the application of fair value, the most important is to be cautious.

First of all, it is necessary to measure fair value with high accuracy. In this process, however, it is necessary to give a comprehensive consideration to all sorts of elements that are active at market as well as all other parameters.

Second, it is necessary to give a reasonable consideration to the use scope of fair value and also strictly put it into implementation according to the new requirements in the Accounting Standards newly issued in China.

Third, it is necessary to establish and apply an internal control system.

### ***59.3.3 Assets Impairment Reserves for Inventories***

A large number of market risks will give rise to many restrictions on the application of fair value.

However, at present, the commercial banks have made a great progress in the risk control technologies.

For example, loans can be classified and evaluated by the banks in accordance with the default rate, and thus a risk assessment system can be established and simultaneously the loss of default can be predicted and calculated. In such a way, the level of risk control can be better improved.

Another advantage of the application of the measurement model of fair value also is that some advanced factors are introduced to the credit risks of measurement, and this suggests that the reduction of assets is permitted to be confirmed ahead of schedule.

### ***59.3.4 Improving Information Management System***

Although Chinese commercial banks have made a great progress in the accounting information processing and simultaneously the degrees of their information and

electronics technologies have been greatly improved, they still cannot effectively meet the requirements when facing up with a great number of the complex risks and so on.

Therefore, the risk control systems of more advanced financial instruments can be introduced by Chinese commercial banks from the advanced countries currently, or a fair value evaluation system can be developed internally by Chinese commercial banks.

In such a way, the quality and decision-making ability of information collection can be greatly improved.

## **59.4 Introduction of Advanced Experience from Foreign Countries**

After the New Accounting Standards of China was put into implementation, Chinese commercial banks are allowed to carry out a classification on the financial assets in accordance with their purpose of holding.

By referring to the measures taken by Financial Accounting Standards Board (FASB) and the commercial banks in the United States, the measures that can be introduced to China are specified in the following.

According to the purposes of enterprises, in SFA115, all debt investments and confirmable equity securities of fair value were classified by the Financial Accounting Standards Board in the United States into held-to-maturity securities, trading securities, and marketable securities and so on.

After fair value is introduced in China, therefore, the measurements of all sorts of measurements models should be processed by using a different way.

For these reasons, the implementation of these new standards as well as the influences of the application of fair value on the emergence of the commercial banks in the United States can be explained by researching the guided asset classification approaches based on holding purposes in SFA115. Therefore, this can provide a large amount of reference data for Chinese commercial banks.

Hodder carried out an analysis on the combination of macro factors and special factors and the modeling of risk control by using the data of more than 200 listed banking companies between 1993 and 1998 as sample.

In the experimental process, it was found that if the implementation of standards were not taken into account, the application of SFA115 will make an increase to the interest rate risk of banks, and banks were allowed not to classify securities into AFS for getting rid of the influences from supervisions.

At the same time, Beatty made an analysis on the measures that were taken by banks to reduce the fluctuation of equity statements and their impression on the emergence of securities investment by using the data of more than 300 banks between 1993 and the first quarter of 1994 as sample.

The data collected by Beatty shows that the proportion of the securities investment held by banks and also the time limit were reduced during the

implementation period of SFA115. At the same time, from the above data, it was found that the portfolio management of commercial banks under SFA115 was actually affected by equity statements and the double purpose of maintaining the elasticity of returns.

## 59.5 Conclusion

In the New Accounting Standards of China, higher importance is attached to the relevance of fair value. In the mean time, there are also some doubts on the reliability of fair value.

First of all, in many cases, fair value can't be directly acquired, but it is necessary to carry out evaluation and calculation. This, however, will give rise to the increase of the operation cost of banks.

Second, it is very easy for fair value to be affected when there are a great number of market risks, and also the one of the characteristics of China's market is that the market segmentation has been very serious. Therefore, it is possible that commercial banks will encounter a great number of mistaken judgments when they are openly facing up to market.

Third, if fair value is highly necessary to be determined by some non-market financial instruments with pricing valuation technique, it will need to rely on its internal model.

Therefore, in the face of the new asset classification approaches, the behavior of banks in risk management will be influenced by a large number of factors. Specifically speaking, banks will be affected in the time limit structure, interest rate structure, securities held types, and the size of portfolio.

## References

1. Lin L, Huang G (2005) Fair value-the measurement model of the future derivative financial instruments. *Commercial Res* 22:134-138
2. Yin H (2004) Management suggestions on the optimization of the voluntary information disclosure of Chinese listed companies. *Finan Account Mon* 12:178-183
3. Ye P, Zhang Y (2006) Improving the information disclosure of commercial banks with fair value. *Finan Account Mon* (15):26-30

# Chapter 60

## Study on Financial Development Based on Dynamic Panel Data Model

Huizhong Liu, Xue Tian, Xiaoyin Hou and Yuhang Li

**Abstract** We should take different regional economic and financial development consideration, when we analyze the effect of China's financial development to promote economic growth. This paper analyzes the dynamic panel data model, and concludes that the financial development has the vital simulation effect on economic growth, and the effect is obvious area differences: financial development promotes economic growth strong region in the east than in the central and western regions. Financial development, increase savings and investment, improve the investment efficiency, so as to effectively promote the economic growth.

**Keywords** Financial development • Economic growth • Dynamic panel data model

### 60.1 Introduction

Among the factors affect economic growth, economic development by many scholars' attention [1]. There are two kinds of different opinions played a role in the financial development is to promote economic growth [2]. Lucas representative viewpoint is not important financial development on the economic growth and economic growth brings demand, financial tools and financial services of financial development result. Instead, some economists such as gold and McKinnon, investment and financial development suggestion positively correlated, so the financial development is one of the factors affecting imports on the promoting effect of economic growth.

---

H. Liu (✉) · X. Tian · X. Hou · Y. Li  
Wuhan University, Wuhan, Hubei, China  
e-mail: huizhongdl23@126.com

In recent years, more research shows that financial development did have an important effect on economic growth achieved through the following two mechanisms [3]. First of all, financial development can increase savings and investment for two reasons: (1) economic development of financial instruments, so as to enrich the more effective mobilizing saving, it can convert idle funds investment; (2) financial development can save transaction costs and information, so it to increase savings for investment. Second, the financial development can improve the efficiency of investment through the two aspects: (1) produce more of the material, with the development of financial investment decision, so as to improve the efficiency of capital allocation, promote economic growth; (2) can improve financial development of financial assets of liquidity, reduce the liquidity risk leading investors to short-term assets into a long period of low yield high yield, improve the fixed assets of the long-term equilibrium products.

Economists on the analysis of the relationship between financial development and economic growth in the related theory, the corresponding empirical research are also increasing. The empirical research can be roughly divided into three stages, according to their analysis method.

The empirical research is the first stage of cross section based on data. In this stage, scholars mainly applied research OLS or WLS relationship between financial development and economic growth [4]. For example, an empirical study on the gold and the related data of 35 representative countries from 1860 to 1963, found that economic growth is the positive relationship between financial developments.

The empirical study of the second stage is based on time series data. Economists, mainly using co integration model and error correction model to deal with the non-stationary time series data, and application of granger causality test, study the relationship between financial development and economic growth. For example, the causal relationships between Arestis Demetriades, inspection financial development and economic growth in Germany, the United States and South Korea and unit root test, co integration test Hansen's VAR model and weak exogenous test, found that financial development promoted economic growth and in all the three counties.

In the third stage, empirical research is conducted on the basis of panel data. Panel data model can not only to expand the research framework model and cross section time series model, and reveals the different lateral heterogeneity unit. Therefore, in recent years, this model has been widely applied in the empirical study of the financial development and economic growth. For example, Cesar Calderon and VAR model of USES panel data and Geek decompose the causality between technique to study financial development and economic growth in 109 developing countries and developed countries from 1960 to 1994, and concludes that the empirical finance development by promoting the economic growth of the human capital accumulation and technology progress, and this effect is strong in developing countries than in developed countries.

According to the characteristics of cultures, the China's financial development and economic growth of related problems, this paper builds a dynamic panel data model



is based on the existing research results to study the dynamic characteristics and regional difference in the financial development on the growth of China's economy.

## 60.2 Model

### 60.2.1 Variables and Data

We use the GDP of every province in China as the explained variable.

Financial development index is an explain variables. According to financial development based on the status quo of, in China, we know that financial assets mainly concentrated in the banking system. For this reason, we choose deposits and loans in the provinces of China express variables [5]. In addition, consider influencing the gross domestic product (GDP) ago gross domestic product (GDP), we choose the previous GDP in every province of China as other explanation variables.

Due to the different historical conditions and geographical position, there is serious imbalance of economic and financial development in various fields. In order to reveal the regional differences research dynamic effect of financial development in all aspects of economic growth in China, we select 30 provinces merged into the eastern, central and western regions. 11 provinces east including: Beijing, Tianjin, Hubei, Liaoning, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong and Hainan. The central region by 8 provinces: Heilongjiang, Jilin, Shaanxi, henna, Hubei, Hunan, Jiangxi, Anhui. The western region including 11 provinces: Sichuan, Yunnan, Guangxi, Guizhou, Ningxia, Qinghai, Tibet, Inner Mongolia, Shaanxi, Gansu, Xinjiang, etc. In this paper, the cross section of the units, each province for samples from 1985 to 2007 years of panel data form.

### 60.2.2 Specification of Model

Considering the influence of previous GDP on current GDP and the heterogeneity of financial development in different areas, we establish the following dynamic panel data model to study the dynamic nature and regional differences of the effect which financial development has on economic growth in China.

$$\ln GDP_{it} = \alpha \ln GDP_{i,t-1} + \beta \ln DL_{it} + u_i + v_{it} \quad (60.1)$$

In the model (60.1),  $\ln$  represents natural logarithm;  $GDP_{it}$  is denoted as Gross Domestic Product of every province in each year, and  $GDP_{i,t-1}$  is lagged value of  $GDP_{it}$ ;  $DL_{it}$  represents the sum of deposits and loans of every province in each year;  $u_i$  is individual effect and  $v_{it}$  is random disturbance.  $\alpha$  measures the influence

of previous GDP on current GDP, and  $\beta$  measures the effect which financial development has on economic growth. If the estimate of  $\beta$  is positive, it shows that financial development promotes economic growth in China.

### 60.2.3 Estimation Method of Model

For ease of presentation,  $GDP_{it}$  and in  $DL_{it}$  are replaced by  $y_{it}$  and  $X_{it}$  correspondingly in the dynamic panel model (60.1). Then we rewrite model (60.1) as  $X_{it}$  is a strictly exogenous regressor, that is  $E(x_{it}v_{is}) = 0$  for all  $t, s = 1, 2, \dots, T$ ,

$$y_{it} = \alpha y_{i,t-1} + X_{it}\beta + u_i + v_{it} \tag{60.2}$$

but  $X_{it}$  is correlated with  $u_i$ .

In order to estimate the dynamic panel model (60.2), we make use of Generalized Method of Moments (GMM) whose basic principle is as follows [6].

At first, we difference model (60.2) to eliminate the individual effect  $u_i$ . That is

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \Delta X_{it}\beta + \Delta v_{it} \tag{60.3}$$

The differenced model can be stacked up as

$$\Delta Y = \alpha \Delta Y_{-1} + \Delta X\beta + \Delta v \tag{60.4}$$

In model (60.3),  $(y_{i,t-1}, y_{i,t-2})$  is correlated with  $(v_{it} - v_{i,t-1})$ , so it is necessary to look for valid instrumental variables of  $(y_{i,t-1}, y_{i,t-2})$  in order to get a consistent estimator.

For  $t = 3$ , we have

$$y_{i3} - y_{i2} = \alpha (y_{i2} - y_{i1}) + \Delta X_{i3}\beta + (v_{i3} - v_{i2}) \tag{60.5}$$

In this case,  $y_{i1}$  is a valid instrumental variable for  $(y_{i2} - y_{i1})$ , since it is highly correlated with  $(y_{i2} - y_{i1})$  and not correlated with  $(v_{i3} - v_{i2})$

For  $t = 4$ , we have

$$y_{i4} - y_{i3} = \alpha (y_{i3} - y_{i2}) + \Delta X_{i4}\beta + (v_{i4} - v_{i3}) \tag{60.6}$$

In this case, same as above,  $y_{i2}$  as well as  $y_{i1}$  are valid instrumental variables for  $(y_{i3} - y_{i2})$ , since both  $y_{i2}$  and  $y_{i1}$  are not correlated with  $(v_{i4} - v_{i3})$ .

One can continue in this fashion, adding an extra valid instrumental variable with each forward period, in other words, for  $t = 5$ , the instrumental variables are  $y_{i3}, y_{i2}$  and  $y_{i1}$ , so that for the period  $T$ , for  $t = T$ ,

$$y_{iT} - y_{i,T-1} = \alpha (y_{i,T-1} - y_{i,T-2}) + \Delta X_{iT}\beta + (v_{iT} - v_{i,T-1}) \tag{60.7}$$

The set of valid instrumental variables becomes  $y_{i1}, y_{i2}, \dots, y_{i,T-2}$

In addition, we have  $E[X_{it}(v_{is} - v_{i,s-1})] = 0 (t = 1, 2, \dots, T, s = 2, \dots, T)$  for  $X_{it}$  is strictly exogenous. Therefore,  $x_{i1}, x_{i2}, \dots, x_{iT}$  should be added to instrumental variables of each  $t$ .



In eastern region, when the sum of deposits and loans increases by 1 % point, the current GDP increases by about 0.44 % points that is higher than the national average. In central and western region, while the sum of deposits and loans increases by 1 % point, the current GDP increases by about 0.13 and 0.10 % points respectively, and it is distinctly lower than the national average.

### 60.3 Conclusion

At the same time, because of different financial system in various areas of the efficiency in eastern China's financial system will be saving more effective investment in central and western regions. As a result, have obvious influence of regional difference in financial development on the promoting function of economic growth.

### References

1. Arestis P, Demetriades P (1997) Financial development and economic growth: assessing the evidence. *Econ J* 107(442):783–799
2. Cesar C, Liu L (2010) Direction of causality between financial development and economic growth. *J Dev Econ* 72:321–334
3. Goldsmith RW (1969) *Financial structure and development*. Yale University Press, New Haven, pp 23–28
4. King RG, Levine R (2011) Finance and growth: Schumpeter might be right. *Quart J Econ* 108(3):717–737
5. Lucas RE (2010) On the mechanics of economic development. *J Monetary Econ* 22(1):3–42
6. Mckinnon RI (2010) *Money and capital in economic development*, vol 9. Macmillan Publishing Company, New York, pp 35–39

# Chapter 61

## Second-Order Factor Analysis on Content Structure of Small Loan Customer

Luo Liu and Shuwen Chen

**Abstract** On the basis of the exploratory and verification analysis of first-order five factors of the content structure of the small loan customer managers' job performance, this paper begins its second-order factor analysis. Through the exploratory analysis of the factors, the result shows that the content structure of loan customer managers' work performance presents clearly 3-dimensioned structure, namely, behavior performance and result performance and process performance. According to the modeling requirement of the structure equation model, by using the verification factor analysis methods, validation has been made to show that small loan customer managers' work performance is the model of second-order three factors and first-ordered five factors.

**Keywords** Loan customer managers • Work performance • Content structure • Second-order factor analysis

### 61.1 Introduction

Customer manager system is the main form of business strategy of modern commercial banks [1]. As the main execution body of customer manager system, the customer manager shall respect the objective law and must take customers as the center and market as the orientation, and provide customers with professional financial services [2]. It is a brand new tenet to apply work performance in the management of customer managers of commercial banks, which also has become a core problem of commercial bank HR management under customer manager system [3]. With the competition of homogeneous product increasing fiercely in financial industry, specialized services of banks become increasingly detailed.

---

L. Liu (✉)

College of Management in Dalian University of Technology, Dalian 116024, China  
e-mail: luoliu25g@126.com

S. Chen

Dalian University of Technology, Dalian 116024, China

Small business loan is a worldwide problem. It is of far-reaching significance to study the customer managers' work performance for our country to realize commercialization and sustainable loan in small enterprises [4]. Therefore, it has become an important issue for the current management theory and management practice to explore the model of work performance of small business loan customer managers.

### ***61.1.1 What is the Working Performance?***

Performance appraisal is a way for the organization to evaluate the individuals' performance, behaviors and working process. Work performance is theoretically described as a method and way for individuals to make efforts to achieve organizational targets, emphasizing individuals' performance and efficiency. Nevertheless, the foreign researchers just constructed the essence of the work performance from the organization of the present situation [5]. They used task performance to evaluate the performance in the past and relationship performance to evaluate the behaviors and standards between individuals in internal organization. Relationship performance is a kind of harmonious factors. But where are the factors which can play a positive role in the future of organizations and individual development? Considering target of organizations, the real endogenous power factors of individuals can not be ignored, especially the whole process of the work of individuals should be paid more attention to, therefore, the domestic scholars need to redefine job performance [6]. Small business loan (Microcredit) is simplified as micro lending, referring to a kind of financial instruments used to provide small loans to small enterprises. Therefore, Chinese scholars Liu Luo and Chen Shuwen has made the systematic research on the model for small enterprise loan customer managers' job performance in small and medium-sized commercial banks, according to commercial bank management principles, objectives and nature, analyzing the characteristics and attributes of small enterprises. Considering the particularity and complexity of small loan customer managers' job, on the basis of competent performance and promotion performance, they creatively proposed "the safety performance", "sustainable performance" and "due diligence performance" three new dimensions, to construct a model of five-dimensioned work performance for the small loan customer managers.

### ***61.1.2 Putting Forward Problem***

Based on the reference related to research achievements, Liu Luo and Chen Shuwen have developed a model of five-dimensioned work performance for small loan customer managers, according to which, "the questionnaire scale of the five-dimensioned structure model for science and technology small loan customer

managers' job performance" was worked out. Two years have passed, during which many inspections have been given to the model, as a result, the five-dimensioned structure model has shown the internal consistency co-efficiency is very high. The stability and reliability of "efficiency variable questionnaires of work performance" are satisfactory. Especially, the creatively bringing forward of the three factors of inspection, "sustainable performance", "safety performance" and "due diligence performance" are very stable performance. It was found that the content of the model presented a complex structure in the process of the study on small loan customer managers' work performance. Not only is there the first-ordered five factors model structure, but also there is a second-order factor structure. This paper will use exploratory and verification factor analysis method to make a further empirical research on the second-order factor model of work performance.

## **61.2 Research Methods**

### ***61.2.1 Being Tested***

Four branches were extracted from city commercial banks as samples for this study, one in the west, one in the centre, two in the east, and small enterprise loan customer managers were taken as the objects of the study. "The questionnaire scale for the small loan customer managers' work performance" was used for measurement. Out of 500 questionnaires, 492 valid questionnaires were received; the recovery rate is 87.5 %.

### ***61.2.2 Tools***

In this article, we adopted the questionnaire scale with 48 entries for small loan customer managers' job performance by Liu Luo and Chen Shuwen. On this basis, according to the interview with some of small loan business managers, the senior management personnel and 20 experienced science and technology small loan customer managers, our study has developed the scale questionnaires for the science and technology-styled small loan customer managers' job performance.

### ***61.2.3 Program***

This research program is divided into three steps:

- The first step is for questionnaires. The discussing of the project preparation and scoring method are emphasized.

- The second step is to collect data. The expansion of the scale questionnaire survey is used, with nationwide samples, small enterprise loan customer managers, coming from city commercial banks for the survey.
- The third step is to analyze data. Audit and arrange questionnaires. According to the odd and even number, questionnaires will be divided into two halves. Extracting odd questionnaires, we make exploratory factor analysis by using statistical software SPSS16.0. According to the modeling requirement of the structure equation model, we extract even questionnaires for verifications by using statistical software lisrel8.7.

### 61.3 The Exploratory Analysis

#### 61.3.1 The Exploratory Research of the Second-Order Factor

On the basis of the exploratory and verification analysis of first-order five factors of the content structure of loan customer managers’ job performance, this paper analyzes its second-order factor. This study sample data are been made exploratory factor analyzed with Principal Component Analysis of the factor Analysis method. Extracting factor to factor rotation with orthogonal variance great method, we choose factors with features of root greater than 1. Using SPSS16.0 statistical software we make factor matrix to four great variance power orthogonal rotating. According to the size of common degrees of the project, we select those projects which are high common degrees and high factor loading, and delete those projects which are low common degrees, low factor loading having more equal cross load. Specific test of factor structure is shown in Table 61.1.

Table 61.1 shows, we get five-factored entries to form three dimensions, to get three-factored structure model, the five factors of load coefficient are far more than 0.5, even reaching 0.7 or more, which are all in the correct factor load, which shows that the three factors are accurate as the second-ordered factor validity of the load customer managers’ work performance. Its total explained variance

**Table 61.1** The results of the analysis of the second-order factor of the small loan customer managers’ content structure of work performance (n = 400)

	Factor 1	Factor 2	Factor 3	Common degrees
Competence performance	834.706			706
Promotion performance		808.699		699
Sustainable performance	791.621		621	
Safety performance	894.804	804		
Due diligence performance	876.789	789		
Variance explained rate (%)	29.557	22.812	21.123	
The total variance explained rate (%)				73.492



reaches the ideal result of 73.492 %. With the Variance biggest orthogonal rotating of Principal Component Analysis of the factor Analysis method, we make an exploratory factor analysis of the five factors of the content structure of the small loan customer managers' work performance. Here is the result of the test, see Table 61.1. Statistical results show that the total variance explained ratio is 73.492 %. Each factor load of first-ordered factors, variance explained rate and common degrees are clear enough to show that the small loan customer managers' content structure of job performance presents second-ordered three-factored structure. The explain quantity is highly satisfactory, and the small loan customer managers' second-ordered content structure of work performance is clearly shown as: result performance, behavior performance and process performance.

With reference to the relevant literature materials, according to the records of the interview with the competent personnel and loan customer managers and the projects contained in the second-ordered factor, we name the second-order factor as the following:

Second-order factor 1: result performance. The main contents include being qualified for performance.

Second-order factor 2: behavior performance. The main contents include performance and promoting sustainable performance.

Second-order factor 3: process performance, safety performance and due diligence performance.

### 61.3.2 The Verification Research of the Second-Order Factor

According to the results of exploratory analysis of the second-order factor, this paper states that the content structure of loan customer managers' of work performance is the models of second-ordered three factors and the first-ordered five factors. According to the modeling requirement of the structure equation model, we analyzed the factor verification of this constructed model by using statistical analysis software Lisrel8.70. We match the 490 sample data with the constructed model (see Table 61.2 for testing cases) and get further completely standard resolution of the second-ordered factor model of the content structure of loan customer managers' job performance.

The standard resolution of concrete structure and parameters are shown in Table 61.1, and the main fitting index is shown in Table 61.2.

According to the theory of structure equation model, the evaluation of the fitting degree of a model is a complex problem. For model evaluation, different

**Table 61.2** The fitting index of the second-ordered three-factored model of small loan customer managers' content of work performance and observation data (n = 492)

$\chi^2$	$\chi^2/df$	RMSEA	CFI	N	NFI
995.60	321	3.102	0.46	0.981	0.966

emphasis is laid on the different evaluation of the fitting index. Therefore, it is generally thought that, whether a model can be accepted, one index can not be enough, several index should be used to have comprehensive assessment. Therefore, referring to a recognized standard, in this study, the index is:  $\chi^2$ ,  $\chi^2/df$ , RMSEA, GFI, CFI, NNFI and PNFI. Among them, the  $\chi^2$ , RMSEA and GFI are absolute fitting index, CFI and NNFI are relative fitting index (also known as value-added fitting index),  $\chi^2/df$  and PNFI are contracted fitting index. Using these three kinds of index, the acceptance of a model is easily to be produced as the result of consensus.

As for SEM, the value of  $\chi^2$  is an index which is a statistical measure of poor fit (badness-of-fit measure). If in a degree of freedom a notable value of  $\chi^2$  is obtained, which shows it is not fit between the observation matrix and theory estimated matrix. The inspection of mode fitness is expected to get the material and the model matched well, so we must obtain an unnoteworthy value of  $\chi^2$ . Scholars generally recommend that the level of the notable value of  $\chi^2$  should be greater than 0.1 or above, the model can be accepted. In other words, an unnoteworthy values of  $\chi^2$  shows the model match observation data.

Because the value of  $\chi^2$  is quite sensitive to the sample data, the bigger the sample is, the easier it is for the value of  $\chi^2$  to be notable, which leads to the model being refused theoretically. Therefore, the value of  $\chi^2$  is usually used as an index to evaluate the whole fitting degree associated with the degree of freedom, namely, the value of  $\chi^2/df$ . Generally,  $\chi^2/df < 3$ , shows integral model fitting is better;  $3 < \chi^2/df < 5$ , shows that whole fitting isn't very good, but can be accepted;  $\chi^2/df > 5$ , indicates that the model fitting degree is worse;  $\chi^2/df > 10$ , shows integral model fitting degree is very poor. In this research the value of  $\chi^2/df$  is 3.102, it is between 3 and 5, though the value is more than 3, the goodness-of-fit of the model is not very good, but can be accepted.

RMSEA is a model adaptation index which is paid more attention to in academic circles in recent years. Studies show that, RMSEA is better than many other indexes in the evaluation of adaptation. The value of the RMSEA is between 0 and 1; the closer the RMSEA is to 0, the better the whole fitting degree is. Generally, when  $RMSEA < 0.05$ , it is thought to be good adaptation;  $0.05 < RMSEA < 0.08$ , it can be regarded as "not bad adaptation";  $0.08 < RMSEA < 0.10$ , it is a moderate adapter;  $RMSEA > 0.10$  it is bad adaptation. In this research, the value of the RMSEA is 0.046, below 0.05, the model is thought to be good adaptation.

CFI index is used to overcome NNFI's lack of effects in the nested model. The value of CFI is between 0 and 1. The closer the CFI is to 1, the better the whole fitting degree of the model is. Generally,  $CFI > 0.90$ , indicates that the model can be accepted. In this study the value of the CFI is 0.98. It is not only between 0 and 1, but also very close to one, which shows that the whole fitting degree of the model is better.

NNFI is not a normed fitting index (Non-Normed Fit Index), which can be used to avoid the influence of the complexity of the model. Generally, the model can be accepted if NNFI is more than 0.90. In this study the value of the NNFI is 0.96,

between 0 and 1, greater than 0.9, closer to 1, which shows that the relative fitting degree of the model is better.

## 61.4 Discussion

Work performance is a performance and efficiency of an individual to realize the goal of the organization, which is a continuous result that can be measured. It is a multidimensional body of the behavior and process. The evaluation of the work performance is not only based on individual's competence performance and work performance, or his promotion performance which only shows whether he can do the job, which belongs to the individual's own behaviors, but it also lay stress on the sustainable behaviors for the future environmental changes, and the whole flow of management and control of individual's working process. Adding sustainable behaviors and the whole process performance to the work performance, we make the core factors of the human resources change profoundly. With such a thinking mode, using three-dimensional visual angle, combining with small loan characteristics, this paper studies the loan customer managers' job performance and have constructed the five-factored structure model of work performance. After the substantial research on the structure of work performance, with theory evidence and empirical analysis methods, this paper concludes that the structure of the performance is a conceptual model of second-ordered three-factored structure, the three factors were the result performance, the behavior performance and the process performance.

## 61.5 Conclusion

Through the research on the analysis of the principal component it is found that there exists second-ordered three-factored structure in the content of loan customer managers' work performance in this article. The three factors were the result performance, behavior performance and process performance. In the structural equation model, the results of the exploratory analysis and verification analysis proves that the small loan customer managers' job performance is the structure model of second-ordered three factors, first-order five factors. In this paper the initial constructed model and the main fitting indexes of the practical survey data reach a better fitting level, which shows that the actual survey data support the constructed model well.

## References

1. Kane RL, Halland WW, Detels R, Knox G (1976) Special needs of dependent elderly person. Oxford 6:24–28
2. Bernardin H, Betty RW (1984) Performance appraisal: assessing human behavior at work, vol 4. Kent Publishers, Boston, pp 185–189

3. Campell JP, Mccloy RA, Oppler SH, Sager CE (1993) A theory of performance. In: Schmitt N, Borman WC (eds) *Personnel selection in organizations*, vol 22. Jossey-Bass, San Francisco, pp 91–98
4. Luo L, Shuwen C (2011) The building of the five-dimensioned structure model of small loan customer managers' work performance. *Journal of the capital normal University, Press of humanities and social science*, vol 2, pp 276–279
5. Luo L, Shuwen C (2011) Study on the model of small loan customer managers' work performance. *J Sch Central Party* 11:45–48
6. Luo L, Shuwen C (2012) Empirical study on the model of small loan customer managers' work performance. *Sci Prog Countermeasures* 16(01):14–18

# Chapter 62

## Innovation on Supply Chain Financial for Loan Indicator Analysis

Peng Li

**Abstract** According to the company and the method of debt in trade credit and unity based logistics features and related costs credit mode structure, and analyzes the cash flow statement of borrowers in supply chain financial innovation. Then, this chapter analyzes the logistics enterprise bear downside risk-averse-key indicators and loan risk tolerance consistent logistics enterprises. The results show that the risk control limits can downside of the season-risk supply chain inventory financing financial innovation and lending risk tolerance is consistent, logistics enterprises.

**Keywords** Supply chain finance • Loan indicator analysis • Loan-to-value ratio

### 62.1 Introduction

Supply chain finance means to cooperative innovation of logistics enterprise, financial institutions such as Banks provide enterprise in the supply chain, especially small and medium-sized enterprise financial services and related services, such as clearing and insurance. In recent years, the world's financial institutions, such as BNP Paribas Dutch bank, Citibank, has taken to the above advantages, began to consider logistics enterprises implement supply chain with financial innovation. UPS, the leading company in the field, and took over the express the first international Banks in the United States, formed a special UPS capital companies all supply chain financial services to their customers and synchronization the data stream, information flow and cash flow [1].

Along with the rapid development of the supply chain, much financial innovation of products, such as finance, accounts receivable financing, warehouse purchase-order financing and future guarantee that the goods name has emerged L/c. However, due to the inventory is the basic elements, the logistics representative

---

P. Li (✉)

College of Economics and Management, Xi'an University of Posts and Telecommunications,  
Xi'an, Shaanxi Province 710061, People's Republic of China  
e-mail: lipeng@guigu.org

factors, provide logistics assets in small and medium enterprise has the good liquidity and liquidity, inventory financing is the core of the supply chain has been financial [2].

Through field investigation and operating method of the supply chain finance can be divided into three different operation modes: the supervision, unified credit and logistics bank. The steps credit model is based on unity as follows [3].

1. Credit bank the right, then deal with logistics enterprise supply chain logistics enterprises' financing themselves [4]. Logistics enterprise borrowers signed the contract and ensure the stock logistics enterprise supply chain financial treatment for a loan.
2. The borrower deposit or extract inventory in accordance with the contract and deposit sales close-end cash account. Logistics enterprise is responsible for the control inventory quantity and value in accordance with the contract.
3. Borrowers to pay off the mortgage, logistics enterprise agreed to the borrower total commitment inventory, and then come back over the contract.

In unity, the mode if the borrower credit application for credit four seasons inventory, logistics enterprises must take seasonal goods price risk consideration, ensure to establish a correct loan-to-value ratio, this is the key risk control inventory financing index. However, this study confirmed interest rates and mortgage amount, but ignore the influence of credit risk guarantee itself, such as price risk the risk of the mortgage [5, 6]. The risk is closely related to the logistics operation of enterprises, especially for chattel collaterals, such as inventory or accounts receivable, the value realization is focus on operational enterprise, so the bank management decision should be considered in the determination of the enterprise loan-to-value ratio and other similar index [7].

## 62.2 Basic Assumptions

Based on Uniform Credit mode under supply chain finance innovation, we suppose a borrower is risk neutral, a logistics enterprise is downside risk averse and the collateral of the borrower is seasonal inventory. We denote with  $c$  the purchase price of a unit inventory, with  $B$  the normal sale price, with  $c'$  the discount price of the inventory that fail to be sold (or the unit price at which suppliers buy back the remained inventory), and with  $s$  the unit cost for inventory storage. Given the randomness of the demand, the logistics enterprise cannot determine the exact amount of the demand, but the distribution function can be determined as  $F(x) = P(\xi < x)$  and its probability density function is  $f(x) = F'(x)$  with increasing failure rate. In Uniform Credit mode, the logistics enterprise is very familiar with the industry and operation of the borrower. Furthermore, due to the higher positivity, the logistics enterprise can get the relative true information of the borrower and so the demand distribution function becomes the common knowledge of the borrower and the logistics enterprise.

If the borrower takes initial inventory  $q_0$  as collateral, the logistics enterprise would provide a loan  $\omega c q_0$  for the borrower referring to the purchasing price of inventory, where  $\omega$  is the loan-to-value ratio of the pledge loan. Then, the borrower applies the loan to reorder  $q$  unit of inventory. In Uniform Credit mode, the logistics enterprise is able to control the borrower’s material flows in this business and makes sure to sell the collateral first. On the occasion when the borrower cannot repay the loan with initial inventory, the logistics enterprise can control the reordering in time depending on their unique advantage and deposit the sale revenue of inventory into the close-end account until they pay off the loan. If the sale cash flow of the total inventory is unable to pay off the loan, the borrower would adopt the funds from other operations to repay the loan with the probability  $(1 - Q)$ . It is similar to the condition that the borrower with the initial inventory  $q_0$  takes advantage of the loan provided by the logistics enterprise to reorder inventory  $q$  and then provide the total inventory  $q_0 + q$  to pledge. In this chapter, we take  $q/q_0$  as the referenced loan-to-value ratio.

In addition, the interest rate set by the logistics enterprise is  $a$ , the interest rate paying banks is  $a'$  and  $a' < a$ . Based on the uniform credit line provided by banks, the logistics enterprise provides small and medium enterprises with inventory-pledging loan and is able to gain the profit of interest margin and also the profit from storage business. However, the logistics enterprise must pay extra money to closely monitor the operation of the borrower. In this chapter, let  $m'$  be the monitoring cost of unit inventory,  $s'$  be storage cost of unit inventory and  $s$  be stock benefit of unit inventory.

In sum, in this chapter, Uniform Credit mode is consistent with Logistics Bank one in the decision-making thought of borrowers and lenders. There are only a few differences between two modes, that is, in Uniform Credit mode, the loan cost  $a'$  that logistics enterprises lend the small and medium enterprises is the interest rate charged by the bank, while in Logistics Bank mode, the loan cost  $a'$  that banks lend small and medium enterprises is capital cost inside banks. And, the former is generally larger than the later.

Based on the above assumptions, when the borrower defaults, the formula of the borrower’s cash flow at the end of period is as follows:

$$X(\xi) = B \min \{ \xi, q_0 + q \} + c' \max \{ 0, q_0 + q - \xi \} - c q (1 + a) - s (q_0 + q) \quad (62.1)$$

By analyzing the formula of the borrower’s cash flow at the end of period, we get Lemma 1.

**Lemma 1**

*When the borrower defaults and  $c' > s$ , if  $q \leq q_3$ , the probability of borrower’s repayment is 1; if  $q > q_3$ , then the probability of the borrower’s repayment is  $1 - F(\xi_x)$ , where  $q_3 = \frac{c' - s}{c(1 + a) - c' + s} q_0$ ,  $\xi_x = \frac{(c(1 + a) + s - c')q + (s - c')q_0}{B - c'}$ .*

### 62.3 Loan Indicator Decision of Downside-Risk-Averse Logistics Enterprise

This chapter assumes that the logistics enterprise is downside-risk-averse. The maximum loss which the logistics enterprise is willing to take is denoted by  $L$  which is the function of the loan amount  $v_0 = cq$ , and then we get  $L = lv_0 = lcq$ , where  $l$  is defined to be the loan loss degree of the logistics enterprise. Due to the downside-risk constraint of the logistics enterprise, we require  $P(loss > lcq) \leq \beta$ , where  $loss = cq(a - a') + (s - s')(q + q_0) - m'(q + q_0) - \Pi(\xi)$ , then get  $P(loss > lcq)$ , which satisfies Lemma 2.

#### Lemma 2

(1) If  $q \leq q_3$ , then  $P(loss > lcq) = 0$ , 2) if  $q \geq q_3$ , there exists a critical point  $q^\varepsilon$ , then

where  $q^\varepsilon = \frac{c'-s}{c(1+a-l)-c'+s}q_0 > q_3$ , and when  $q > q^\varepsilon$ ,  $P(loss > lcq)$  increases in  $q$  monotonously.

$$P(loss > lcq) = \begin{cases} 0 & \text{if } q_3 < q \leq q^\varepsilon \\ QF\left(\frac{(c(1+a-l) + s - c')q - (c' - s)q_0}{B - c'}\right) & \text{if } q > q^\varepsilon \end{cases} \tag{62.2}$$

#### Proof

(1) If  $q \leq q_3$ , the borrower is bound to repay and the loss is 0. So,  $P(loss > lcq) = 0$ .

(2) If  $q \geq q_3$ , when the borrower repays the debt, the profit of the logistics enterprise is  $cq(a - a') + (s - s')(q + q_0) - m'(q + q_0)$ ; when the borrower doesn't repay the debt, the profit is:

$$\Pi(\xi) = B\text{Min}\{\xi, q + q_0\} + c\text{Max}\{0, q + q_0 - \xi\} - cq(1 + a') - s'(q + q_0) - m'(q + q_0). \tag{62.3}$$

Then the loss is:  $loss = cq(a - a') + (s - s')(q + q_0) - m'(q + q_0) - \Pi(\xi)$ . When  $\xi = 0$ ,  $loss = cq(a - a') - c'(q + q_0) + s(q + q_0)$ , and there exists a critical value  $q^\varepsilon$  of inventory amount which the borrower loans to reorder. The critical value satisfies  $\frac{loss}{cq} \leq \frac{(c(1+a)+s-c')q'-(c'-s)q_0}{cq^\varepsilon} = l$ , then get  $q^\varepsilon = \frac{c'-s}{c(1+a-l)-c'+s}q_0$ . As  $l > 0$ , we have  $q^\varepsilon > q_3$ . When  $q_3 \leq q \leq q^\varepsilon$ ,  $P(loss > lcq) = 1$ , that is,  $P(loss > lcq) = 0$ .



Similarly, when  $\xi > q + q_0$ , then  $\frac{loss}{\xi > q + q_0} = cq(1 + a) - B(q + q_0) + s(q + q_0)$ . Based on the proof in Lemma 1, we have  $B > c(1 + a) + s$ . So, when  $\xi > q + q_0$ , the loan loss must be 0, and then we get  $P(loss > lcq) = 0$ .

When  $q > q^\epsilon$ , we have  $P(\{loss > lcq\} \cap \{\xi > q_0 + q\}) = 0$  from the above deduction, and have:

$$\begin{aligned}
 P(loss > lcq) &= QP(cq(1 + a) + s(q_0 + q) - B\xi - c'(q_0 + q - \xi) > lcq) \\
 &= QP\left(\xi < \frac{cq(1 + a - l) + s(q_0 + q) - c'(q_0 + q)}{B - c'}\right) \\
 &= QF\left(\frac{(c(1 + a - l) + s - c')q - (c' - s)q_0}{B - c'}\right)
 \end{aligned} \tag{62.4}$$

Since  $q > q^\epsilon$ , we get  $(c(1 + a - l) + s - c')q - (c' - s)q_0 > 0$ , and since  $c' - s > 0$ , there must be  $c(1 + a - l) + s - c' > 0$ . According to the distribution function properties, we know  $F\left(\frac{(c(1+a-l)+s-c')q-(c'-s)q_0}{B-c'}\right)$  increases in  $q$  monotonously, and then  $P(loss > lcq)$  increases in  $q$  monotonously.

According to downside-risk constraint  $P(loss > lcq) \leq \beta$  of logistics enterprise, we can get the maximal loan-to-value ratio which logistics enterprises can determine as Theorem 1.

### Theorem 1

*Just considering downside-risk constraint  $P(loss > lcq) \leq \beta$  of logistics enterprise, the maximal loan-to-value ratio which logistics enterprises can determine in inventory financing under the Uniform credit mode is:*

*where  $\beta$  is risk tolerance level of logistics enterprise about the loan, and  $\beta > 0$ .*

$$\omega_{\max} = \frac{(B - c') F^{-1}(\beta/Q) + q_0(c' - s)}{q_0(c(1 + a - l) + s - c')}$$

#### Proof

If  $q \leq q_3$ , we have  $P(loss > lcq) = 0 < \beta$  according to Lemma 2, if  $q_3 \leq q \leq q^\epsilon$ , we may get  $P(loss > lcq) = 0 < \beta$  based on (62.2), so we may know that the maximal reordering inventory is higher than  $q^\epsilon$ , if  $q > q^\epsilon$ ,

considering  $P(loss > lv_0) \leq \beta$  and according to (62.2), we have:  
 $P(loss > lcq) = QF\left(\frac{(c(1+a-l)+s-c')q-(c'-s)q_0}{B-c'}\right) \leq \beta$ .

Because  $q = \omega q_0$ , we have  $\omega \leq \frac{(B-c')F^{-1}(\beta/Q)+q_0(c'-s)}{q_0(c(1+a-l)+s-c')}$ . According to Lemma 2, we know that  $P(loss > lcq)$  increases in  $q$  and  $\omega$  monotonously, so we know

that the loan-to-value ratio when  $\omega = \frac{(B-c')F^{-1}(\beta/Q)+q_0(c'-s)}{q_0(c(1+a-l)+s-c')}$  is the maximal loan-to-value ratio which logistics enterprises can determine. More than the value, the risk of logistics enterprise can't satisfy the risk tolerance level  $\beta$ .

## 62.4 Conclusion

Based on the unified logistics features and related costs credit mode structure, and analyzes the cash flow statement of borrowers in supply chain financial innovation. Then, this chapter analyzes the logistics enterprise bear downside risk-averse-the key indicators of risk tolerance, loan consistent logistics enterprises.

## References

1. Biederman D (2004) Logistics financiers. *The J Commerce* 21(4):40–42
2. Boot AWA, Thakor AV, Udell GF (1991) Secured lending and default risk: equilibrium analysis, policy implications and empirical results. *Econ J* 101:458–472
3. Jiménez G, Salas V, Saurina J (1983) Dermination of collateral, 11(4):498–503 (unpublished)
4. Buzacott JA, Zhang RQ (2004) Inventory management with asset-based financing. *Manage Sci* 24:1274–1292
5. Maqbool D, Hu Q (2008) Financing newsvendor inventory. *Oper Res Lett* 36:569–573
6. Gan X, Sethi SP, Yan H (2004) Coordination of supply chains with risk-averse agents. *Prod Oper Manage* 13(2):135–149
7. Gan X, Sethi SP, Yan H (2005) Channel coordination with a risk-neutral supplier and a downside-risk-averse retailer. *Prod Oper Manage* 14(1):80–89

**Part IV**  
**Education in Management Science I**

# Chapter 63

## Research on Curriculum Reform Based on Probability Theory and Mathematical Statistics

Xiaohong Liu, Qilei Feng, Yongli Zhang and Shujuan Yuan

**Abstract** Independent College as a new school system of Higher Education, how to train people effectively to adapt to the needs of society is its urgent problem. This chapter analyzes the current situation and identifies problems in teaching, from the practical situation of teaching on Probability theory and Mathematical Statistics in Independent Colleges, and then, proposes a solution to optimize the teaching methods. This paper, based on ensuring the students grasp the core knowledges, research how to use A large number of examples and modern teaching methods to changing the mode of purely mathematics teaching and guiding the students to solve statistical problems around, so as to stimulate students' interest and motivation in learning, to laying a solid foundation for the study of specialized courses.

**Keywords** Independent institute • Probability and mathematical • Materials construction • Evaluation system

### 63.1 Introduction

Probability Theory and Mathematical Statistics which is a strongly practical application of mathematics, which is a subject studying of statistical regularity for a large number of random phenomena, so Its theory and method has been widely used in various theoretical and applied research in the field like science, engineering, agriculture, medicine, management, economics, culture and other disciplines. This course < Probability theory and Mathematical Statistics > as an important basis for university courses has a very important foundational role in studying and using professional courses in the future, dealing with practical problems in practice and training their thinking quality.

---

X. Liu (✉) · Y. Zhang · S. Yuan  
Qinggong College, Hebei United University, Shangshan, China  
e-mail: lily130203@yahoo.cn

Q. Feng  
Beijing Institute of Eudcation, Beijing, China

Independent Colleges is a new mode of running school derived under vigorously promoting “mass higher Education”. To meet the requirements of today’s social and economic development, most of the independent colleges develop applied and innovative talents as their goals, and defined as “Undergraduate senior application specialists”. Compared with ordinary undergraduates, they have a strong practical ability, compared with vocational students, who have a more systematic fundamental theories. In teaching, they should be distinguished from ordinary colleges and vocational colleges. Today, in face of a new educational objects, the independent colleges started late. Therefore whether the development of training programs or are the arrangements of courses, Independent Colleges is at a exploratory stage and some problems are exist that course content, teaching methods are unsuited with training objectives. Probability theory and Mathematical Statistics as an important part of the basic theory teaching system in Independent Colleges, also has many problems and face many challenges, mainly in the following areas:

### **63.2 Poor Mathematical Foundation and Lacking of Initiative to Learn**

students of Independent college with lower scores for admission, most of their mathematical basis are poor, however Probability theory and Mathematical Statistics is the description and research to random phenomena, which its Way of thinking in dealing with problems are very different from other mathematics curriculum studied previously, so the students in the learning process needs to be changed the way of thinking on math class in the past. In this course, students generally fell the concept is abstract, the thinking is difficult to carry out, the method of problem-solving is too hard to grasp that allows their enthusiasm learning this course greatly reduce, even, individual students with weak foundation just give up this course.

### **63.3 The Materials and Teaching Content Lack of Specific and Application**

Most textbooks the students of Independent college use are same with the second groups of undergraduate college. These materials have strong theory while weak practice, but the third undergraduate students with weak foundation and low learning motivation were unable to grasp the strong theoretical knowledge, barely do, it only can reduce the teaching effectiveness. In recent years, with the further expansion of mechanism for Independent Colleges, number of textbooks written for the Independent college came into being, but these materials is only streamline the theoretical content but still lack of examples of practical applications. The traditional teaching ideas—“heavy probability, light statistics” haven’t been effectively

improved, and isn't suitable for the training objectives for the "Applied Talent" of Independent Colleges.

### **63.4 Monotonous Teaching Methods and Methods**

Most teaching methods in Independent College are still same as the general undergraduate class, but are insufficient consideration for the students' actually received ability. In learning, students' interest of probability theory is not strong but of statistics, especially for some practical examples, is greater. As the basis of the past knowledges are not solid, they couldn't understand some of the statistical theory, which will be just copy and imitate the data.

### **63.5 Teacher Staff is Relatively Weak**

Teacher staff of Independent College mainly composed of two parts: one part comes from the primary university. During to they stay at the teaching position for a long time and contact with the second groups even the first groups undergraduate students had better basis, their preferred teaching method, does not apply to independent college's students; the other part comes From the young teachers just beginning work. Lacking of experience makes them difficult to grasp both teaching materials and students, to some extent, affecting the effectiveness for this course.

### **63.6 In Response to These Main Problems Arising in Teaching, I Think We Can Take the Following Measures to be Improved**

#### ***63.6.1 Reasonable Teaching Orientation***

Independent College's objective is to training "Applied Talent" who could face for market directly, so with this training objective, the characteristics of the course—"Probability and Statistics", and various specialized needs of different fields, we need to work out a reasonable teaching programs and curricula.

#### ***63.6.2 Strengthen the Teaching Materials's Construction***

According to the training objectives of Independent Colleges and the actual situation of student, we prepare the materials fit for the actual situation of students. In the process of preparing, we Should based on the students' actual situation and

abandon large number of theoretical derivation and advanced mathematical knowledge, should strive to achieve that the basic concepts and basic theory expression are accurate and content is easy to understand, convenient for teachers to teach, students to learn. These materials focus on develop students' awareness and thinking of Probability and Statistics and improve their ability to Identify problems. And solve them.

Reduction and transformation of theoretical knowledge need to fit the development level of students.

Based on protecting the integrity of knowledge, it could be deleted some theoretical derivation of simple mathematics, such as Poisson's Theorem, etc. For the content which will affect student's understanding after deleting, explain of theoretical knowledge need to be combined with analysis of actual example so as possible to reduce the difficulty of mathematical knowledge [1]. For example, Total Probability Formula which is an important element of "probability theory and mathematical statistics" is a difficult point for students. If the formula is just given directly without any proof, this students cannot understand its significance that the Total Probability Formula could break up the whole into parts and make difficult to easy. At this time to introduce the method of case, we can use different scale of production and defect rate in different workshops of factory to analysis and get the defect rate of total plant, then, the proven ideas and substance will show gradually with solving of problem.

Increasing the statistical part of the knowledge content, completely changed the teaching idea—"heavy probability, light statistics"

In existing textbook of "Probability theory and Mathematical Statistics", part of probability occupy a larger proportion, however, part of statistics related to little content about Simple Parameter Estimation, Hypothesis Testing, Regression Analysis, but these are not meet the requirements of all students entirely. For example, many students use the rank sum test in the courses learning process, however, this knowledge originally belonged to area of mathematical statistics couldn't be gotten by students in the course of "Probability theory and Mathematical Statistics". So we have to look at ways to popularize statistics, and prepare of teaching materials on statistical-based and probability theory supplemented for different needs of students, in teaching materials appropriate to add some simple non-parametric [2] and multivariate statistical knowledge, such as Rank sum test, principal component analysis, cluster analysis etc. finding ways to enable students with no or less knowledge of calculus and linear algebra get the statistical methods [3].

To join knowledge of statistical application software, develop statistical modeling capabilities.

Since the data processing operation is exceptionally large in probability theory and mathematical statistics, we should also develop their ability to use computers at the same time of teaching. Among much computer statistical software, SPSS software is favored by the majority of non-mathematics students and staff, which makes some more complex analysis processing such as cluster analysis, principal component analysis, factor analysis become quickly and accurately. We can, in the

textbook, appropriately introduce software package of SPSS for data processing, arrange for some classes of computer. At the time of developing students' numerical calculation and data processing capacity, we could stimulate students' interest in mathematics, and lay a solid foundation for specialized courses learning.

### ***63.6.3 Reforming the System of Examination and Evaluation, Evaluating Students Reasonably***

Due to the course Probability theory and Mathematical Statistics as a basic course is always taught in large classes, teachers usually difficult to understand each student's learning situation, which leads to the phenomenon—a final paper determine the final outcome. Through the test papers consider the knowledge is limited, so the evaluation system can be designed as follows:

The first part is students' usual achievement (20 %). Giving students plus incentives who diligent in thinking and courage to speak on the class; Assigning homework and thinking problems after-class and arranging quizzes after complete each chapter, make the exam to become an important means to stimulate enthusiasm for learning, diagnostic learning condition and help improve the effect. Second is the designed and practical model (20 %). Teachers give questions or let students design their own problems, and survey data, use of statistical methods and statistical software to find out some conclusions. Through abstracting, modeling, solving and analysing practical problems, to improve students' ability to solve practical problems with probability statistical methods. The third is the final exam (60 %). Do some innovation on Questions, reducing the amount of memorizing content and increasing terms of volume in independent thinking, analysis and application. For the more complicated formulas and concepts presented in the examination, available for inspection. Through the final exam, analysing of the scores each item to evaluate students' situation and ability to apply of each knowledge point, finding out the weak links in order to adjust and improve the original design of teaching.

Overall, there is still a long way to go for the research of Probability theory and Mathematical Statistics in independent college. Only we continue to explore, reform and innovation teaching position, teaching materials, teaching improvement, teaching staff, performance evaluation and so on, that Independent College can complete the training objectives, "training creative talent" and "training application-type talent", can make the road go faster farther.

## **References**

1. Casella G, Berger RL (2007) Statistical inference. Mach Ind Press 37:287–291
2. Shun S (2002) Non-parametric statistics notes. Beijing Univ Press 02:361–366
3. Mao S (2008) Course construction and development of probability theory and mathematical statistics, Beijing, higher education press, mathematics course forum on 22:34–44



# Chapter 64

## Research on Aesthetic Psychology of Effect of Art Acceptance

Lu Shao

**Abstract** This paper discusses the relationship between aesthetics psychology and art acceptance. Aesthetics as the study of psychology is actually the theoretical basis of Western modernist art and emerged. Therefore, how to assess the aesthetic psychology to accept the results with the art of how to evaluate together. This paper studies the psychology of aesthetics with the art of acceptance of results linked to the development of history, through the art of aesthetic psychology to examine the effects of development acceptable to the art in the chaotic phenomena, the aesthetic reception of artistic development of the general laws of psychology.

**Keywords** Aesthetic psychology • The effect of art acceptance • Aesthetic reception of arts

### 64.1 Introduction

Western modernism and postmodernism art collectively referred to as the western modern art, western modernist art is in the negative traditional norms set and habits know developed on the basis of, postmodern art practice activities designed to break the boundaries of art and life [1]. The beginning of the twentieth century, the western art atmosphere began to change, and gradually formed a share from the trend of the realism. Appeared in some modern art schools-beast pie, cubism, futuristic, dada pie, performance, surrealism, abstract doctrine, the pop art. Most scholars believe that the trend from Cezanne and impressionism after beginning, which has experienced by Matisse, as a representative of the beast pie, with Picasso as a representative

---

L. Shao (✉)

Art and Engineering College, Xi'an Polytechnic University, 710048 Xi'an, China  
e-mail: Lu\_Shao@yeah.net

of cubism, kandinsky, as a representative of the abstract art school, etc. From the theory is clearly impressionist standard broke traditional a little perspective [2].

## 64.2 The Main Points of Aesthetic Psychology

### 64.2.1 *The Definition About Art of Aesthetic Psychology*

Grace ohaim in the art and the visual perception of art to the definition which is this: the essence of art is that it is a concept and idea of the substance of the unity of appeared. Here said the idea, that is, for objects in the consciousness of the emotional expressivity and overall understanding thoughts significance, etc. The idea of material appeared, it is to point to an artist with a substance used to select media performance this whole grasp of the structure of the form. Unity is to point to this form structure itself should not be realistic material bound, and should contain consciousness of the overall assurance sufficient to perform the style of the force. That idea and concept of material should be done with the form of heterogeneous appeared. The meaning of art required to present this significance structure and the style of the structure to achieve consistent between. This consistency, aesthetic psychology is called with form sex. Here, refers to the artistic creation abandon the real details, the direct expression of the integrity and essential things. Grace ohaim thinks, a worthy of the name must meet art two conditions: first, it must be strictly and real world separation [3–8].

### 64.2.2 *The Thinking About Art of Aesthetic Psychology*

Aesthetic psychologies think, artistic thinking can't stay in consciousness stage, still must be quickly will be perceived content reappear. The so-called representation, which is in the creation of a material through the media perception concept reappear, makes the forms, with visible external form. Representation of the concept of consciousness is not mechanical reproduction, but through a creative activity of the brain. Reproduce product with consciousness concept with huge generalization. Perception is not equal to reproduce a thing a things, whether it has the ability to reproduce is a real artist mark. Essentially, is to use the psychology of aesthetics with shape theory in particular medium create a perception of the concept of equivalent structure. He points out that the sea, grace: but no matter what the media, reproduce and perception concept has a structural similarity. In the format of the tower of theory, will be different medium of this kind of appearance structural similarity called isomorphism. The structural similarity is in fact an force of the structure of the similarities [9]. Modern arts way of thinking is different from traditional realistic painting art's way of thinking, the traditional aesthetic theory fails to explain modernist art's way of thinking, and aesthetic psychology about art thinking is better for our paper examines modernist art provides a new Angle [10].

### ***64.2.3 The Function About Art of Aesthetic Psychology***

About the function of art, grace, haim think: art high reputation is that it can help mankind to know the outside world and itself, it in the human eye present before it can understand or believe that is the real thing. In his view, the function of art is that it is human a way of understanding the world, and from the Angle of understanding and believe to understanding the world, that is, from the point of view of the subjective to understanding the world. To grasp the art world with scientific understanding the world has its common: that is an abstract, but the scientific theory of the law is with abstract, and art is with the abstract structure rules. This structure rules is a force structure rule. Thus, the grasp of the art of the world, in fact, a kind of music type discussed. The force of the structure by direction and the strength which will have a rise and fall, the weak and strong, forward and backward fundamental key, thus make it has emotional expressivity. At the same time, the music type discussion is also a kind of to the world of the grasp of the emotion. And this kind of emotional grasp and is different from the ordinary pleasant sensation, often contain some kind of moral and religious significance.

## **64.3 Aesthetic Psychology Profoundly Reveals Effect the Inherent Development Law of the Western Art Acceptance**

For western art accept effect and traditional realistic painting art evaluation, people often taken an either/or attitude. In the modern painting art was born at the beginning of, art accept by most of the artists and the effect of the theorists negative and left out in the cold. With the rapid development of art accept effect, modern painting art is called absolute art, highly respected. Through the gestalt psychology aesthetics to look at the history of the development of the western art accept effect, can be in the chaos of the art phenomenon, see the effect of the development of western art accept clear context [11, 12].

### ***64.3.1 Breakthrough***

The western art effect is to accept the realistic painting traditional breakthrough on the stage of history. Turn over the western painting we saw in before impressionism, by an artist in different times for our world is mostly with the actual image visual world similar image. The real world of the concept of imitation originated from the ancient greeks era, and as a kind of aesthetic system, establish the takes Renaissance. Aristotle's art imitates theory for thousands of years artist of the bible as a creation. In the different stages of art history,

had had to attempt to including imitating art, not only the Greek and Roman art, is the European Renaissance period of classical art, also are in the art for a demand the desire of the true face reproduces the world dominated period. In the Renaissance, to Italian painter, as a representative of the creation group perfected the reappearance of the real artistic technique. This period, art gimmick greatly enriched, spirit connotation also strengthened, but there is a widespread and must abide by the law is the objective reality must be given a truly reproduce, subject to the principle of imitation. In order to further proof of the real scientific representation, center perspective was born. Center perspective say simply, it is in the eyes and the physical world to erect a between vertical glass, and then will be through this glass eyes see objects paint glass, get the center of perspective with painted that style. Center of perspective is just can truly reality to copy the a skill, equal to the imitation of nature for the correct provides a set of standard according to science, also makes those with this method of complete picture of objective reality into the accurate copy. Grace o haim think: this is the history of western thought a dangerous time! This new find is equal to that of humans all the creation of success, at best they are but is to natural of accurate mechanical duplication just. Cezanne of modern art is perhaps the greatest contribution of in this. In the twentieth century's important but not a painter from Cezanne works some effects. In the development of modern art, if not Cezanne achievements and examples, was unthinkable, no other artist to his successors have such an important relationship. We want to understand Cezanne for later western painting art development of the important role, it needs to use the realization and he usually make proper adjustment of interpretation. Realize, in fact also is in aesthetic psychology his reappearance. Cezanne painting method is to choose his motif scenery, portrait characters, still life, etc.; Second, the perception of the motif with consciousness sum up, form the concept of consciousness. Cezanne thinks, the person's perception was born of the chaos, but an artist must be able to make this confusion into orderly order, and artistic achievement fundamentally, is within the scope of the vision for the structure of the order. This structure deep in the nature of things in which does not exist and individual subjective feeling in. We know, consciousness for objects (in Cezanne there is motif) of the overall assurance, the result is to create a corresponding to the object and the general form of the structure, and is what we call the force structure. Cezanne had here desire to get such a structure order is a kind of objective force structure. Cezanne will natural objects of art as his female topic, he asked the venter subject to him are interested in structure and spatial relationships.

### ***64.3.2 Establishment***

In experience after Cezanne, modernist paintings to really appear. Ma di this beast pie and Picasso's cubism by Cezanne painting to fully explore the basic theory and

established mature art accept effect theory. Accurately describe is not equal to the whole truth is the program of the art accept effect, this is Matisse and he sent the first time clearly put the painter. Matisse think painter should pursue object of the essence of the real, against the traditional realism to describe the object accurately. How to reach pursuit of the nature of the object in reality? This is the Matisse always adhere to the personal faith: let the composition is subject to performance. All in all, I seek is performance. Matisse significant contribution to the performance is made with the interpretation of the modernity. Performance is not the expression, and at the same time, the performance is not instantaneous feeling, but from the nature of the more lasting things. Performance more is not precisely because accurate is not true. So Matisse performance means what? My dream is a kind of balance of the art, a no more annoying and suppress the theme of the pure solemn art, a kind of to all white-collar worker, whether he's a businessman or writers alike art, it is like a quiet influence, a kind of spirit, wei, similar to sit up can eliminate fatigue armchair of things like this. This performance is based on what? Is the final form of the vitality of the structure, as Matisse speak: on the color and lines should be on the final form for the vitality of the structure for the premise. The final form of the structure in the final is one of the most stable, summarize most mean. In the art of all genres of accept effect, the biggest impact by Cezanne in Picasso as a representative of cubism. To cubism, traditional realism tethers were swept away. Cubism was the abandonment of traditional perspective illustration, near-far narrow method, the volume of performance, light and shade contrast method, and many other mimic natural creation methods and art theory, mainly because the use of the traditional art and art theory method by the effect, give a person is an illusion and illusion, this kind of appearance and illusion can neither reflecting the panorama, also cannot reveal the nature of things. Therefore, whether they be how of deformation to form processing, or destroy all the objects and disintegration image, and then to the composition of the subjective; Or the natural form into plane geometry, and overlapping, development to a picture showing things of several different ways; Or through the scraps of paper and tobacco forms of joining together to destroy the image with the objective cause fragmented picture, they are eager to achieve their aim is only one, namely reflect the whole face of the things, or reveals the essence of object visible behind. Cubism and achievements of cubism means that their painting has been basically out of the material bondage, make all the elements of painting become the representation of the idea.

### ***64.3.3 Outstripping***

In Kandinsky before painter, although created and his paintings have the same aesthetic value of the works, but the reality of visual interest is not lost. Matisse and Picasso while keeping the modernist paintings from the bondage of material basically, but does not mean they painted the no object.

From Kandinsky's start, some modernist school painter to continue the development of the theory of the painting, the complete revolution, they in theory and action to get rid of the material completely bound, beyond the elephant art, will be painting developing in a absolute abstract art. Kandinsky published in 1912 "on artistic spirit", theoretically in general, in what has been critical of representation for the purpose of objective image of traditional art, the reappearance of the abstract expressionist inner need a theoretical demonstration. He to the traditional realism of art criticism is based on the work of art on the basis of understanding. Kandinsky think: art belong to the spiritual life. Art is a kind of internal needs of the external performance, works of art must contain internal factors and external factors. Internal factors is the artist's feelings, it must exist, or works of art becomes a fake, inner need to decide the work of art external form; External factors is to point to by internal factors arouse audience's feelings. Success in the works of art, the two kind of affection is similar or the same.

## **64.4 The Research on Aesthetic Psychology of the Effect of Art Acceptance**

### ***64.4.1 The Aesthetic Acceptance About Art of Aesthetic Psychology***

Art is aesthetic receiving the entire human art activities of organic component, the 1960s with philosophy, aesthetics, and psychology, the exchange learning, the rise of communication, art of truly accept effect system formed. The art of aesthetic psychology reception of the research is to try to "psychology" from the Angle of "art" to the witness, in cross areas open receptive aesthetics research. An Art aesthetic acceptance is a subject spirit, and accept the emotional recognition and appreciate the process. Art aesthetic accept is to accept the move to create activities subject. Hegel's points out: "beauty of art is appeal to feel, feelings, consciousness and imagination. In the two degrees in experience, accept main body and create as main body in experience the emotion and reason, also can show their wisdom and mind, and its strength target to the essence of art works in, to get some kind of aesthetic creation pleasure. And, by countless aesthetic receiving subject to create out of the common artistic image, overall than their artistic creation to the significance of the main body works to deep, overall. Art creation subject created works of art, only through accept of the main body of the aesthetic receiving activities, to reflect its social significance and aesthetic value, can form a truly the vitality of art. "Any literature this paper has not qualitative, is a multi-layered unfinished schemata structure. It's there is itself a 'summon structure has many' blank piece, when readers will own experience of life, life vicissitudes of life, and the life of the unique sense of diffused into the meaning

of the paper, through the living experience in this paper to materialize, the works will fill up blank space, at this time, the work is not independent, literature, but the relative, and for my work became my. Works, of art world my world, be my meaning of life.

#### ***64.4.2 The Psychological Acceptance About Art of Aesthetics Psychology***

Art in their own individual accept main body aesthetic psychology as the foundation, through to the social psychological assimilation and conform to, to adapt and resist, achieve finally with suitable artistic effect. In art activities, art accept is not passive process, it is conducted on the basis of the creation, to create. In art aesthetic accept, accept the main body (observers) according to your own life experience, personality interest, thoughts and feelings, aesthetic preference and life consciousness, etc., to carry on the processing both art works, supplements and rich, will create personal emotional input subject created artistic image, and then create a unique artistic image, even for the original art for new development, added image, show the artistic creation subject in the art created image never say or never think of things, so that the artistic image become more rich and bright and the profound. This kind of art aesthetic receiving the main body in the process, to create activities, is actually a kind of artistic creation subject of aesthetic experience physical form-the art work experience of two of the process. In the two degrees in experience, accept main body and create as main body in experience the emotion and reason, also can show their wisdom and mind, and its strength target to the essence of art works in, to get some kind of aesthetic creation pleasure. And, by countless aesthetic receiving subject to create out of the common artistic image, overall than their artistic creation to the significance of the main body works to deep, overall. Art creation subject created works of art, only through accept of the main body of the aesthetic receiving activities, to reflect its social significance and aesthetic value, can form a truly the vitality of art. "Any literature this paper has not qualitative, is a multi-layered unfinished schemata structure. It's there is itself a 'summon structure has many' blank piece", when readers will own experience of life, life vicissitudes of life, and the life of the unique sense of diffused into the meaning of the chapter, through the living experience in this chapter to materialize, the works will fill up blank space, at this time, the work is not independent, literature, but the relative, and for my work became my. Works, of art world my world, be my meaning of life. It is in the projection and reveal the reason of fusion, the reader will own life experience, and the life of the works, modal investment not qualitative, established the aesthetic value of literary works for realization". The effect of the works of art history, forever in the aesthetic receiving accept main body process. And so, for art aesthetic accept speaking, foster and improve the quality of the main body of the accept aesthetic is clearly important. Only accept subject really set up its subjectivity, through the cultural art learning to constantly training, enrich their aesthetic sensibility, imagination and understanding, to make art aesthetic accept really help art aesthetic value realization.

## 64.5 Conclusions

In conclusion, the art of aesthetic psychology research accept effect “aesthetic psychology” from the point of view of “art” to carry on the analysis. This article from the aesthetic psychology and art accept, the relationship between the aesthetic psychology, art in turn from the effect of art, and the aesthetic accept to accept Angle discussed. Through the analysis of this paper, we can clearly feel to accept the aesthetic psychology theory as the guide of art effect will be in constant after receiving the development process will have been the perfect.

## References

1. Zhu G (1984) The history of western aesthetics. The People’s Literature Publishing House, Beijing, pp 392–398
2. Zhu D (1984) The contemporary western aesthetics. People’s Publishing House, Beijing, pp 39–42
3. Ge Ci the Yankees (1985) The artistic psychology. Shanghai Literature Press, Shanghai, pp 389–393
4. Gao N (1988) The artistic psychology. Liaoning People’s Publishing House, Shenyang, pp 87–94
5. Tong Q (1993) Modern psychology aesthetics. China Social Science Press, Beijing, pp 1038–1042
6. Se’er Yin (1997) Some problems of acceptance aesthetics vol 33. Fudan University Press, Shanghai, pp 370–378
7. Freud (1987) The Freud aesthetics vol 121. Knowledge Press, Beijing, pp 399–403
8. Kampot Richie (1990) The world arts. Zhejiang Literature and Art Publishing House, Hangzhou, pp 390–398
9. Yong liangYang (1998) Psychology of art aesthetic. Guangdong people’s Publishing House, Guangzhou, pp 49–54
10. Colin Wood (1985) The principle of art. China Social Science Press, Beijing, pp 02–15
11. Chao gang Pi, Shi lun Zhong (1988) The guidance of aesthetic psychology. Chengdu Telecom Engineering University Press, Chengdu, pp 490–496
12. Guang qin Zhu (1983) The artistic psychology. The People’s Literature Publishing House, Beijing, pp 487–492



# Chapter 65

## Efficient Scheme to Improve Engineering Practice Ability of Undergraduate Students Based on Opening Laboratory

Lei Cui

**Abstract** Engineering practice is important ability necessary for engineering students, a brief analysis of the current construction environment in undergraduate engineering and equipment engineering training in the lack of practical ability, proposed to carry out the implementation of an open experimental teaching in laboratory, can effectively improve the teaching effect and the cultivation of students' practical innovation ability, promoting students' engineering practical ability training and the students' employment competitive.

**Keywords** Opening laboratory • Engineering ability • Innovation

### 65.1 Introduction

The rapid development of science and technology, social trends in the demand for talent tends to both solid professional foundation management technology rapid development, social trends in the demand for talent tends to both a solid theoretical basis of professional knowledge and to take on the project design, construction and management capacity, but also the integrated use of good, high-quality personnel to work independently [1]. 2010, the Ministry of Education's "excellent engineer" training program, you can see the future training needs have the engineering capability and innovative spirit. However, engineering capability and innovative classroom training only alone, the books can not be easily learned, and only through a large number of practical exercises, through a variety of ability in practice to continuously improve in order to enhance students' ability to use project. Engineering abilities of students in strengthening basic knowledge of engineering science and engineering and technical means to learn at the same time, more innovative ideas to strengthen the establishment of engineering and engineering to create an integrated approach to master. Therefore, the laboratory as a good platform for engineering training school, in training students in engineering and innovation plays a very important position [2].

---

L. Cui (✉)

North China Institute of Science and Technology, Beijing, China  
e-mail: cuilei2001@sohu.com

## 65.2 Raise Students' Project Quality, and Improve the Project Practice Ability

Building environment and equipment engineering is a new professional, students of engineering problems facing more. The professional students, in addition to the command of the original except the heat transfer and fluid mechanics, thermodynamics and other basic theoretical knowledge outside, still need more and more people to grasp and building, and man and nature and other aspects [3]. This requires professional students not only to build ring to the professional knowledge of the firm will have a strong engineering practice ability to adapt to future employment competition. Build ring kind of cultivating students' engineering practical ability, we first need to set up students' project consciousness. Engineering education and training of consciousness, is to make the students gradually clear, and in the following working what to do, what to do, how to apply the principle of combining the practice of the technology and experience accumulation, and application in practice.

## 65.3 The Current Problems Existing in the Practice Teaching

Building environment and equipment of civil engineering specialty original "heating, ventilation and air conditioning engineering", "gas engineering" and "water supply and drainage project" in the part of "building water supply and drainage" merger and become [4, 5]. The professional after the merger, students' ability to project higher request, built by the students to grasp of ring the professional knowledge of the more broad scope, obtain employment after graduation with engineering problems more. But the current undergraduate education under the current system, build ring undergraduate engineering practice ability training is still a relatively weak links. The practice teaching is still at the attached to the theory teaching and practice teaching reform lags behind theory of the reform of teaching content, lack of specific training students' practical ability of practice teaching of related. From the practice teaching form relatively independent, the continuity and complementary to each other is not strong, not a complete, the system of practice teaching system. Look from content, the engineering practice content quite obsolete, lack of renewal, and actual production line [6] Practice teaching by the school can't to enhance the ability of the engineering practice for actual requirements, experiment and cognition practice often take typically less than the cultivation of the students' of purpose. In addition the practice teaching experiment in content many for the verification experiment is given priority to, comprehensive and designing experiments and combining the characteristics of the building of professional ring engineering experiment and training and inadequate.

## **65.4 The Open Laboratory as Raising Undergraduate Engineering Practice Ability Platform**

The traditional practice teaching, experiment teaching is just a subordinate position and played in the service of the role of teaching theory, on the one hand, many students passively to deal with experiment, finish the experiment carelessly, not too much time inquiry experiment results; On the other hand, some have a spirit of the students to solve in experiment and design of the actual problem met or achieve some design thought, want to experiment but couldn't find the place. At present, only with the original experiment teaching method and means, already have to can not meet the need of talent training now. So, reform teaching methods, it is imperative to the open laboratory, it is also the unitary resource engineering advocating. Open laboratory, for students to explore, innovation, cultivating practice ability and engineering practice ability to build a good platform, students can use after school time developing some new experimental subject, also can undertake some science and technology innovation projects. Of course the open laboratory, and only is not a day to night opened the door, but to provide students with a fully open and free of the innovation of the experimental environment. Is reasonable in teachers under the guidance of step by the students themselves, purposefully relevant knowledge, to design experiment content, subject themselves to accomplish a topic. Some previous open laboratory, as conditions, open project is not reasonable, students have no interest involved. Choose reasonable open form, lets the student in the open professional laboratory environment experiment, played a student's initiative to improve the experiment interest, in this kind of environment, just may attractive and innovation ability. At the same time through a certain level of innovation experiment and planned to practice the operation skills training, to enlarge our scope of knowledge, can enhance the experiment design ability, operation ability, improve the ability to analyze and solve problems and research cooperation spirit.

### ***65.4.1 Students Choose Open Experiment According to the Actual Situation***

This part of the open project aimed at a freshman and sophomore year students of the open laboratory. Because a freshman and sophomore student foundation was relatively professional knowledge was weak, for many of the instruments have no contact with, operation and use up is not familiar with. Because of the characteristics of the professional build ring, engineering practice for environmental monitoring need to use plenty of instruments to test the indoor environment of the change, which requires the students to build ring of all kinds of monitoring temperature, humidity, air pressure, velocity, and the use of the instrument and meter, and to achieve skilled, accurate; To instrument used in the role of components, the performance parameters of the detection method is very familiar with. To students in the limited time

available to meet this requirement, meet the engineering practice needs this needs a lot of practice. Our laboratory to students build ring provides a lot of practice opportunities, make full use of some old equipment replacement of temperature, humidity down, pressure gauge let students repeatedly demolition, the outfit, maintenance, through these methods in common use in the student to the instrument of components of the function, performance parameters testing soon to master.

#### ***65.4.2 Choose the Right Experiment Item, Strengthening Students' Project Practice Ability***

For senior students, students according to the theories of knowledge based on the laboratory condition existing fixed by the experimental project. According to the students' own interest hobby, relying on science and technology activities subject institute, and carry out the small production, the small paper activities in science and technology, etc. In our hospital in the activities in science and technology, professional students build ring to declare "classroom air quality and the learning efficiency investigation and analysis of the relationship between" subject, won the first prize in hebei province and college students' science and technology innovation has six article third paper excellent results. Subject to the air inside the classroom group through the in situ test, quality research questionnaire survey and the numerical simulation method of combining the and exploring different season in the classroom environment and the relationship between the students' learning efficiency. Through the field to test the classroom the internal environment to test, get the indoor environment of the objective condition, building indoor environment are the most direct and the clear situation, for the indoor environment quality control means the final judgment. Through the research on the subject, students will be in the building environment "of knowledge and actual working condition combination of completely. Through to the analysis of the different operating conditions of the indoor environment and monitoring, on how to improve the internal air quality, the classroom for the construction of the environment design, management and use of have the strong understanding. Through this activity to strengthen the students' team cooperation spirit, through the scientific papers written greatly improved students' project practice ability.

#### ***65.4.3 Open Training Base; Cultivate Students' Project Practice and Practice Ability***

Many engineering students in after studying the theory of the course, the practice field and work on most of the equipment and devices do not know, have more very person would have a "deer for horse" joke. It's all because of the students in the school study theory without practice and light of the results. For students have in these problems, built in our laboratory ring on training base cultivating engineering practice to a better teaching effect. The students here can see various forms of

heat exchanger, different types of compressor. Through the disassembling of pump many students on the pump principle understood. In the training base, according to students an appointment, in accordance with the conditions and the existing practice base material, the teacher about the practice project of audit guide students to develop and implement solutions. Students make full use of waste equipment, according to the design of your own refrigeration system, complete small air conditioning system of welding, installation, commissioning, some reconstruction project can even put into use. In the training base, students have their design and installed a give and drainage and heating system, and to enhance the students' confidence building ring, and competitive.

## 65.5 Summary

Engineering education goal is training to adapt to the needs of the community, the comprehensive quality of the overall development, has the "outstanding engineers" basic quality senior applied engineering and technical personnel. At present, our country's higher education work focus is on education development scale from to pay attention to improve quality, practice teaching is particularly important. Therefore, the open laboratory in engineering colleges and universities as influence the quality of teaching an important factors, as to cultivate college students' project practice ability and innovation ability of the important way, the education system in future play an important role.

## References

1. Shui CJ, Wei LB et al (2004) Building engineering training teaching center. *Lab Res Explor* 5:70–73
2. Fu S, Liu SZ et al (2004) To strengthen training the connotation construction engineering training quality improving. *Lab Res Explor* 10:76–77
3. Cui L, Pan TQ et al (2010) Engineering thermodynamics experiment course reform discussion. *Educ Vocat* 23:169–170
4. Wang XB (2009) Opening laboratory and mechanism research. *Lab Res Explor* 5:11–13
5. Cao WJ, Pan YC et al (2004) Established electronic subject innovation practice and training base of the exploration. *Lab Res Explor* 10:12–14
6. Zhu X (2011) The application of EDA in the engineering practice of quality training. *Lect Notes Electr Eng* 112:115–118

# Chapter 66

## Efficient Teaching Model of Participatory Constructing in Plant Protection Teaching

Fan-Bin Kong, Wei-Hai Li and Ming-Wang Shi

**Abstract** This paper analyzes the disadvantage of traditional teaching used in the major of plant protection teaching, to build a participatory teaching model. Participatory teaching attracted growing concern of educators for its changing dominant position of teaching and the unique of guiding students to take part in teaching. The method of instill teaching is still used in teaching theory of plant protection. Details are taught in practicing courses, and students imitate the operation, lacking thinking of design and understanding. In standard curriculum, complete teaching in scheduled and students understand what the teacher teaching. Participatory teaching model is a new model. Teach application of the principals, forms of organization, assessment methods and management were discussed.

**Keywords** Major of plant protection • Participatory teaching model • Construction

### 66.1 Introduction

The major of Plant Protection in undergraduate colleges have abilities of teaching the basic theory, knowledge and skills, and management, teaching and researching in agriculture and other relevant departments or units [1]. Facing to new of market economy, science and technology for development and social needing talent in 21st century, we need to change the traditional mode of teaching. Participatory teaching attracted growing concern of educators for its changing dominant position of teaching and the unique of guiding students to take part in teaching. In this paper, we research and explore applications of participatory teaching methods in teaching practice in plant protection [2].

The disadvantages of traditional teaching used in the major of plant protection. In our traditional teaching, we treated teachers as subject in teaching, instead

---

F.-B. Kong · W.-H. Li · M.-W. Shi (✉)  
Henan Institute of Technology School, Xinxiang 453003, China  
e-mail: Shimw888@163.com

treating students as educated as object or being corrected conscious or unconsciously. It is bound to undermine the teaching effect, because of subversion of the dominant position [3].

The method of instill teaching is still used in teaching theory of plant protection. We teach pure theory and some application examples in Plant protection. Details are taught in practicing courses, and students imitate the operation, lacking thinking of design and understanding. Because of the lack of research and thinking, we usually focus (including school supervisors, colleagues, students) on the superfluous problems of professional teaching whether teachers can teach in school on time. In standard curriculum, complete teaching in scheduled and students understand what the teacher teaching.

## 66.2 Building Participatory Teaching Model

### 66.2.1 Designing of Participatory Teaching Model

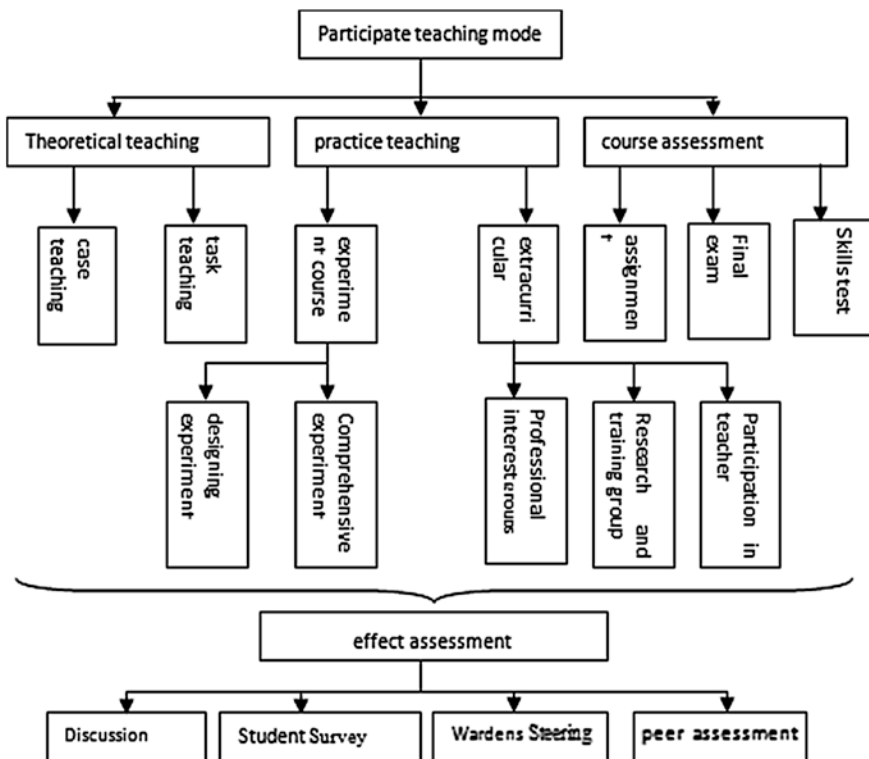


Fig. 66.1 Participate teaching mode

Participatory teaching can allow students to take part in all of teaching. It is a comprehensive, having impacts on multifaceted, multiangle, in which have a positive effect on its students, teachers, and teaching. For students, participatory teaching can help students increase the position of subject; for teachers, participatory teaching can help them promote the quality of teacher profession; for teaching, participatory teaching can help improve teaching effectiveness and learning efficiency (Fig. 66.1).

### ***66.2.2 Practice Participatory Teaching Use***

Participatory teaching should reflect the stage of teaching, and teaching should be based on different grades and classes to design different levels of participation and specific methods. First-year students mainly study literacy course; Second-year mainly learn the basic course. Third and fourth-grades study professional courses. It should approach different ways based on different grades.

There are significant differences between students of different types or even the same class. For example, for studies, their cultural course level are poor, but with high professional courses. For General enrollment, they have high levels of cultural course, but low-level of basic course. For the same class, because of differences from rural or urban areas, they have significant differences in the understanding course of plant protection. Thus, it is unscientific to use one standard to measure students, which make basic differences of students more obvious. To enable students to get an overall improvement and assure the quality of learning, we should reflect participatory teaching based on the basic differences.

### ***66.2.3 Teacher's Self-Awareness and Improve***

Teachers chose to take part into organize classroom teaching time to consider their own knowledge, ability, character and physical condition. Teachers try to avoid weaknesses to chose the most able to display their talents, the best performance in the form of their talent. Second, according to the development needs of students chose to take part in teaching organization. Teachers to keep learning, to form based on to develop student life, teaching ideas, access to knowledge, to develop and improve students' self-learning ability. Students to take part in through the fitting, question, summarize, reflect on and improve the inductive ability, learn ways of thinking, to create conditions for self-development.

### ***66.2.4 Set Up the Dominant Position of Students***

Students are the main body of participatory teaching learning. Involved in teaching; teachers do in teaching and learning to fully prepare students to create an atmosphere of full participation in their own, while giving students some free



time. Involved in teaching, each student's personality, abilities, strengths, preferences and other differences, teachers should strive to build a platform to students to show the opportunities for students in the activities of self-understanding, self-regulate, self-evaluation, self-development.

### ***66.2.5 Organizational Forms to Adapt to the Teaching Objectives***

Participatory teaching of teaching organization form according to the relevant teaching principals to chose. Based on teaching objectives, the nature of teaching content to chose the right teaching organization. If the teaching goal is to develop students self-learning ability, the problem can be in the form of self; if the teaching goal is to develop student's skills, can be used in the form of demonstration; if the teaching goal is to train students to analysis the ability of induction, and can be used in the form of the case. Different disciplines or the same discipline of different content, classroom organization should also have their differences.

## **66.3 Reform in Education**

### ***66.3.1 Case Teaching***

The so-called case teaching is under to guide teachers, to perform the case, let the student with the related knowledge learned analysis, and let the students learn to analysis problems, problem-solving methods and means, and thus improve their theoretical knowledge to understand. In the teaching into the case study, students are no longer passive learning, but actively take part in the teaching, increasing student interest in learning.

### ***66.3.2 The Task of Teaching***

Task of teaching make students in the learning combined with the task or question, to analysis problems, to complete the task to guide and direct students, interest and motivation in learning. Teachers use constructivist teaching theory, the design of teaching content into one or more specific tasks, for students through to complete specific tasks to master course content, complete the teaching task.

### ***66.3.3 Practice Teaching Organization Form***

Professionals involved in building a plant protection practice teaching. In the first and second grade arrangement in responsibility to arrange fields in the forms

of production, students can chose according to their own preferences of several crops, but also to carry out the test insect pest control; in the third and fourth-grade, arrange production practice and graduation thesis, the student has the right to chose the production mentor and research direction (diseases, pests, pesticides), a graduation thesis by teachers for students to chose, students can also be under to guide instructors, according to their interests up questions. By giving students some choice, stimulate students' interest, enthusiasm and initiative in learning, to enable students to be fully developed personality, innovative spirit and ability to get good training. Positive guidance, development of the student's interest to enable students to take part teaching students to create various good growing environment.

### ***66.3.4 The Experiment Course of Participatory Teaching***

Lessen the confirmation experiments; increase the design, synthesis experiments. Design experiment allows students to design their own experiments program based on the experimental purpose, decide the needed pharmaceutical experiments, utensils, the experimental problems that may occur early in the forecast, teachers will only play a role in resolving. Experiments can be integrated as much as possible for students to apply theoretical knowledge learned in teaching to fully improve the students analyze and solve problems. For confirmation experiments, the teacher don't will experiment procedures in detail, to enable students prepare in advance, questioned in the experimental class, the teacher to answer.

### ***66.3.5 Extracurricular Activities***

For freshmen and sophomores to establish a professional interest group, to develop professional interest in learning; third-grade students to set up research and training group, to develop identify and solve problems; fourth-grade students to participate in teacher research, to improve research capacity, and lay a good foundation for further studies and further work. Interest groups can allow students to identify forestry pests and diseases, to understand the harm; research training groups allow students to do experiments to understand the occurrence of some pests and diseases, habits; teachers participating in the research, allowing students to undertake part of their own research projects, proposed test procedure, conclude the test results. These, creating more open laboratories, teachers should strengthen guidance and timely solve the students questions, do not let students detours too much, not against the enthusiasm of the students, let students ask more questions, so students in the implementation in the sense of accomplishment and pleasure.

## 66.4 Summary

Effect evaluation. Examination form to be used several times in the assessment and combination of various forms, guide and encourage students to innovation. Examination includes the basics of closed book examination, to enable students to write an essay in nature, or pest identification, identification and proposed control methods. In addition, the usual lecture with questions and assignments to combine with test. Meanwhile, in the scholarship evaluation, excellent student selection and evaluation of graduate student recommend, have to reflect the students to analyse and problem-solving skills and innovation needs, increase incentives and policy orientation.

In the teaching management should pay attention to students' individual character development, become rigid management for flexible management. As in the school macro control, the carry out of credit; while reducing the needed courses, increased electives for students through many minor, elective and share in various extracurricular science and technology practice, to achieve self-study, self-management, cultivate students' interest, hobbies and expertise. Beside adopt flexible length, reference professional education to plan to set learning fixed number of year, ahead of the full credit to students, can the graduation in advance or in advance to register for the graduate student; In the period of the supplies of the difficult to achieve the needed for graduation student, allow to extend their learning time, delay graduation, make different basis and students can according to each arranged for the study progress and to graduate time.

## References

1. Li B, Xi X, Ding Fei et al (2002) Practicing and thinking of "Participatory" teaching model in agricultural teaching. *Higher Agric Educ* 6:39–41
2. Yan H, Li B (2009) Reforming and building features training model in the major of plant protection. *Higher Agric Educ* 9:44–48
3. Zhang H, Youhong Y, Chen N et al (2010) "Environment introduction" participatory teaching research. *Guangdong chem* 37(9):177–178

# Chapter 67

## Research on Safe Routes Based on the Relevant Laws

Ying Xi and Baozhen Pang

**Abstract** The security of bus routes receives more and more attention. This paper researched on the bus routes based on the related laws and regulations of the state and school policy. Through establishing the related model, setting the each dangerous obstacles in travel route, such as the minimum distance of bus travel, sidewalk crossing and so on. We analyzed on the multicollinearity of variables by the forecasting model poisson regression, and then reach the laws and effective control measures, the school rules and security measures, which can effectively improve the safety of students.

**Keywords** The safe route • Linear variable • Model analysis

### 67.1 Introduction

Along with the vehicle of road more and more, the multifarious occurrence of the traffic accident, and the safe trouble of campus vehicle is outstanding day by day, safe route in the school is subjected to strong concern [1]. At the same time, also know descending trend of activity in the school and the athletics activity, government and authority organization already more and more concentration how promise the safety and student going to school takes part in an athletics activity to raise body character up [2]. In 2000, discuss on the World Health Assembly a key risk factor of physical strength activity is in the chronic paroxysm prevention and the control; Till 2007, World Health Organization (WHO) development outline is mainly the safe condition that provides to walk or rides bicycle to go to school

---

Y. Xi (✉)

Academic Administration, Hebei Vocational College for Correctional Police,  
Shijiazhuang 050081, China  
e-mail: Ying\_Xi112@yeah.net

B. Pang

Research Department, Hebei Vocational College for Correctional Police,  
Shijiazhuang 050081, China

and it related law policy to increase route safety in the school and body character. Some items study enunciation: The improvement of infrastructure item includes on the sidewalk and lower equipments, such as speed, transportation reposition of redundant personnel and transportation conductor, etc., and the street intersections, bicycle drives solution of problems like safety, etc., can effectively promote a society to the exaltation of the safety of the school route and the exaltation of the body character of student's oneself [3]. For this situation, this research aim at examine campus route safe and relevant law status of relation, study route safety in the school guarantee of relevant of policy and measure [4].

## 67.2 Principle and Method

By bringing together relevant data, using a cross-sectional analysis examination of national laws and school route security relationship [5]. It is reported, the state legal (Legislative) legal six effective factors as independent variables were studied: bus travel distance minimum requirements, the dangerous route from distance, cross at the crosswalk safety, traffic safety, driving speed and the school environment surrounding area [6].

The national law stipulates that the school bus drives the request of distance's least, then indicates certain distance inside; the school pursues studies to living to provide bus transportation [7]. The lowest school bus drives distance to change the quantity is a continuous diagraph distance, take kilometer as unit, change to measure in the national law of all analysis in Be control change to measure. Include one among them common of change to measure-estimate factor, for the sake of examination the school bus drive of distance: 0 (do not be apart from), 1( $\leq 1$  km), 2( $>1-2$  km), 3( $\geq 2$  miles) among them 0 Be contrast a reference. At the same time, to whether allow law rules to request going to school to be apart from outside of the dangerous route carry on coding enactment (1 % dangerous route exception, 0 % not exception). These usually drive short distance (for example is shorter than minimum distance request) concrete circumstance enactment according to the school bus, if walk to or from the school/bus stop constitute student safety concealed suffer from the intersections that lies in transportation or insecurity [8]. These datas draw up to use same law to study the above-mentioned method and specially focus at them whether request or encourage the surroundings is at school after set sign: (1) On the sidewalk; (2) Pass by door Wei; (3) Traffic control measure (if the speed limits, the transportation stability turns to plan an equipments); (4) Accelerate area. The law is 2 % requests of coding, 1 % encouragement/suggestion, 0 % has no Lyu a method to forbid. Analytical code: The law data divides the line to four binary systems to change quantity to carry on measuring whether each law requests (1 %) and don't request (0 %, Yao encouragement/suggest or have no law). Then carried on once according to the national law to these topics and change the quantity carry on analysis and made sure a few coding rifts of end treatment, which can be seen as Table 67.1.

**Table 67.1** The state security channel distribution map in all provinces and all schools

State law	All provinces		All schools	
	Proportion (%)	Tick, 2007–2010	Proportion (%)	Tick, 2007–2010
Minimum distance method for bus				
Not	51.0	0.0	60.1	-3.7
≤1 km	13.7	0.0	4.4	+2.2
>1–2 km	27.5	0.0	30.0	+2.0
>2 km	7.8	0.0	5.6	-0.5
Tax risk route distance method				
No exemption	70.6	0.0	76.6	-3.9
Exemptions exist	29.4	0.0	23.4	+3.9
The pavement construction				
No/encourage	90.2	-1.9	68.8	-1.8
Need	9.8	+1.9	31.2	+1.8
Across the road is employed				
No/encourage	77.8	0.0	85.5	-1.1
Need	22.2	0.0	14.5	+1.1
Traffic control measures				
No/encourage	90.2	+1.9	42.9	+0.2
Need	9.8	-1.9	57.1	-0.2
Speed area				
No/encourage	19.0	-2.0	13.5	+1.2
Need	81.0	+2.0	86.6	-1.2

The survey carried on a processing and we visited some cities to research on the method of public opinion, while computing the circumstance that the physical activity responds to a rate and amount as to its win three reaction data of problems the following: 54.6 % (respond 578 schools), 70.6 % (respond 748 schools), 61.8 % (respond 641 schools). The first problem asks if the student is allowed to walk or ride bicycle to go to school. The second problem's student in the school will estimate to walk or ride the day that the bicycle goes to school from house to school on the average have of proportion. The interviewee provided a proportion that estimate student has. This last problem dosage is turned form degree that evaluate the interviewee's feeling's know. Is any may be obstacle to 8 kinds of different factors, like student ride bicycle to walk at school: "The school is too far to walk", "the transportation is dangerous", "lack sidewalk", "not ability horizontal wear street", "bad weather", "crime", "lack a bicycle" and other factors. Here particularly before introducing four obstacles, as Table 67.2 shown [9].

**Table 67.2** Descriptive statistics of the sample

Features	Average (%)
School policies and measures (outcome parameters)	
Have a walk/cycle disorders (%)	
The lack of sidewalks	30.2 (1.6)
The lack of through the guard	21.4 (1.4)
Traffic	53.7 (1.7)
Distance	46.2 (1.7)
Weather	23.3 (1.2)
Crime	12.7 (1.1)
The lack of a bicycle frame	18.5 (1.3)

### 67.3 The Size of Model Sample

According to model related data, include the study sample that 1967 schools constituted an end among them. It is laid to 1,770 schools to get to 1,894 schools through a regulatory end amount of sample. On the supposition that make all students ride bike to go to school, then here within three years for change to measure of data.

#### 67.3.1 Statistical Analysis

The data added the prejudice that the power has to reflect the school of national population. All analytical gatherings have the related status of each school in the national law. The logarithms regression model is the barracks used to evaluate some national law and school rules etc. in order to go to school such as the student route safety. The data that the initial model controls exhausts the trend of having time, however, study result enunciation regardless is a law to also have no time in research to change inside the segment, don't shows Zhao for a year, so any model descend physics to change within a year the reason for measuring. On this data foundation, we used a lake loose distribute model of estimate national law relationship with of route in the school. The proportion had is different in the model and of the difference of too many of the student of the amount of schools walk, the bicycle goes to school and has at school or have no the law of nation of the possibilities all come to estimate logistics model, as Table 67.3 shown.

#### 67.3.2 Data Analysis

Because of the route of their law dangers, each will provide an exceptional distance request. Is total but speech, 29.4 %s all including the distance method that a

**Table 67.3** The link between the national security path and law

Law	Obstacle	The school developed to measure ratio (%)		Adjusting ratio (%)		
		Have law	No law	No adjust-ment	95 % adjustment	All adjustments
The minimum distance of school bus ride						
≤1 km	Distance	47.1	44.2	1.31	0.74	2.31
>1–2 km	Distance	50.5	44.2	1.21	0.88	1.66
>2 km	Distance	43.2	44.2	0.65	0.38	1.13
Dangerous course exemption	Traffic	49.2	55.0	0.88	0.63	1.25
The pavement construction	Sidewalk	22.0	33.9	0.76	0.52	1.11
Through the defenders need	Through the guard	12.3	23.0	0.36d	0.22	0.58
Traffic control measures	Traffic	50.2	58.3	0.71c	0.53	0.95
Velocity area needs	Traffic	53.0	58.2	0.75	0.53	1.08

school bus of danger drives route tax-free. Outside of minimum distance and dangerous route exempt from law, and most may need an intersections guard (9.8 %) and may need to limit a speed peripheral region school (81 %) most. Only 22.2 % arrives 38.6 % to request to control measure at top in the construction sidewalk and transportation of school. But only 39.9 % schools locate at in a lowest limit school bus to drive distance to request respectively inside and only 23.4 % is to locate at national exempt from inside a route of danger in one. The sample school probably needs an intersections at least guard (14.5 %) and may need a speed restriction region (86.6 %) most 31 % schools are declaring to request to locate at on the sidewalk, need the school is in the circumferential transportation carry on controlling measure. If the influence of a national law or transportation existence the adjustment then changed for the control several rates measuring to lower 64 %. Is same, if the government requested transportation to control measure the several rates the report transportation rate of then causing the school to lower 29 %.

### 67.3.3 The Experimental Results

Usually, we have to let all schools have a school bus to drive to be apart from minimum distance method or a law request or traffic control measure sidewalk. Adjust a lake loose regression model enunciation, if be apart from less than 1 km, allow the route distance of going to school of all students, which shows that is



higher than the request of the least of national distance. If be apart from between 1 and 2 km, then request the tax-free route of a danger, or request to once wear public security, traffic control measure, and the periphery limits the school of speed region. But the possibility of physical estimate is a distance is 0:00, the school bus route safety is more obviously high than other circumstances. The lake of physical estimate loosens a rate estimate to ask guard and 55 % regions of intersections to need speed restriction (or: 0.45, 95 % can believe zone: 0.23, 0.85).

## 67.4 Conclusion

As we know, this is the research that carries on a national law and car route safety in line in the school relation for the very first time. We discovered that the establishment of the related law of nation can effectively assure that the school bus go on the car route in campus. It can increase the society's rest assured degree for school bus and reduce the danger. However, the related protection law in the nation requests and crosses student's report of school, school bus in the school's going car route still will be a point problem concerned. For the distance in the school enactment, to some extent, the key of school bus' driving is route obstacle and distance. Therefore, we can use to stipulate dangerous route tax-free and transportation to control measure to promise a student safety. Our analysis suggests that the only national law asks traffic control measure to effectively lower the obstacle of school bus route and promises student safety.

## References

1. Yuan Q (2007) To regulate bus traffic safety management work several ponders—from the American school bus management inspiration. *Publ secur sci* 104(6):90–92
2. Zhihua D (2009) Legislative intervention on school bus traffic safety. *J Chongqing Jiaotong Univ (Soc Sci edn)* 9(6):18–21
3. Wang Z (2009) China should be established as early as the bus system. *South metropolis newspaper* 01(16):A30
4. Zheng X (2002) School bus—passenger transport market to be a virgin field. *Chin investment* 18(2):78–80
5. Zhao C (2007) New standards for school bus on policy hides business chance encounter awkward. *Econ inf daily* 12(5):004
6. Cai Y (2008) China bus industry fly shortly. *Auto saf* 14(10):22–23
7. Wang Y, Chen C (2008) To plug the loopholes in the management of school bus safety. *Transp enterp manag* 12(5):6–7
8. Li T, Yan S, Zhang H (2008) The public security industry and industrialization of the scientific definition. *Chin Publ Secur (Academic edn)* 4(3):176–179
9. Zhu Y (2007) American school bus system. *Teaching: the principal reference* 3(7):61–63

# Chapter 68

## Research on Coupling Relationship Between Campus Stability and Social Prosperity

Meiqin Guo and Baozhen Pang

**Abstract** This chapter describes the problems faced by campus stability, as well as the influence campus stability has on social development, and the feedback role social prosperity plays in campus building. It also gives qualitative interpretation for the coupling relationship between campus stability and social prosperity, provides a new idea for campus security, and lays the foundation for social development.

**Keywords** Campus stability • Social prosperity • Harmony • Coupling relationship

### 68.1 Introduction

At present, with social progress and rapid economic development, campus work is facing new challenges. Campus is the cradle of talent for national and social development, so campus stability and development are related to social harmony and stability, closely linked with economic development and modernization, and it can also maintain the stability of the campus, creating a good educational environment. Stability is the cornerstone of social development [1]. Without stability, economy and society continuing to move forward will be an empty promise. From the perspective of the purpose of reform and opening up, and social development, social stability means people can live and work in peace and contentment, in happiness and joy, which is the purpose of our development. Without social stability, our development will be in purpose deletion and value nothingness [2–4]. On the other hand, from a developing point of view, social stability is the basis of the reform and

---

M. Guo (✉)

Academic Administration, Hebei Vocational College For Correctinal Police,  
Shijiazhuang 050081, China  
e-mail: Meiqin\_Guo@163.com

B. Pang

Research Department, Hebei Vocational College For Correctinal Police,  
Shijiazhuang 050081, China

development, without social stability, reform and development will lack basic conditions and our social progress and well-being of the masses will not be achieved [5].

## **68.2 Factors Affecting Campus Stability and Management Measures**

### **68.2.1 Factors**

With social development and the deepening of reform, there are a lot of new cases and new problems in school management and schools have to make corresponding countermeasures for a variety of circumstances [6].

#### **68.2.1.1 The Influence of Social Environment**

With social and economic development, the construction of material civilization is gradually accelerating. While enjoying the fruits of material civilization, people also have the constant pursuit of spiritual civilization. But one cannot ignore a problem: the policy of “soft-hand and hard-hand” lead to some people’s distortion of values of life, and some bad effects like money worship, hedonism, individualism tend to spread. Some cultural entertainment in the society are opening to underage students, and the network of the information age are spreading harmful information to underage students, especially those cafe, billiards, electronic game room, directly attracting them, all these are seriously affecting the physical and mental health of the students.

#### **68.2.1.2 Intrinsic Factors of the Students**

Young students are in adolescence, with their physical and mental development not mature enough, lacking necessary knowledge of mental health and sexual knowledge [7, 8]. Moreover, their poor ability to distinguish and poor self-management skills, and their outlook on life, values and world view are still in an unstable state. Everything is full of curiosity to them, and with a little temptation they will fall and cannot extricate themselves, and they are easy to go astray, all these are important factors influencing campus instability.

### **68.2.2 Management Measures**

Strengthen the management of school, and improve various rules and regulations, troubleshoot problems in a timely manner to further enhance students’ thinking and understanding.

Strengthen the construction of campus culture and enrich social practice. From the perspective of the environment education, good campus culture can help cultivate students' ideological sentiment, enrich their extra-curricular life, and guide their healthy growth.

#### Running of parents schools

Students' ideological and moral behavior is affected by various factors, including schools, families and society. Parents are children's first teachers, and they have long-term, profound and subtle influence on children's ideological and moral development. Therefore, parent's schools should be established and its implementation, the staff, lectures, and time should be put into practice. Adhere to home visits and the reception of visitors.

Implement the policy through the combination of ideological education, legal advocacy and psychotherapy [9].

Ideological hazard is the largest risk. In order to help them establish a correct outlook on life, world and value, ideological and political education should be strengthened. We should give full play to the power of grass-roots organizations and strengthen the students' ideological education to prevent those bad ideas from tempting to affecting the students, and to strengthen their ability to resist corrupt and hostile thoughts. As for services, there should be warmth, truth, and love. Thus, with a good service attitude, high professional ethics, and high-efficiency, we can create a stable and quiet learning environment for the students. Do counseling works, timely resolve psychological disorders, and set up a counseling room with full-time psychological counseling teachers to provide a careful analysis of students' psychological condition, to understand their psychological dynamic, and to fully mobilize the students with stimulating language. For those who cannot be strict on themselves, teachers should require see good things on them, give full play to their strengths, and mobilize their thinking. In addition, various training should be provided to make the students have a strong psychological prevention and a good psychological quality, so that they can have the psychological ability to prevent and cope with unexpected events.

#### Strengthen the strict management of local orientation [10].

Strict management of every aspect of school should be strengthened, especially the strict management of the students' dormitory, dining room, extra-curricular entertainment and other aspects of life, such as things that happen very often in student dormitories, like staying overnight, not returning back, not turning off the lights on time, and using electricity without permission, etc. School should increase check and management, and the usual water and electricity system. The students should line up in the dining room, put bicycles at designated locations, not make much noise in the corridor, and use civilized terms and Mandarin. School should also the implement a round-the-clock duty system to know students' activities, and should give full play to the role of the students and the student leaders, establish inspection teams and rating system to fully mobilize the students to form a joint management situation.

### 68.3 Harmonious Society and Campus Stability Education

To build a socialist harmonious society is a major task of our party when the cause of socialism with Chinese characteristics was proposed by the Communist Party. This suggests that the overall layout of the cause of socialism with Chinese characteristics with the continuous development of our economy and society. And more clearly, the Trinity of the socialist economic construction, political construction and cultural construction has developed into socialist economic construction, political construction, cultural construction, and social construction. This strategic move has great practical significance and far-reaching historical significance. Building a socialist harmonious society is the inevitable requirement to seize and make good use of important strategic opportunities, and to achieve the grand goal of building a moderately prosperous society. China's reform and development is at a critical period. The contradictions and problems faced by China's economic and social development may be more complex and more prominent at present and for a long time in the future.

To seize and make good use of important strategic opportunities and to achieve the grand goal of building a moderately prosperous society, we must correctly deal with these contradictions and problems, and coordinate the interests of all parties more intensively and more properly, correctly handle various social contradictions, and vigorously promote social harmony. School as a place to train people should be an important base in social development and civilization. School education has two functions to promote human and social development, and it also plays a significant role in mind, imparting knowledge, establishing the value of life. Therefore, school education should take up the important task of building a harmonious society and create a harmonious campus, which is the basis for building a harmonious society. Without a harmonious campus, there would not be a harmonious society. Harmonious campus should be a democratic, with fairness, justice, honesty, stability and order. Fairness and justice mean that interest parties within school are properly coordinated, various contradictions are properly handled, and fairness and justice are effectively safeguarded and realized. Honesty and friendliness among the staff and students, equality, friendship, harmony, stability and order are factors affecting the mechanism of school organization, sound management, good order, stability and unity.

Teachers and students should establish a democratic, equal, and harmonious teacher-student relationship. They should cooperate with each other, respect each other, share their thinking, experience and knowledge, exchange each other's feelings, experiences and ideas to achieve mutual development of both teaching and learning. In their interactions, teachers should not only understand and respect the students, but also show tolerance and equal treatment of the students.

Students should establish a new relationship of mutual respect, mutual encouragement, and learning from each other, equality, solidarity, and common progress among them. The time a student spent at school is relatively long, so he had to establish a good relationship with the students and maintain a harmonious and normal communication to obtain a psychological sense of security and belonging, which will be conducive to their progress and growth.

“Fair rights, equal opportunities, fair rules, fair distribution” are the embodiment of the fairness of a harmonious society. In school management, only when these four requirements are realized can we truly realize people-oriented education and fully mobilize the majority of teachers. To achieve the “four requirements” means one should fulfill his responsibility and also pay attention to the disadvantaged to realize the balance of interests. On the one hand, this reflects the socialist principle of distribution; on the other hand, this is good for the formation of a harmonious team atmosphere, and the enhancement of the cohesion of the School Board to maximize the creative potential of each person.

“Respect labor, respect knowledge, respect talent, respect creation” reflect the principle of efficiency of a harmonious society, but also serve as the basis for people-oriented education. Teachers use their own knowledge to make contributions to the heritage and development of human civilization, and they are playing a creative role in the construction of a well-off society. Only by achieving these four can we stimulate the creative enthusiasm of our teachers, encourage them to work actively and consciously for teaching and educating. Therefore, to embody the concept of people-oriented management, we must vigorously advocate the concept of glorious labor, noble knowledge and valuable talent to create a great atmosphere, which is the basis for building a harmonious campus. Only a campus that fully follows the school rules and promote the overall development of students can be regarded as a harmonious campus.

## 68.4 Analysis Coupling Regularity Analysis of Campus Stability and Social Prosperity

### 68.4.1 Coupling Function of Campus Stability and Social Prosperity: Double Exponential Function

According to the research, coupling relationship between campus stability and social prosperity can be shown in a logarithmic curve [11]:

$$y = a \lg x + b \quad (68.1)$$

In the equation, “y” means campus stability; “x” means per capita gross national product; “a” and “b” mean undetermined parameters.

In addition, the relationship between the campus stability and per capita GNP shows an inverted “U”-shaped change, which can be expressed as [12]:

$$z = m - n(x - p)^2 \quad (68.2)$$

In this equation, “z” means social prosperity; “x” means per capita gross national product; “m”, “n” and “p” mean undetermined parameters. Therefore, based on these two relations, mathematical methods can be used to deduce that the

coupling function between the campus stability and social prosperity is a double exponential function [13]:

$$z = m - n[10y - ba - p]2 \quad (68.3)$$

### 68.4.2 Degree of Coupling Function

By drawing on the concept of capacity coupling physics and capacity of the coupling coefficient model, we can get a coupling model of the interaction of multiple systems [14].

$$C_n = \left\{ (u_1, u_2, \dots, u_n) / \left[ \prod (u_i + u_j) \right] \right\}^{\frac{1}{n}} \quad (68.4)$$

To be more convenient, we can obtain the degree of coupling function of campus stability and social prosperity.

$$C = \sqrt[2]{\frac{U_A(u_1)U_A(u_2)}{[U_A(u_1) + U_A(u_2)]^2}} \quad (68.5)$$

Obviously when the degree of coupling function “C” tends to 1, which is the maximum, different systems and elements within one system will achieve a benign resonance coupling, and the system will tend to a new ordered structure.

The relationship between campus stability and social prosperity is mutual influence, mutual restraint and mutual promotion from disorder to coupling, then from disorder to coupling of dynamic change. To make both developments enter a virtuous cycle, a real scientific coupling mechanism should be established.

## 68.5 Conclusion

To build a harmonious campus is difficult and complex, which requires a development advancing with teaching, research and development. It is also a long-term journey and an eternal theme, the whole society, especially the educators should participate comprehensively and make unremitting efforts. The coupling relationship between campus stability and social prosperity can provide a strong basis for the building of a harmonious campus, and lay a solid basis for the campus stable development. At the same time, improving campus stability is conducive to the stability of the society and speed up the pace of China’s socialist modernization, which has broad research prospects and great significance.

## References

1. Ye SX (2010) Fusion of campus culture and enterprise culture in vocational institutes. *J Tianjin univ prof* 1:33–35
2. Zhang T (2010) Research on fusion of campus culture and enterprise in vocational institutes. Tianjin coastal professional university for example. *China's excellent master's thesis*, vol 3, pp 77–82
3. Xiaoguang Y (2006) The party school physical education in yunnan province during the students' social adaptability. *Training Res* 12:22–28
4. Yu L (2007) The college students' social adaption. *Psychological health. Modern life* 2:17–21
5. Xuejun D (2009) The problem analysis and Countermeasure of college student's social adaptation ability. *J Huaiyin Inst Technol* 6:45–50
6. XiaoY (2009) The effects on college students' ability of social adaptation. *Mod enterp educ* 12:4–8
7. Jinyan L (2009) College students employment and social adaptation ability of campus culture under the financial crisis. *South J* 5:11–19
8. Yin X (2007) College students' Setback causes analysis and anti frustration education. *Cult educ Inf* 23:34–40
9. Chen L, Zhuang W (2007) The problem of the social adaptability of college students. *Ideological political educ res* 3:98–102
10. Lixiong Z (2009) The understanding of social integration social adaptation social—talking with college students about social issue. *J Qujing Normal Univ* 1:10–16
11. Bin Z, Chen Y (2011) The multi-campus university freshmen's adaptation to the educational study. *School of Party construction and Ideological education (higher education edition)* 1:123–127
12. Guo J, Wenhui Y (2008) Study on sociology personnel occupation adaptation ability. *J Chengdu Univ Technol* 4:88–91
13. DengSheng Z, YongJian Y (2009) Five One: Fusion and development of campus culture and the enterprise culture in vocational institutes. *J Heilongjiang higher Educ Res* 1:148–154
14. Ding SZ (2004) Man's existence and education— the contemporary value of marx educational thoughts. *Harvard University press, Cambridge*, vol 33, pp 75–81



# Chapter 69

## Study on Applying Implicit Learning Theory in Nursing Teaching

**Xuexia Zhang**

**Abstract** The method of analysis within the meaning of implicit learning, characteristics and recent research results presented will be applied to the possibility of the teaching of nursing etiquette; the results of implicit learning theory contribute to teaching and learning of skills disciplines; conclusions implicit learning theories in nursing education has broad application prospects.

**Keywords** Implicit learning • Application • Nursing teaching

### 69.1 Introduction

To further promote the reform and development of nursing education in the theory of implicit learning in nursing etiquette teaching review, want to give nursing education to bring new inspiration.

### 69.2 Meaning of Implicit Learning

The term implicit learning (implicit learning) was first proposed by the United States the psychologist Reber [1]; he described the unconscious process to stimulate the complex knowledge of the environment [1]. Implicit learning is a subconscious learning, as the same foreign language, we read much more, will subconsciously feel the implicit rules of the language, resulting in the sense of the phrase, and this sense of language acquisition of implicit learning results.

---

X. Zhang (✉)

Sichuan College of Traditional Chinese Medicine, Mianyang 621000, China  
e-mail: eibj@foxmail.com

### **69.3 Essential Characteristics of Implicit Learning**

Some studies have shown that [2], implicit learning (1) Automatic four characteristics: implicit learning will be automatically generated, without the individual consciously discovered. (2) Abstract: Implicit learning the essential attribute of abstract things, namely, the knowledge gained is not dependent on the surface form of stimulation. (3) Comprehension: the product of implicit learning in some extent can be aware of. The (4) immunity: the impact of performance regardless of age and IQ as well as less susceptible to the influence of individual differences.

### **69.4 Research of Implicit Learning Theory Applied to Skill Areas**

At present, China's research on implicit learning has only just started, but its presence has aroused widespread concern. This theory in our country more used in the field of psychology and its application in the skill areas at home and abroad there has been some research, such as: (1) The Masters, [3] found that: the pressure in the case, the implicit learning group skills automatic interruption than the explicit group, that is implicit learning skills acquired are less vulnerable to external factors interfere with. The (2) Graf, [4] studies have shown that: the ability of implicit memory is not easy to increase with age and decline; therefore, the skills learned through implicit learning can be maintained longer. The (3) implicit memory is characterized by: Implicit learning skills in people to accomplish specific tasks operating inadvertently shown [5]. (4) Implicit Learning not only make the motor skills to maintain a longer time, but also conducive to the mastery of complex motor skills and to adapt to a variety of stress conditions, the same time, the implicit learning ability to learn complex skills to operate imperceptibly, comprehensively [6]. The results of these studies of implicit learning, is a great encouragement to the education sector, it can make up to a certain extent its own drawbacks of explicit learning.

### **69.5 Relationship Implicit Learning and Explicit Learning**

Explicit learning refers to the learner through conscious effort and achieves their goals, understanding, memory and grasp of knowledge, with clear rules, aimed at problem-solving learning methods [7]; it is the emphasis on student's conscious the activities involved in learning [8]. Explicit learning is a learning method in our traditional teaching high school students [9].

Research has shown that: implicit learning and explicit learning over time, to promote learners' knowledge accumulation plays an increasingly important role;

both with each other to promote the key role of implicit learning and explicit learning in a timely manner with; the interaction between the two played an invaluable role in human learning and life, [10]. In other words, implicit learning has always existed with and interacts with explicit learning, the relationship between implicit learning and explicit learning that they not only can be coordinated, and may promote each other. If you can take the initiative both organically combine the teaching applied to the care of etiquette, student learning will produce unexpected results.

## 69.6 Possibility of Implicit Learning Applied to Nursing Etiquette

The consciousness of the characteristics of implicit learning without increasing the burden on nursing students learning to enable students to easily acquisition of knowledge of nursing etiquette rules. Establish time care for patients, patient-centered philosophy in nursing students through Blackboard and publicity pictures, watch movies, videos and other forms, so that students monasteries, and this concept into their own attitude, consciously in the clinical care of this concept into practice.

For abstraction of implicit learning, Reber, and Lewis [11] Experimental study of a string of the inherent grammatical rules example, they first presents to the subjects and asked them to memory, and then again they presented in any order the string, the results of subjects ungrammatical rule string to adjust a number of grammatical rules of the string, far more than the example provided in line with the rules of string, Obviously, subjects received a deep abstract knowledge of the potential structure reflects the nature of things. Likewise, teachers in the classroom to teach students the knowledge has remained mostly on the surface form, to the students rise to the intrinsic nature of things, usually after a very long time. Implicit learning of abstract, consciously abstract characteristics of the essential properties of things, happens to be able to help us accelerate the process, the students have learned as soon as mature, reach to use freely the extent.

Dulany [12] studies have shown that in the experiment, he first asked the subjects to learn a string of potential grammatical rules and then ask them to classify the new string, and asked them to point out to determine whether these characters string together or substandard grammar rules based on that characteristic is what results show that: the correct rate of the subjects specified by the characteristic high, indicating that implicit learning of knowledge can be aware of and extract use. Therefore, understanding of implicit learning, implicit learning products to a certain extent can be aware of the characteristics to make conscious use of implicit knowledge become possible.

We know that care etiquette is a very practical course, the care and operation of learning and knowledge, ability, age, motivation is closely related to [13]. Ability, younger students are weak and older students to form pressure teachers to teach

them more laborious. If the use of anti-interference characteristics of implicit learning, guide students to learn, can make up the impact of such individual differences, and help to improve teaching and learning effect.

In clinical care, nurses are often faced with a patient's condition, the high hopes and great trust of the intense work rhythm and the patient, the stress level is high, the pressure to make nursing students calm one can grow from a novice cope with a variety of complex clinical situations, nurses, and often requires the accumulation of many years of clinical experience. However, the implicit learning theory research results indicate that implicit learning for the knowledge and skills will be more conducive to the learning of complex skills will be maintained longer, better cope with the various pressures to accelerate the growth of nursing students, as clinical nursing students to develop higher quality conditions.

So far, nursing etiquette courses teaching more and more attention, thinking on the improvement of teaching methods is also increasing. Feng et al. [14], the situational approach is better in the teaching of nursing etiquette; Sun et al. [15] experiential learning in the teaching of nursing etiquette will have a good effect. These theories put forward, aroused the attention of the nursing education sector in China, many schools offering this course, taking into account the reform of teaching methods, therefore, also done a lot of implicit learning theory in the teaching of nursing rituals carried out bedding.

## **69.7 Application Envisaged of Implicit Learning Theory in Teaching of Nursing Etiquette**

### ***69.7.1 Strengthen and Guide Visually and Intellectually***

For the education of nursing students in nursing etiquette from them into the first day of school began, when the students' heart is full of enthusiasm and curiosity at this point, we should further mobilize their enthusiasm through posters, manuals and watching movies, give them the visual stimulus in their hearts to establish a correct concept of nursing and nurses, image, and lay a good foundation for the future in nursing.

To guide students in terms of ideology, which saves resources and effective method is to create a bulletin board. It was suggested that the bulletin board (bulletin board) for the dissemination of information from the teachers to make students more sensitive to new ideas very effective; available in simple terms means to attract students' attention to the introduction of new ideas, and thus stimulate students to think [16]. The bulletin board should allow students to openly express the idea of the column, teachers and students feedback bags; it is a good answer student's doubt in his heart can inspire students to pay more attention to relevant information. The contents of the bulletin board design should be teaching the same objectives, the use of dynamic step-by-step process, step by step guide students in

the conceptual and ideological set of scientific ideas suitable for the application of knowledge of nursing etiquette and rules to facilitate the care of the future to guide students practice.

### ***69.7.2 To Enhance the Perceptual Knowledge to Promote Implicit Learning in the Teaching Process***

In the teaching process, we should strengthen the use of students' implicit learning, the use of flexible teaching methods, so that students who use explicit learning method is difficult to comprehend the knowledge unconsciously grasp. Learn the care operations, it is recommended that the role-playing. Studies have shown that the use of role-playing method (role-play) will not only help students appreciate the intrinsic link of the steps, to effectively promote the mastery of the skills, but also conducive to the students experience of the patient's mood, learning, and communication with patients techniques [17]. In addition, we can also use a variety of teaching methods help of implicit learning, such as a game law, to experience the method, cooperative learning, guide students to make full use of the advantage of implicit learning and explicit learning the combination, to help students learn nursing etiquette knowledge.

### ***69.7.3 To Promote Students' Implicit Knowledge Acquisition in Practice***

Implicit learning to emphasize the importance of implicit knowledge in practice, especially in the very practical skills class to learn. As we learn to swim, regardless of how science in class, how vivid, no practice is not really learn to swim. Through practice, learners unconsciously mastered the internal rules of interaction between the human bodies with water after swimming context; freely use this rule without conscious effort.

As medical personnel, practical experience, mostly from the contacts of patients with treatment and care process. So, let the students early exposure to patients is essential. It was noted that the care of chronic patients committed to better practices, medical gifted first-year enrollment to help students better understand patients and their families, to stimulate students' interest, and this approach to learning by 90 % of students spoke highly of this helpful for students to gain practical experience, but also pointed out that the freshmen experience, led by the more mature high school students to achieve better learning outcomes [18]. We can learn from this approach to teaching nursing etiquette, a freshman in high school nursing students under the leadership of obtaining the patient's consent, they were interested in chronic disease nursing home care and health education for nursing students practical experience to the importance of nursing and nursing

career with confidence. At the same time promoting their conscious learning nursing knowledge, and consciously care procedures used in nursing practice. Care of chronic diseases, they will unconsciously learn the application of the rules of basic care to lay a good foundation for future teaching and learning of nursing etiquette.

## 69.8 Conclusions

Implicit learning in China's still in the preliminary stage, the exploratory stage, implicit learning theory into the teaching of nursing etiquette in order to promote teaching concepts, teaching strategies and teaching methods update. The enormous potential of implicit learning, it can be applied not only in the teaching of nursing manners, and can be applied to other nursing teaching. How to make better use of implicit learning theory for nursing teaching, learn how to make the implicit and explicit learning to achieve the best combination, remains to be further research and study.

## References

1. Reber AS (1967) Implicit learning of artificial grammars. *J Verbal Learn Verbal Behav* 6(2):317
2. Xiuyan G (2003) Implicit learning unconsciously—a study. *Educ Sci* 19(6):41–44
3. Masters R (1992) Knowledge, knerves and know-how the role of explicit versus implicit knowledge in the breakdown of a complex motor skill under pressure. *Brit J Psychol* 83(2):343–358
4. Graf P, Sebacter DL (1985) Implicit and explicit memory for new associations in normal and amnesic subjects. *J Exp Psychol: Learn Mem Cogn* 11(3):501
5. Xu DZ (2000) Implicit memory theory and practice of discourse. *Xinyang Normal University*, vol 20(3), pp 49–52
6. Xiuyan G (2004) Revelation of implicit learning skills class teaching. *Psychol Dev Edu* 1:87–91
7. Dienes Z, Altmann GTM, Kwan L et al (1995) Unconscious knowledge in artificial grammars is applied strategically. *J Exp Psychol Learn Mem Cogn* 21(5):1322
8. Fan W, Wu D (2001) Revelation of implicit memory and implicit learning of physical education. *Guangzhou Physical Education Institute*, vol 21(3), pp 36–38
9. Zhou Z, Ren J (2002) Implicit learning theory research progress on physical education. *Beijing Sport University*, vol 25(6), p 817
10. Xiuyan G (2002) Texts for the relationship between implicit learning and explicit learning. *Psychology* 34(4):351–356
11. Reber AS, Lewis S (1992) Toward a theory of implicit learning: the analysis of the form and structure of a body of tacit knowledge. *Cognition* 5(2):333
12. Dulany DE, Carlson RA, Dewey GI (1985) On consciousness in syntactic learning and judgment: a reply to Reber, Allen, and Regan. *J Exp Psychol Gen* 114(1):25
13. Li X (2002) *Nursing education*, vol 1. People's Health Publishing House, Beijing, p 38
14. Feng L, Zhang (2011) Scenario training in the teaching of nursing etiquette. *J Inf* (7):106–107

15. Sun Y, Fu Z (2008) Experiential learning in the teaching of nursing etiquette. *Health Vocat Edu* 26(23):70–71
16. Hekelman FP, Glover PB, Galazka SS (1992) Bulletin boards for faculty development. *Med Teach* 14(4):287
17. Steinert Y (1993) Twelve tips for using role-plays in clinical teaching. *Med Teach* 15(4):283
18. Kamien M (1990) Can first-year medical students contribute to better care for patients with a chronic disease? *Med Ed* 24(1):23

# Chapter 70

## Coupling Effects of Regional Economy and Local Universities Construction

Lei Chen

**Abstract** The development of local universities pulls the development of the regional economy and the development of regional economy provides a platform for the local universities to develop and makes them vigorously in return. This chapter will discuss the coupling effects of the regional economy and local universities. It is believed that the coupling effects between the regional economy and the local universities should be strengthened and the suggestions will be given.

**Keywords** The regional economy • The local universities • The coupling effects

### 70.1 Introduction

Coupling refers to the act or process of linking two or more circuits so that power can be transferred between them usually by mutual induction. Through this way, the objective phenomenon that two or more social phenomenon are linked together to come into effect can be called coupling as well. Knowledge and economy is also a mutual coupling process; As one of the endogenous factors of the economic development, the application of knowledge has input new vigour for the development of economy, especially the application of the new knowledge and technology makes the economy develop rapidly; in return, the development of economy provides a powerful material support for the generation of knowledge, and makes more money be put into the construction of discipline and the research and development of science and technology in higher education. Therefore, the development of economy promotes the generation of new technology and knowledge, and the transformation from the economy to knowledge has been realized. The process of the transformation between knowledge and economy is known as “coupling effect”.

---

L. Chen (✉)

Luoyang Institute of Science and Technology, Loyang, China

e-mail: chenleileo@yahoo.cn



## **70.2 The Coupling Effect between Local Economy and the Construction of Local Universities**

In the knowledge economy era, the function of the universities gradually develops from simply focusing on the production and dissemination of knowledge, research and development of new technical achievements to an entity which has various functions, such as, achievement transfer, test, hatch enterprise, business advisory, training and so on. Especially in recent years, the rise of university science and Technology Park has a significant impact on the structure, competition and development strategy of the regional industry group. Therefore, it not only provides science and technology and human resource for the progress of the regional economy, but also promote the formation of the industries which are relevant to the universities, expand the regional scale and improve the grade of the area.

### ***70.2.1 The Development of Universities Pulling the Development of Regional Economy***

The development of universities pulling the development of regional economy is reflected in two aspects:

On the one hand, the development of universities provides intellectual support for the development of regional economy. Firstly, owing to the particularity of knowledge producing, it is no doubt that local universities become an inseminator for the development of regional economy and the society. Increasing the local investment in universities, the scale of recruit students will be expanded and the majors will be adapted to the development of economy, so that the contradiction of personnel insufficient will be relieved in certain degree and the development of regional economy will be promoted effectively. Secondly, the university promotes the development of regional third industry. From the perspective of investment, the investment in universities is equivalent to increase the regional wealth in some extent. From perspective of consumption, the investment in universities contributes to pull the regional consumption and increase the regional consumption level. In fact, college students are stable long-term tourists, because they live on campus for four years, and will attract part of their parents, relatives and friends to come for visit, which will promote the development of the city traffic, real estate, tourism, stationery, catering, and culture. Besides, this also creates lots of opportunity for employment and the development of the third industry in the region. Finally, the universities boost the development of high-tech industry. With the coming of knowledge economy, today, the universities have play an important role in facilitating the development of economy, and do not work as a plotter any longer, but a guider. In addition, universities will gradually become an entity which has various functions, such as, achievement transfer, test, hatch enterprise, business advisory, training and so on, and dive the high-tech industry development. For example, the

Cambridge science park in Britain, silicon valley in the USA, and Zhongguancun in Beijing, are all established based on universities and have acquired great achievements.

On the other hand, universities should build brand specialty which can promote the development of regional economy. Firstly, the formation of the brand specialty often needs several years, and most students graduating from universities will become the backbone of the related field, which makes the universities' major concept deeply influences the development trend of the industry. Because of this, the establishment of brand specialty has strong guide and support function. Therefore, the establishment of brand specialty has a significant role in creating regional fist industry. Second, the university should establish special majors and train the students who can adapt to the regional economy development. If universities want to establish special majors, they should change the methods of training talents and set up the professional systems which adapt to the regional economy development. Finally, the local universities should make great effort to make professional cluster to promote the upgrading and transformation of regional economy industry. The so-called professional cluster refers to a set that consists several relevant majors in which there is a key major which composes one or more key construction majors that have powerful strength and high employment rate and other several projects which have the same project objects, technology field or professional discipline foundation.

### ***70.2.2 The Regional Economy Development Promoting the Benign Construction of Universities***

At the same time, the regional economy development promoting the benign construction of universities is also reflected in tow parts.

For the first part, the rapid development of regional economy increases the financial revenue in this region, and in return, the increasing of financial revenue would make the government increase the infrastructure investment accordingly. For the region in which there are good traffic conditions, convenient communication and perfect public facilities, the construction of university will develop fast as well and great economic benefits will be realize.

For the second part, whether regional economy development is good or not, it basically relies on the region's enterprise's profit condition and how many the units are. If the regional economy grows well, it will create greater market space, more products demand and put forward higher product requirements. For this, enterprise will carry on new products and new technology research. Among them, some product development and research are entrusted by the enterprise to universities or they will work together. On one hand, enterprise invests to universities to do R&D; on the other hand, universities' research and development ability will be enhanced. Besides, the enhancement of the university research and development ability will further push up the enterprise profitability, thus increasing the regional GDP, and form a good cycle.

## **70.3 The Problems in the Coupling Effect of Regional Development and Universities Construction and the Countermeasures**

### ***70.3.1 The Problems in the Coupling Effect of the Regional Economy Development and the Construction***

Firstly, local Colleges locate unknown. The modern universities mainly have three functions: teaching, research and service. Teaching is to inherit knowledge and truth to students; scientific research mainly refers to innovation, and service means to serve the society. With the development of society, the functions of universities present the development trajectory from academic to socialization and the university functions to serve society is increasingly strengthened. As a local university, its important mission is to serve the regional economy, solve the regional social problems and provide intelligence support to the local economy development. Therefore, the university should combine the its running conditions, and establish characteristic professional to develop application oriented talents for the local economy development; at the same time, the local university should also encourage teachers and researchers to go out and do more technical guidance for local economy and solve problems for enterprise timely.

Secondly, the need of raising the contribution which local universities have made to regional economy development. [1] The coordination degree of the local universities structure and economic structure is not strong. Because of historical reasons, local universities, in the construction of the majors, often focus on traditional subjects, and set up a larger share in the scale of recruiting students and the majors, while only set up a small proportion in emerging discipline establishment and recruit students [2]. For example, in Henan province, in environmental engineering, communication engineering and biotechnology fields the talents have a bigger gap, and some professionals are almost blank, such as aircraft manufacturing engineering and so on. Therefore, when regional industrial structure changes or has adjustments, the local university should also adjust to the development of the economy in this region [3]. The level that the local universities directly involve in economy development is low. The local universities participating in economy development is mainly realized by elaborating their technical support, consulting services, education and training, information exchange and other functions. The main forms are “technology transfer”, “university-enterprise cooperation” and “university science and technology industries” and so on. However, as the role of high-tech incubator, the local universities are still not evident. With the upgrading of industrial structure and the generation of new economic growth point, local universities need to promptly seize the opportunities to accelerate the development of universities in serving regional economy [4].

Finally, the need to improve High knowledge industrial clusters of the regional economic development and the establishment of open economic system. Firstly, it

is essential to create clusters of high professional knowledge to promote regional industrial upgrading and economic restructuring. The industrial system of regional economic development relying solely on a few large companies support is fragile. Industrial clusters can reduce transaction costs between enterprises, get access to new technology and new materials fast, own plenty of professionals in the industry and increase the strength of the external negotiations. Meanwhile, the close proximity of peer competition not only can be conducive to the transformation of technology updates and product upgrades, but also will bring a variety of market needs. The role of market forces, industrial development inevitably trend to industry clusters. How to overcome the inertia of the development, improve the quality of industrial development, especially to promote the sustainable development of industry, these problems become increasingly severe. Establishment of a regional cluster of high-knowledge industry needs to a professional cluster support of local colleges and universities. Cluster requires a high professional knowledge from professional construction mode, training mode, curriculum and teaching team in a bid to achieve the promotion of the overall educational and management levels of the professional clusters. Secondly, the degree of the establishing open economic system needs to be improved. Open should not only attract foreign capital, but also absorb external knowledge. In order to promote the development of the regional economy, an open economy should be established; the economic system should be open further, and domestic and foreign capital, talent, technology are necessary to introduce to the region; ideas need to be changed completely so that information, personnel, technology can be free in movement in the region.

### ***70.3.2 Realizing the High Quality Coupling Effect of Local Universities and Regional Economy***

Firstly, the setting of majors in local universities adapting to the regional economy structure. In today's society, knowledge and technology has been a decisive factor for economy development. With the constant depth of higher education, the functions of university education, major setting, the teaching content and the targets training should be more adapt to the structure of the regional economy, because only do this, the cultivated labors can meet the requirements of society and market. Currently, the tendency in set the training direction and departments in the local university can be seen already.

Secondly, the model and goals of local university fostering personnel should adapt to the demand for talent in the regional economic development. Practice has proved that human resources are the fundamental driving force for the country's development and regional economy development. In the training of human capital, the model and goals of local university fostering personnel must be adapted to the needs of professionals in the regional economy development. There are some types of training higher education talents in our country, such

as research, practice and practice-based research. The rapid development of new industrialization in municipalities and provincial capital cities is faster, which lead to the fact that a large number of high-tech industrial parks largely rely on local universities and research institutes, such as Beijing Zhongguancun Science Park, Suzhou New District Industrial Park, Hi-tech Industrial Park, which required research and research practice-oriented talents which are trained by the local universities. However, as the local universities, because they are influenced by the factors of the economic systems, economic strength, technological content, the local industrial structure and economic disparities in the regional economy, their educational goals and personnel training should be positioned on the regional economic construction and social development. Finally, the adapting of the level of local university teaching and research and regional economy development. Currently, China is on the new industrialization way of high-tech, good economic returns, low resources consumption, little environmental pollution, human resources into full play. At present, there have been a lot of results in research and development of higher education in China is in the world lead, which mainly relies on the fast development of universities and research institutes. It is the tendency that the universities develop in a way like a chain produce-learn-research. In industry, according to the features of low high-tech of the traditional industry, low level of industrialization, strong scientific research or not, higher education can give full play to their strengths in scientific research to establish research projects, increase R&D investment and strengthen the “university-enterprise cooperation” to solve business problems. In the part of agriculture Structural adjustment, higher education should be actively integrated into the national strategic plan for investment in agriculture to promote emerging technologies, develop green, high-quality agriculture, improve the product structure of animal husbandry and increase their income.

## 70.4 Conclusion

Local government plays an important role in connecting the local universities with the development of regional economy. Besides, it should pay more attention to the scientific researches which are closely related to the region and industry, and focus on supporting and sponsoring the projects which can serve the construction and development of the regional economy directly. With doing this, on the one hand, it can help the local universities to improve and supplement the problems of insufficient scientific research conditions and funds, in order to enhance their research ability; on the other hand, it can provide high quality talent resources for the development of enterprise and regional economy, solve the difficulties and problems in the development of the region, gradually boost the coupling relationship between local universities and the region economy development, and realize the universities' sustainable development in serving the regional economy development.

## References

1. Wang YT, Jin H (2009) Study on the constructing countermeasures to field of university knowledge coupled with economy in Hebei province. Hebei: Hebei Acad J 29:39–45
2. Guo J, Wenhui Y (2008) Study on sociology personnel occupation adaptation ability. J Chengdu Univ Technol 4:88–91
3. Wu B-R, Qiu X-J, Wang G-J (2009) The driven and interaction between the construction of the local universities discipline and regional economy. Hebei: Edu Vocation 6:135–141
4. Zhu DS, Yu YJ (2009) Five one: fusion and development of campus culture and the enterprise culture in vocational institutes. J Heilongjiang high edu res 1:148–154

# Chapter 71

## Analysis on the Psychological Adjustment of College Students Based on the Principle of Self-Management

Xue Wang, Jingzhi Wang and Lijuan Zhang

**Abstract** Today's society requires the college students to not only have ability, integrity, good professional knowledge and skills, and good moral character, but also need to have strong psychological qualities. But facing the pressure from learning, living, and work, society and school have given the students too much pressure, which brings great test to the students' psychology. According to the research on college students, students' mental health deserves attention self-management principles have great significance in the process of students' psychological adjustment. From the perspective of self-management, this paper analyzes the main psychological problems faced by college students and builds a student's 'psychological quality index model. Through factor analysis by the SPSS statistical analysis method, the students' self-management model was established based on the psychological adjustment, which is designed to give students a sense of self-management to help their self-adaptation of psychological problems and to achieve mental health of college students.

**Keywords** Self-management • Psychological adjustment model • Factor analysis • SPSS

### 71.1 Introduction

College students are the pillars of our country in the future, and they are also the hope for the future. With the continuous reform and opening up of the society, it is called on the students to achieve all-round development, with not only solid professional knowledge, but also good moral character, a strong body and a healthy

---

X. Wang (✉) · L. Zhang

Institute of Education, Department of Psychology, Handan College, HanDan 056005, China  
e-mail: Wang\_Xue21@yeah.net

J. Wang

Institute of Education, HeBei Normal Unieiversity, Shijiazhuang 050024, China

mind [1]. Students are facing lots of social pressure, which has brought a lot of negative impact on the psychological problems. This is gradually getting everyone's attention. Self-management is to make people take the initiative to adjust and change their behavior and mental activity, the impulse effective control, to overcome negative emotions, and to actively seek a suitable way to develop good psychological quality. Self-management is one of the students' necessary successful psychological adjustments [2]. College students with self-management will be able to give full play to their initiatives and can effectively organize various activities to overcome the psychological barriers to achieve self-psychological adjustment. The role of adaptation is to reduce the students' mental distortions caused by psychological problems or unhealthy phenomenon, through effective self-psychological adjustment. We should train college students to be in good health and to have psychological quality, thereby becoming the new talents of social development in the future [3, 4].

## 71.2 The Definition and Principle of Self Management

Self-management can also be called self-regulating, self-control, self-directed and so on. It is an important component of the advanced capabilities. In simple terms, it means people have the freedom to manage [5]. For college students, it is the ability to play with initiative to strengthen self-discipline and make progress in their own learning, work, life, etc. In order to achieve self-management and improve the results. Self-management is the individual regulate their own ideas, goals, behavior and mental performance, and organizes, manages, constraints, and inspires themselves.

Combined with modern management science theory and contemporary characteristics of the students, college students need the necessary self-management principles of conduct to restrain themselves.

Firstly, follow the principle of self-awareness, which means understanding of physiology, heart, intelligence, expertise, behavioral characteristics and the cognition of surrounding environment. It is the basis of self-management and correct evaluation from the objective and subjective understanding of their own.

Secondly, follow the principle of self-motivation, which is a state of mind to achieve their goals, dreams and be able to produce a driving force to promote them to maintain a positive mental outlook.

Thirdly, follow the self-adaptation principle, which means adaption to society and adaption to their conditions, and to adapt to the system itself. This requires the ability to quickly adapt to the surrounding environment and the driving force to take the initiative to change things around.

Fourthly, follow the principle of self-regulation, which means the adjustment of human condition and attitude. Maintain a good psychological and physiological state and an upbeat mood.



**Fig. 71.1** Three stage of psychological adjustment



Fifthly, follow the principle of self-control, which means constraining their own behavior, ethics, constraint, and setting a noble life and values.

Therefore, self-management must be an effective overall system, with complementary characteristics and promoted features. Students must have an effective management of their own, in order to achieve all-round development and healthy growth. Based on the on the principle of self-management of Rosa Say, this paper combines the whole process of adaptation of mental health to conclude that college students' psychological adjustment needs to be based on the principle of self-management to realize self-psychological adjustment. Self-management is the process in which people work, study and plan, and means the implementation of regulation and, ultimately, the process of evaluation and reflection. From the perspective of self-management, we have come to three stages of psychological adjustment of college students: self-planning, self-regulation and self-evaluation, which are shown in Fig. 71.1.

### 71.3 Psychological Quality Index System

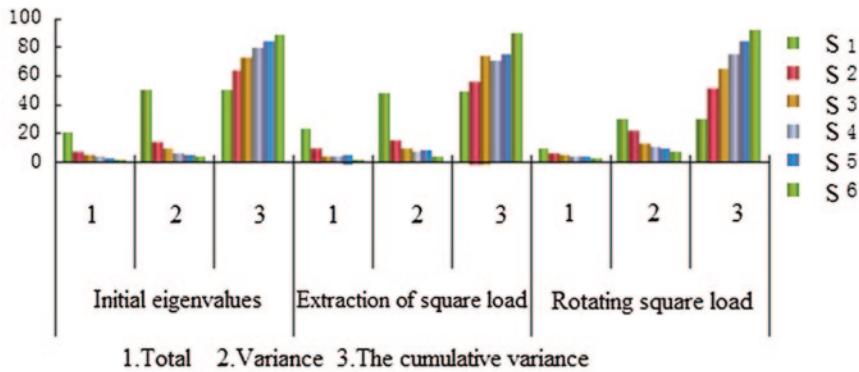
Many factors affect students' psychological health and they have complex structure [6]. Only through multi-angle and multi-level thinking to design psychological quality indicator system, can we accurately analyze the students' mental health problems, and can they effectively carry out the psychological adjustment activities in order to achieve self-psychological adjustment and achieve the mental health. Therefore, the first mental quality research and analysis to determine the quality of students' mental structure should be able to find the direction of psychological adjustment. The first thing is the design of the questionnaire, based on psychological quality factors and indicators of evaluation of each factor which are set to five levels according to the five-point scale [7]. They are "not important, less important, average, more important, very important", and the corresponding score are 1, 2, 3, 4 and 5 points. Through expert scoring, we draw students' psychological quality index score, which are shown in Table 71.1.

**Table 71.1** Psychological quality index analysis

Factor	Score	Factor	Score	Factor	Score
Confidence	4.26	Decisiveness	3.60	Keen on information	4.23
Independence	4.19	Writing	3.57	Perseverance	4.21
Self-evaluation	4.02	Professional ethics	4.10	Observation	4.19
Self-respect	4.00	Integrity	4.02	Initiative	3.89
Self-dignified	3.99	Responsibility	3.95	Awareness of competition	3.81
Self-motivated	3.80	Self-disciplined	3.84	Prediction	3.72
Emotional control	3.75	Knowing right and wrong	3.72	Glamour	3.69
Sense and emotion	3.71	Awareness of crisis	3.33	Leading	3.40
Positive attitude	4.22	Self-taught	4.20	Control	3.38
Confidence		Innovation	3.95	Expression	3.97
Independence		Analysis	3.92	Socializing	3.93
Self-evaluation		Idea	3.87	Adaption	3.86
Self-respect		Comprehension	3.84	Handling affairs	3.70
Self-dignified		Insight	3.81	Coordination	3.60
Self-motivated		Logicity	3.79	Planning	3.42
Emotional control		Executive force	3.73	Management	3.30
Sense and emotion		Practice	3.68	Organizing	3.53
Positive attitude		Organizing	3.62	Teamwork spirit	4.18

**Table 71.2** College students' psychological quality indexes explained variance sum

	Initial eigenvalues			Extraction of square load		
	Total	Variance (%)	Cumulative variance (%)	Total	Variance (%)	Cumulative variance (%)
1	20.152	49.516	49.516	23.152	47.516	48.516
2	7.384	14.010	63.526	9.384	15.020	56.526
3	5.173	9.863	73.389	4.173	8.873	74.389
4	3.048	6.341	79.730	4.048	7.351	69.740
5	2.730	4.986	84.716	5.739	7.986	74.716
<i>Rotating square load</i>						
1	9.762	30.021	30.021			
2	5.811	21.14	51.161			
3	5.019	12.981	64.142			
4	0.698	10.942	75.084			
5	3.013	8.997	84.081			



**Fig. 71.2** The variance sum of students' psychological quality index factors

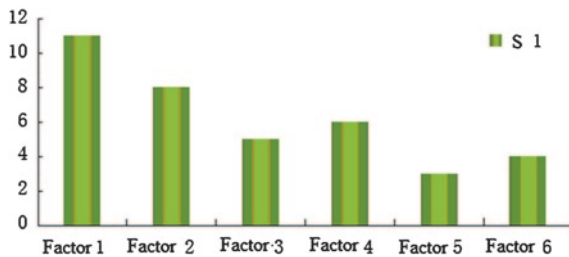
### 71.4 Research Methods and Data Analysis

Analysis of correlation coefficients (CITC) by SPSS analysis software on students' psychological quality indicators for the overall project has removed some irrelevant factors; a KMO = 0.911 (larger than the standard 0.5), Cronbach's  $\alpha$  0.976, with an excellent letter degrees. The Chi-square value (Bartlett test) and 4312.529 is zero compared to the index factors derived from observations of the significance, so the factor analysis can be used for data analysis [8] (Fig. 71.2).

As is shown in Table 71.2, the first factor's eigenvalue is 9.762, accounting for 30.021 % of the total variance. And 1–6 factor account for 91.593 % of the total variance of the eigenvalue (greater than 60 % of the standard). Remove the factor of only a few per cent of the explained variance, so the students' psychological

**Table 71.3** Psychological quality indicators after the rotated factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
X21 0.879	X36 0.810	X34 0.873	X5 0.915	X2 0.874	X14 0.902
X22 0.856	X12 0.781	X35 0.861	X4 0.804	X1 0.851	X11 0.716
X26 0.801	X16 0.737	X37 0.721	X8 0.719	X6 0.730	X30 0.682
X20 0.791	X15 0.712	X33 0.579	X3 0.656		X19 0.571
X24 0.783	X13 0.683	X18 0.476	X9 0.599		
X29 0.759	X16 0.645		X7 0.537		
X28 0.737	X32 0.629				
X25 0.727	X31 0.603				
X23 0.694					
X27 0.681					
X10 0.632					



**Fig. 71.3** Psychological quality indicators after the rotated factors

quality indicators only taking six factors would be sufficient. The variance of the cumulative contribution rate retain their values before and after factor rotation.

Table 71.3 is obtained by the maximum variance or the rotation method with rotated factor loading matrix to get the final six factors, namely personality, adaptability, self-control, skill, interpersonal skills, and self-improvement capability (Fig. 71.3).

### 71.5 Conclusion

Social competition is very fierce, and under the great pressure, the students should adopt an appropriate way to make self-psychological adjustment for their own psychological problems from six aspects: psychological quality of character, adaptability, self-control, skill, interpersonal interaction ability, and self-improvement. Self-management is the most effective way and means for the psychological adjustment of college students. The psychological adjustment of college students is not a simple matter, but a comprehensive and systematic process, and it requires self-planning, self-regulation and self-evaluation to

finish the gradual implementation. Society, universities and families should give more guidance for college students; give full play to college students own sense of self-management, so that they can guide them to deal with mental illness and bad mood. Then they can continue to enhance and integrate into society, so that there are able to have healthy psychology and actively carry out independent learning, and constantly improve themselves and improve their core competitiveness, so as to get a better place in society.

**Acknowledgments** This work is supported by two programs. One is the program Research on the role of father's influence on child's mental development, funded by 2010 Hebei planning projects of social science (No. HB10VJYD22). And the other is the program Research on the role of father in adolescents' psychological health effects, funded by 2011 Hebei provincial "Twelfth Five-Year Plan" special subject of education and science (No. 11080019).

## References

1. Lei P (2007) Research on the students' self-management principles. *Basic Educ* 11:77–79
2. Wang Y (2002) Self-management research. *Psychol Sci* 25(4):453–464
3. Rosa Say. 12 rules for self-management [EB/OL]. [2011-10-06]. [www.lifehack.org/articles/lifestyle/12-rules-for-self-management.html](http://www.lifehack.org/articles/lifestyle/12-rules-for-self-management.html)
4. Zhixian Z (2010) Instructional design framework for the knowledge age: the promotion of learner development, vol 4. China Social Sciences Press, Beijing
5. Timm PR (2003) Translator Han Jinglun, successful self-management, vol 4(4). Economic Management Press, Beijing, pp 199–204
6. Ma J (2009) Counselling life: counseling learning, vol 12(3). Education Press, Shandong, pp 48–53
7. Xi T, Cheng C (2010) Contemporary Chinese students' psychology and education. Shanghai Education Press, Shanghai
8. Fumin F (2007) Mental health and development, vol 1. Tsinghua University Press, Beijing, pp 33–35

# Chapter 72

## Study on Cooperative Learning Teaching Mode in University Tennis Teaching

Nian Tang and Peng Li

**Abstract** The teaching reform in physical education curriculum not only requires advanced theoretical guidance, but also requires successful experiences as a support. Therefore, based on common college tennis teaching practice, we dialectically absorb the previous existing cooperative learning research results and analyze the theoretical basis and advantages of the cooperative learning teaching mode and experimental research is conducted in practical teaching so as to release the long-standing shackles of traditional teaching mode on students' emotional culture and creative thinking to further explore the impact of this mode on the student achievement, interest in learning, attitudes, group cohesion, ability to cooperate and analyze problems, etc. to serve as a reference for the reform of China's physical teaching mode to further perfect and enrich the physical teaching theories and practices to promote sustained, healthy and effective development of the physical education.

**Keywords** Sport • Tennis teaching • Cooperative leaning

### 72.1 Introduction

There are connections and differences between tennis teaching and other sports. The tennis teaching has its own unique sport characteristics and technical requirements [1]. The doubles and team projects in tennis sports are helpful for cultivating the students' collaboration sense and collective spirit, providing possible theories and preconditions for applying cooperative teaching mode in teaching. As a new teaching mode, at present, there have been studies on how to apply it in basketball, volleyball, aerobics, dancesport, swimming and table tennis [2]. However, there are very few studies on how to apply it in tennis teaching. The

---

N. Tang (✉) · P. Li  
Sports Institute, Huzhou Teachers College, Huzhou, China  
e-mail: tangnian1233@163.com

existing studies have shown that, compared to the traditional teaching mode, the cooperative teaching mode is not only able to well compensate the defect of knowledge unilaterally imparted to students by teachers and passively accepted by students but also more focus on the interaction between the students. It is helpful for building three-dimensional teaching structure in which not only teaches interact with students but also students can interact with students to apply this new mode in classroom teaching [3]. Therefore, in the cooperative tennis classroom teaching, the teacher is not the only information source any longer. This new mode enables students to guide each other, judge each other, teach mutually and learn from each other. Thus, in the classroom, the students become the director promoter and consultant while the teacher plays in the role of direction, stimulating the motivation, assessment and promotion. Practice has proved that: different from the traditional teaching mode in which the teacher is absolutely authorized, this new mode is not only more helpful for stimulating intrinsic learning motivation in students, making students take more initiative to explore knowledge and skills, strengthen team spirit and set up the belief of life-long study but also enables sports workers reasonably change the methods of teaching and learning so as to prevent any student from leaving behind and achieve the purpose of obtaining great teaching effectiveness [4].

Based on common college tennis teaching practice, by dialectically absorbing the previous existing cooperative learning research results, this essay analyzes the theoretical basis and advantages of the cooperative learning teaching mode [5]. Experimental research is conducted in practical teaching to explore the practical value of the application of this new mode in tennis teaching mainly from the perspective of the impact of this mode on the group cohesion and cooperation ability. This study is to serve as a reference for the reform of China's physical teaching mode to further perfect and enrich the physical teaching theories and practices to promote sustained, healthy and effective development of the physical education.

## **72.2 Impact of Cooperative Learning on Results of Learning Tennis Technique**

The tennis learning mainly refers to tennis technique learning and tennis theory knowledge learning. Tennis technique learning means a process to search, imitate and obtain tennis sports knowledge useful for the learner in the tennis classroom teaching environment and digest and absorb and incorporate it into the learners' sports technique orbit thereby enhance their tennis sports ability. In this study, the tennis technique learning mainly refers to the forehand technique while the tennis theory knowledge learning mainly refers to explanations, views and understandings of various theories about forehand techniques.

Scores on tennis techniques obtained by students in the experimental class in which cooperative learning mode is applied are different significantly ( $p \leq 0.01$ )

from that obtained by the students in the control class in which traditional teaching mode is applied. The reasons are analyzed as follows. Why? I think, its reasons are as follows:

### ***72.2.1 Collective Goal-Oriented Motivation***

Collective goal as a orientation means that in a cooperative learning class, the learners are able to and willing to follow the awareness and behaviors to strive for the final learning goals of the entire class. The collective goal-oriented motivation makes a person have a definite goal and learning awareness. To increase the group scores as a goal, every person in the group does not only be very strict with their own learning but also like to help others and make efforts to contribute to the group. This forms a virtuous circle. Therefore, personal achievement has been naturally improved.

### ***72.2.2 Roles of Knowledge Sharing and Active Cooperation***

Knowledge sharing means sharing or use the knowledge together. In the experimental class in which the cooperative learning mode of tennis teaching is used, the knowledge sharing and active cooperation require students to communicate fully with each other, use and share the tennis knowledge, techniques and cultures they have learned and even the field equipments. The sharing and use of the tennis knowledge together by the students makes it possible to share the sharing of the tennis techniques, facilities, equipments, etc., not only enriching to the greatest extent the tennis learning resources and the perspectives of the problems but also enabling the students to share to the greatest extent all the resources required in the tennis learning and thus, promoting the learning.

### ***72.2.3 Informal Tennis Monitoring Effect in Cooperative Learning***

Informal tennis monitoring effect means in the cooperative learning of the tennis techniques, informal monitoring, supervision and management between students at the learning site or some special link and process so as to make the learning outcomes reach the targeted goals. By experiment, I have observed that, the elements constituting this informal monitoring network mainly include language supervision, technique comparison and technique correction. In the language supervision, students usually encourage each other with, such as, saying 'come on' in practice. In terms of technique comparison, students often say 'Look, I just do it



like that'. In terms of technique correction, students usually use short sentences to remind of the learners. For example, when learning the forehand swing technique, the students who have mastered this motion may shout to the ones who have not mastered it "Swing the hand to the ear". In the process of cooperative learning of tennis, the students in the experiment class communicate with each other while playing a role in learning monitoring. This monitoring effectively has prevented such "pseudo-cooperation" phenomena as passive learning, desert and unable to concentrate in tennis class and has increased the efficiency of learning tennis.

### ***72.2.4 Positive Role of the Technique Leaders***

The technique leaders mean the ones who are able to master the techniques learned in the tennis learning firstly and have the ability and quality to positively guide and help other learners to learn. In the tennis class, the technique leaders usually are learning activists, active students in class, enthusiastic students and students take the lead. In the traditional technique teaching, teacher demonstrates the technique motion to the students before the students practice and mainly by feedback of the teacher. Therefore, the ratio of the teacher and the students is 1:30. Thus, the teacher is unable to teach every student personally. Many students are unable to absorb 100 % of the contents the teacher impairs and complete 100 % of the task arranged by the teacher. In the experiment class in which the cooperative learning mode is implemented, what the teacher faces is a group and makes full uses of the wisdom of the group members. This requires there is a reliable 'technique leader' who is able to master the motions the teacher demonstrates firstly and has the ability and quality to guide and help other members to learn in every group. The technique leader plays a role in ensuring definite tasks are assigned to every group and each group helps each other complete the learning tasks. In this way, the ratio of the teacher and students is 1:6. This helps effectively to solve the problem that teacher is unable to teach each student in person.

### ***72.2.5 Cooperative Learning can Make Full Use of the Teaching Space and Time***

As all knows, in most of China's colleges and universities, a problem tennis teaching commonly faces is high-enthusiastic students, insufficient venues and insufficient teaching time. Take this study as example, in every semester, there are 30 students per tennis elective class while only 3 pieces of venues are available of teaching use. Thus, a problem in teaching that only about 8 or 9 students are playing tennis and other 22 or 21 students are waiting beside arises. This teaching environment extremely tests the organization capacity of the tennis teachers. The in cooperative

learning mode, every group is a practice unit, in which, every member has his own definite tasks. Although it is not the turn for a member to play tennis, he also helps others to correct the motions, thus, he increases his understandings about the tennis techniques, which greatly reduces the time wasted in changing students to play tennis during which no one play tennis. Meanwhile, it is also a learning process for the students observe the batting process by his companions. The observer must image the correct motion before he makes accurate and careful judgements.

Theory is the systematic summary about the natural and society knowledge summed up by the people from the practice. The tennis theory is the abstract, general and systematic statements and explanations about tennis, such as forehand swing technique, backhand swing techniques, serve technique, smash technique, etc.

At the end of experimental teaching, the students are tested in terms of the basis tennis theory knowledge and motion tips and other relevant knowledge, which has shown that, the students in the experimental class not only master the theory knowledge better than the ones in the control class do but also understand the tennis as a sport more completely and profoundly significantly, especially, much more quickly understand the movement principle of the tennis technique motions and master the applications of the techniques. In the same time period, the students in the experimental class more accurately master the motions and complete the motions in higher quality than the ones in the control class. In the tennis technique learning, the master of the techniques may also reflect in the understanding of the theory knowledge of the tennis techniques, such as some basic sports bio-mechanics principles. The master of the theory knowledge by the students in the experimental class in which cooperative learning mode is applied is also different significantly ( $p \leq 0.01$ ) from that by the students in the control class in which traditional teaching mode is applied.

In colleges in China, the master of the theory knowledge by general students is not the key content in the physical teaching practice. However, practices have shown that mastering certain theory knowledge is helpful and meaningful for technique learning. In cooperative learning, students are required to share learning information together to the greatest extent, including naturally the sharing of the theory knowledge. Although teacher unnecessarily focuses on the imparting of the theory knowledge in teaching, by cooperative learning, once some student sums up some elements, characteristics, natures and laws in learning the tennis techniques, this will be inevitably provide some help for cooperation learning team to learn techniques.

### **72.3 Impact of Cooperative Learning on Interpersonal Skills**

Generally, interpersonal skills, also known as interpersonal communications, refer to a process in which individuals convey some information to other individuals by language, text or physical movements, facial expressions and other means.

Usually, interpersonal communications rely on the following conditions: (1) The one who convey the information and the one who receive the information understand the information consistently. (2) There is information feedback timely during the communication process. (3) Adequate communication channel or communication networks. (4) Certain communication skills and communication willing. Interpersonal skills are the necessary skills for the college students to meet the needs of the social development. It is very important to improve the interpersonal skills of the modern college students.

The cultivation of the interpersonal skills of college students is mainly achieved through such two aspects as learning knowledge on interpersonal skills and cultivating interpersonal skills. The knowledge on interpersonal skills mainly includes the interpersonal psychology knowledge and social etiquette knowledge imparted in class and learned after class. Cultivating interpersonal skills is realized mainly by the following ways: consulting individuals and groups of college students, strengthening the construction of the class as a collective, strengthening the construction of the dormitory cultures, guiding the activities of student societies.

In terms of cultivating the interpersonal skills of college students, tennis class is also an important way to cultivate the interpersonal skills of college students. As a curriculum, the special learning atmospheres created by the uniqueness of the tennis sports is also helpful for cultivating the interpersonal skills of college students. In this study, interpersonal skills mainly refer to such five aspects between students as active exchanges, adequate refusal, self-disclosure, conflict management and emotional support.

Firstly, the learning of the concept of cooperative learning is promoted by interpersonal communications in teaching. Therefore, cooperative learning is helpful for promote the interpersonal skills of the college students. Different from the traditional teaching class in which competition plays an essential role in the classroom. Others' success means the failure of themselves, as they may think. Thus, the students who get high grades study very hard and are afraid of being exceeded by others while those students who are poor in study are very keen to be concerned about. But it turns to be counterproductive usually. Serious polarization exists in terms of both achievements and psychology. But the evaluation in the cooperative learning is based on a group as a unit. So the phenomena discussed above do not exist in cooperative learning, because in a group, a person's success is not a real success. Only all the members in a group work together can best achievements be achieved.

Exactly because the interpersonal skills between students have been improved, students can help each other, learn from each other and share resources together. Thus, not only a good learning atmosphere is created but also the personal achievements have been improved indirectly. After the experiment, the students in the experimental class do not only have cooperation awareness and behaviors in class, but also support each other and cooperate mutually in the discussion of problems, learning and work after class. They continue to follow the spirit and essence of cooperative learning and apply them, which achieves good results among students.

Members in a group reestablish new relationships and feelings mutually and created a harmonious cooperation atmosphere during the process of mutual understanding and mutual help. Thus, they gradually apply this to all aspects of the life. It is good for the development of both themselves and others.

## 72.4 Impact of Cooperative Learning on Group Cohesion

Group cohesion means the attractiveness and solidarity of the group to every member and the degree and strength of mutual relying, mutual coordination and mutual solidarity between group members.

View of constructivist is that learning is a constructive process by internalization, reorganization, operation and active exchanges of each student in his own different knowledge world. This has shown the dominant position of the students in the learning activities. Therefore, the teacher shall fully set up in teaching educational idea of “Student-Centered” and actively carry out the teaching concept of extracurricular cooperative learning.

Organize cooperative learning after class. Then, students gradually may look the extracurricular cooperative learning group as his own control collective. Some group (such as extracurricular cooperative learning group) usually enables a student to be off other groups (such as street gangs) after it becomes a student’s control group and his corresponding values. Therefore, an extracurricular learning group under a teacher’s careful guidance enables to concentrate a student’s attentions on learning and promote the student’s learning both in class and in extracurricular more effectively.

The effects of the students’ cooperative learning in class can not be fully reflected due to time and space limitations of the cooperative learning in class. Therefore, shall adequately carry out extracurricular cooperative learning to compensate and promote the cooperative learning in class based on the cooperative learning in class.

Extracurricular cooperative learning may be carried out upon the completion of the cooperative learning in class. As the expansion and extension of the cooperative learning, the extracurricular cooperative learning may further improve the effects and quality of the students in their cooperative learning. Therefore, introduce the cooperative learning to extracurricular after the cooperative learning in class has obtained certain effects. Guide the students to adequately establish extracurricular learning group, develop cooperative learning tasks and correspondingly evaluate the cooperative learning of the students and provide feedback information timely so as to make the extracurricular cooperative learning activities carried out more effectively.

To establish extracurricular cooperative learning mode is valuable and meaningful practically to students. Extracurricular cooperative learning is to make the students cooperate to learn together the tasks they have not completed in class or a new task. The extracurricular cooperative learning has created an open

extracurricular tennis learning environment in which students are able to arrange independently and which is suitable for students to participate in. Thus, the students' learning tennis space gradually extends outward from class to extracurricular. Therefore, extracurricular cooperative learning is the compensation and extension of the cooperative learning in class. The two are interrelated and mutual penetrated and they are one.

## 72.5 Conclusion

The teaching reform in physical education curriculum not only requires advanced theoretical guidance, but also requires successful experiences as a support. Therefore, based on common college tennis teaching practice, we dialectically absorb the previous existing cooperative learning research results and analyze the theoretical basis and advantages of the cooperative learning teaching mode and experimental research is conducted in practical teaching so as to release the long-standing shackles of traditional teaching mode on students' emotional culture and creative thinking to further explore the impact of this mode on the student achievement, interest in learning, attitudes, group cohesion, ability to cooperate and analyze problems, etc. to serve as a reference for the reform of China's physical teaching mode to further perfect and enrich the physical teaching theories and practices to promote sustained, healthy and effective development of the physical education.

## References

1. Tan W (2009) Cooperative learning theories and implementations, vol 7. China Personnel Publishing House, Beijing, pp 22–28
2. Zhenyin X, Ronghua S (2008) Moral educational significance of cooperative learning. *Shandong Education Res* 4:9–15
3. Peirui C (2009) Cooperative learning: the royal road heading for a new century—on research on and experiments of cooperative learning. *Shandong Education Res* 3:49–53
4. Zonghu Q, Wenxuan Y (2007) Modern society and school sports, vol 8. People's Sports Publishing House, Beijing, pp 39–42
5. Sliven R, Hongyu W (2010) Cooperative learning and student achievements: six theoretical perspectives (trans). *Foreign Education Data* 1:33–39

# Chapter 73

## Application of Heuristic Teaching Method in Art Education

Wei Wei

**Abstract** The paper starts from the point of the requirements of art education development, analyzes and discusses how to implement modern art ideas in art teaching process, applies effective heuristic teaching method to open the creative inspiration of students and cultivate their creative ability and achieve the educational purpose of forming perfect personality. The heuristic teaching method in art education varies from person to person, and therefore, it also the teaching method varying with different cultures. It is good to solve the contradiction of generality and particularity of art education, the art education can take into account the pluralistic characteristics of nations and cultures when implementing the fundamental principle of education, it can also consider the characteristics of the traditional culture and teach students in accordance with their aptitude, adopt different treatments in education according to the culture differences, so as to complete the teaching task of art education excellently.

**Keywords** Application • Heuristic teaching • Method • Art education

### 73.1 Introduction

As an important part of quality-oriented education, the art education plays an important role in the realization of quality-oriented education [1]. The art education injects the art nutrition into in the basic qualities of all the people, and these nutrients will benefit the lifelong development no matter what occupation it is. This is the ultimate goal of art education. As an important part of art education, the art education cultivates people's aesthetic sense and has a unique

---

W. Wei (✉)

Art Institute, Xinxiang University, Xinxiang, China  
e-mail: weiwei1233211@163.com

impact on image thinking skills, as well as the art creative ability and perfect personality [2, 3]. “It takes 10 years to grow a tree and a 100 years to bring up a generation of good men”, it cultivates the observation ability and practical ability of the students through art education training [4]. The education has a wide range of professional courses, both Western painting and Chinese painting, both practical and theoretical, from process art to education internship and folk art and others are compulsory. The purpose of broad learning content is to make the normal school students to fully master the art knowledge and skills, so as to be proficient in the art teaching method and qualified for the art teaching work. In current multicultural era, the art education emphasizes on multicultural learning and pay more attention to the learning and research on local ethnic, folk culture and folk art at the same time. Therefore, we should vary from person to person and teach students in accordance to their aptitude in the art teaching [5, 6]. The heuristic teaching method can perfectly apply the personality and learning interest of students, so as to train their art imagination and creative ability. Improve the aesthetic taste and form the perfect personality and other art education purposes. The art teaching seeks “intelligence”. The intelligence stresses to explore the potential and wisdom of the students. The art education is not just skillful, aesthetic, imaginable and creative, and it should be concerned about the students’ personality completion and the comprehensive upgrading of human quality. The art teacher should apply effective methods in the perceptual process to guide students to observe things and promote mentality, that means to use the image to develop the field of known and unknown, so as to organize the experience as a creative product, the experience should be regarded as an active intelligent integral, so as to develop the intelligence when cultivating aesthetic feeling.

As a teaching method varies from person to person and teaching students in accordance with their aptitude, the heuristic teaching can greatly lead the students’ multidirectional thinking skills, and also the teaching method training the students’ creative spirit and aesthetic taste to meet the requirements of the art education development. The word “inspiration” derives from “The Analects of Confucius”: “the tutor should not to enlighten the student, until he has turn the problem over in his mind and arrive a level of obtaining some thoughts, but can not speak out the standard answer”. The heuristic teaching method is a teaching method that teacher guides the students to think actively and develop the wisdom of students. This kind of teaching is fundamentally against the “chalk and talk”. Its basic spirit is to fully stimulate the students’ intrinsic motivation of learning and mobilize the students’ learning initiative and enthusiasm, so as to promote their positive thinking; and this method always encourage the students to think, observe and act to acquire knowledge by themselves. It explains the process of teaching and learning as the interaction of teacher and students, it’s the contradictions and reunification process of knowledge mastery and ability development. The dialectical relationship between the law “stimulate” and “produce” in the heuristic teaching is the effect relationship, the “stimulate” is the prerequisite and condition of “produce”, and “produce” is the development

and results of “stimulate”. To make students both “stimulate” and “produce”, it’s necessary for teacher to successfully “stimulate”.

## 73.2 Inspiration of Creative Thinking and Creative Ability

Innovation is the core spirit of the art education, and the importance of art is innovation. The art disciplines has a unique effect in training the students’ create awareness and on the cultivation of creative thinking and development promotion of the students’ creative ability. The cultivation of creative ability should emphasize on the creative thinking firstly. Arey, an American psychologists, have pointed out that the creation starts from illogical, and then polishes and integrates by logic and ultimately transcends the logic. That is to reach the “reasonable” from the “unexpected” through rational creative. Yin Shaochun pointed out that in the beginning of creation, the first thing is to transcend the logic restriction and regular thinking method consciously, in order to obtain more possibilities to produce many new and unique thinking. The creative thinking runs through the process of the discovering and solving new problems. Through learning the performance techniques, cultivate the creative thinking of students, and respecting and training the individuality of students is the basis of inspiring creative spirit and creative ability. The art is a product of personality, its approach is divergent, and there will be no art life if there is no personality. Even if the same images, there are great differences in a different painter’s brush. The person is not limitable, the education can not limit people, only to guide it to comprehensively, freely, positively generate. In the art learning, the teacher should be good at discovering the unique personality of each students, carry out the teaching according to their personality differences, and promote the development of personality. It is also the basis of creative spirit and creative ability. “If the human potential and difference are respected, the methods of self-creation are certainly various”, the famous contemporary American philosopher Morris said. The teaching model of synchronization, routinization, standardization and collectivization in school is not conducive to the discovery and development of students’ personality. The most important element of art is not only common, as well as personality. Therefore, attach the importance to things cannot known and seen by all of us, but the things you can feel and experience, and encourage the students to visualize the personalized things. Art practice is an important factor for personality development.

For example: when learning laborate-style painting, many students have learned the traditional delineation method, but a lot of students think that the traditional delineation in traditional Chinese painting can only be showed by rice paper and paintbrush without further consideration, while in my class, I inspire the students to show the traditional delineation on black card paper by gold, silver light pen for painting. This method can unconsciously cultivate the students of the concept and awareness of expressing and emphasizing the personality, as well as creative realization.



### 73.3 Aesthetic Inspiration

The art education completes the aesthetic education mainly through appreciation and creative teaching. Eighty percent of information comes from the visual senses, and the art education is the most directly stimulated from the sensory. The developments of aesthetic capabilities, the shaping of aesthetic realm, the soul cultivation have a role in the improvement and development of learners' intelligence structure and will structure.

The inspiration of aesthetic taste; beauty is hidden in all aspects of human real life, the colorful nature is also the cradle of human aesthetic, if a person without knowing the beauty in real life, he can not correctly aware and understand the artistic beauty, educating and training the students to observe and discover the beautiful thing in real life is the most original power to carry out beauty creation. Therefore, the primary task of art class is to train the students' abilities and habits to observe the life and let the students to experience and creatively express the beauty in our life when observing. For the students having different habits, thinking characteristics, aesthetic taste in different nationalities, we should also apply different aesthetic inspirations: inspire Ewenki students to absorb nutrients from the culture of Shamanism; inspire Mongolian students to absorb nutrients from nomadic culture, inspire Oroqen students to absorb nutrients from the culture of hunting, and so on.

The inspiration of aesthetic ability; inspire and guide the students to experience, identify, determine the aesthetic ability, it is an important part to improve the heuristic education. The current features of aesthetic education are that the goal of aesthetic education has developed from training the students' ability to observe, feel and understand the artistic beauty to training the students' ability to create beauty. The ways and means of aesthetic education are also very rich, and the traditional aesthetic often limits to art appreciation and edification. While in our modern society, the field of aesthetic education is more extensive than ever before. The natural landscape, environment decoration and clothing matching are closely linked with the aesthetic, so it's important to improve the aesthetic quality through art teaching.

The aesthetic education is an important part of moral education; the depth of art education and gradual forming of aesthetic feeling have more in-depth beauty experience, and produce emotional experience according to individual needs. These feelings also regulate the human mental process and express their feelings. No matter what kind of students, their materials have beautiful colors and lively shapes, how can they help cheering? This will produce a happy and relaxed classroom atmosphere, and the aesthetic feeling would straightly pop out from the heart instantly! Aesthetic education not only trains students to find the beauty and to create beauty, and the aesthetic feeling has closely link with moral and ration. The principles of beauty, i.e., truth, goodness, beauty, these three factors are a unified integral. The correspondence of art and moral people usually said emphasizes the correspondence of ideological and psychological quality and the art level.

Only training the high integrity of students can produce truly beautiful art. And the appeals of the aesthetic feeling also adjust and balance the person's mental process to form a sound psychology.

### **73.4 Inspiration of Practice Ability**

Guide the students to improve their observation, thinking and operating abilities through the practice and bravely expression process, train the students' coordination use of eyes, brain and hands. In my daily teaching, I always encourage the students to participate in a variety of art practice. For example: a simple black-board design, dance posters, holiday beautification for school, dormitory and classroom, etc., these activities can improve the students' practical ability.

Art learning is both mental and manual activity, and it achieves the learning objectives through applying the eyes, brain, and hands. The uniqueness of art disciplines decides the particularity of art teaching, and it also decides the learning process of art should be distinguished from other disciplines.

Visual art education should guide the students to look with heart, look as much as possible, look as carefully as possible, and this is also the most basic method to train the sensibility of students. Art learning needs many appreciations, stresses and performs the feeling. For example, in the bust sketching class, inspire the students to accurately present the character modeling features, we should firstly require the students to quietly observe its characteristics for a moment without starting drawing, do not indoctrinate the figure painting, while emphasize the cultivation of students' keen capture capabilities to the object characteristics.

Emphasize the participation and operation and the diversification of teaching content, which helps to train the students' knowledge migration and innovative thinking. With the wide range of art teaching curriculum, under the guidance of the teacher, the techniques, creation, traditional painting, folk art, practical art, painting, comics, cartoons learning of students allow them become better at learning and also full of creative ability. Therefore, rich and diverse art teaching contents comply with the social needs of rapid development, and also meet the needs of individual physical and mental development of students.

### **73.5 Inspiration of Imagination**

Art learning and art creation are inseparable from imagination, and the imagination even closely associates with the whole process of the art learning. Even drawing a sketch, pencil sketch or color sketch, it always first imagines the desired effect in the mind, and then gradually draws towards the intended effect. Chinese painting stresses the "well-thought-out plan", that is the idea imagination before drawing. Without the participation of imagination, the art learning can not be carried out.

The cultivation, exploration and application of imagination are most important and the most basic in art education. In art education, through the flexible use of the various discipline knowledge, carry out inquiry and integrated art activities, consciously dig and cultivate the imagination of students to achieve good teaching results. En Tianzhang pointed out that in the education, we should nurture the creative thinking of students in the thinking order of association—imagination—creation. In art teaching, encourage the students to think, deliberate, create, and take measures to protect the spark of imagination.

### **73.6 Inspiration of Interest**

Interest is the best teacher. The teacher should give full play to the charm of art disciplines in art teaching, so as to attract and inspire the learning interest of students to mobilize their enthusiasm for learning, and this is the crucial point to the result of the entire teaching. The Chinese saying said, “He who knows the truth is not equal to him who loves it, and he who loves it is not equal to him who delights in it”. The interest is the psychological factor, the emergence of interest inspires the students to recognize the things around and participate in related activities. When Xu Beihong was a child, he saw the “peep show” (the animated toys introduced from Western) and aroused the interest of art; in the childhood of painter Titian in Renaissance Period, he unconsciously took the juice to draw a Virgin Mary, his father found his talent in drawing and then sent him to Venice to study painting. Such a accidental motive or interest has become the beginning of a painter. Therefore, if the internal motivation works, its interest would be raised to produce the impulsive effect. The art education is a visualized, entertaining, lively aesthetic education, in order to achieve the teaching purpose and make students like art class, so as to play the endless charm of art disciplines in the education process, the education should focus on the flexible application and teaching student with different methods in accordance with their aptitude and mobilizing their enthusiasm for learning.

### **73.7 Conclusion**

The paper starts from the point of the requirements of art education development, analyzes and discusses how to implement modern art ideas in art teaching process, applies effective heuristic teaching method to open the creative inspiration of students and cultivate their creative ability and achieve the educational purpose of forming perfect personality. The heuristic teaching method in art education varies from person to person, and therefore, it also the teaching method varying with different cultures. It is good to solve the contradiction of generality and particularity of art education, the art education can take into account the pluralistic

characteristics of nations and cultures when implementing the fundamental principle of education, it can also consider the characteristics of the traditional culture and teach students in accordance with their aptitude, adopt different treatments in education according to the culture differences, so as to complete the teaching task of art education excellently.

## References

1. Mingtai C (2009) Art education, vol 12. Heilongjiang Press, Heilongjiang, pp 1–7
2. Tingyu W, Ling H (2008) Painting art education, vol 30. People's Publishing House, Puyallup, pp 88–94
3. Zhipu H, Min J (2007) Art education, vol 10. People's Publishing House, Puyallup, pp 124–130
4. Suritai E (2007) Research on Ewenki folk art, vol 22. Inner Mongolia Cultural Press, Huhhot, pp 49–54
5. Suritai E (2007) History of Mongolian art, vol 7. Inner Mongolia Cultural Press, Huhhot, pp 10–18
6. Hongjian W (2008) Introduction to art, vol 3. Culture and Art Publishing House, Beijing, pp 9–13

# Chapter 74

## Research on Further Education of Teachers in Middle School

Guomin Li and Ruihong Wu

**Abstract** By making analysis towards the current situation of the further education of the middle school teachers in Hengshui of Hebei province, this chapter finds out the problems and puts forward the suggestions so as to improve the gym teacher resources, accelerate the development of the teaching quality, and enhance the cultivation quality for the students.

**Keywords** Middle schools of Hengshui • Gym teachers • Further education • Current situation

### 74.1 Introduction

The ultimate purpose of the further education of the middle school gym teachers is to improve the comprehensive quality of the gym teachers, including ideological and political aspects, professional ethics aspects, professional knowledge and skills, humanities, etc. By making analysis towards the current situation of the further education of the middle school teachers in Hengshui of Hebei province, this chapter finds out the problems and puts forward the suggestions so as to improve the gym teacher resources, accelerate the development of the teaching quality, and enhance the cultivation quality for the students.

### 74.2 Research Object and Method

#### 74.2.1 Research Object

The middle school gym teachers of Hengshui.

---

G. Li (✉) · R. Wu

Physical Education Department, Hengshui College, Hengshui, China  
e-mail: blakehorse83@163.com

## **74.2.2 Research Method**

### **74.2.2.1 Documentary Analysis Method**

Read various monographs and documents related to education, further education, life-long education, etc.; collect the material related to the implementation status and course offering of further education.

### **74.2.2.2 Questionnaire Method**

According to the research purpose and contents, consult the relevant experts and coaches; design the questionnaire aiming at the middle school gym teachers; issue 200 questionnaires, retrieve 176, with 154 effective questionnaires, the effective rate reaching 87.5 %.

### **74.2.2.3 Mathematical Statistics Method**

Analyze the available data in detail and make the conclusion by applying the excel 2003 to establish data base.

## **74.3 Results and Analysis**

### ***74.3.1 Gym Teachers' Cognition of the Further Education and Motivation Analysis of Participating in Further Education***

The gym teachers' attitude towards the further education has impact on the effect of the education to some extent. From Table 74.1, it can be seen that 20 % respondents believe the further education is quite helpful to their jobs, 55 % helpful, 14 % less helpful, 12 % helpless, and 4 % unclear. From Table 74.2, the purposes of 28 % gym teachers' participating in further education are job title and promotion; the reason for 23 % teachers' taking part in further education is that the schools requires them to participate in it; 17 % teachers hope they can achieve improvement in education and teaching proficiency; 15 % teachers hopes to continuously improve themselves by further education; only 11 % hope to improve their theory level by further education. In addition, from the above data, it shows that the gym teachers lack subjective cognition towards the further education. A great majority of middle school gym teachers do not fully realize the value and significance of the further education [1]. Consequently, it leads some teachers to passively cope with the further education so that they waste the scarce further education opportunities and time. On the other

**Table 74.1** Gym teachers' cognition of the further education (n = 154)

	Unclear	Helpless	Less helpful	Helpful	Quite helpful	Sum
N	4	12	21	86	31	154
%	3	8	14	55	20	100

**Table 74.2** Motivation of gym teachers' participating in the further education

	Job title, promotion	Improving level	Self improvement	Improving theory level	School requirements	Others
N	123	73	66	47	98	26
%	28	17	15	11	23	6

hand, the basic-level schools misunderstand the further education. They take it for granted that the gym teachers' participating in the further education will have influence in their teaching work, so they just dispatch some non-backbone gym teachers to serve as a stopgap instead of dispatching teachers to take part in it [2].

### 74.3.2 Time Management of Further Education

As for participating in further education, it takes some time from the teachers to receive such new education. Therefore, it is quite important to reasonably arrange the time of further education [3]. The survey shows that the middle school gym teachers of Hengshui take part in further education mainly in summer and winter vocation, and 13 % teachers receive this education in weekends, only 11 % in their work time. From the interview of the school leaders, they are willing to dispatch the teachers to have the education in winter and summer holiday. On one hand, it can relieve their teaching pressure and ensure that there are sufficient gym teachers to finish the work in the normal teaching. On the other hand, it is a kind of guarantee that the teachers receive the education during a centralized period, for that long-term dispersed learning may make the teachers unable to ensure the continuity of study.

### 74.3.3 Ways of Participating in Further Education

From Table 74.3, as for the ways of participating in further education of middle school gym teachers of Hengshui, the amateur training accounts for 62 %; visiting and having lectures account for 17 % which ranks 2; the partly off-job training accounts for 9 %; only 2 % teachers have remote network education through modern information means. From the above data, the Hengshui gym teachers prefer relatively traditional amateur training as the learning way. The learning leaders and the supervisor department should increase the interaction opportunities

**Table 74.3** Ways of participating in further education

	Off-job training	Partly off-job training	Spare-time training	Visiting, attending lectures	Remote network education	Others
N	123	73	66	47	98	26
%	4	9	62	17	6	2

between the gym teachers and other colleges. Besides, they should utilize more modern teaching means, which can make contribution to new development and breakthrough for the teachers on teaching concept, teaching ways, etc.

### ***74.3.4 Situation Analysis of Course Offering of Further Education***

#### **74.3.4.1 Courses of Further Education**

Through the survey towards the relevant department of further education, it can be known that the existing further education courses include: ideological and political education, education concept and practice of physical courses, sports science knowledge, modern education theory and practice, modern education technology, information technology, teaching method and skills of sports, body and mentality development of students, knowledge of assessment, sports science research knowledge, some subject knowledge related to school gym management, etc. The survey shows that, 7.8 % respondents think that the current course offering is quite reasonable; 21.45 % believe it is reasonable; 36.4 % believe it is just common; 24 % hold it is not quite reasonable; 10.4 % hold it is not reasonable. Moreover, from the above data, more than half teachers are not satisfied with the course offering of the further education. They take it for granted that the offering does not meet their demands and expectation, especially shortage of some practical courses, such as computer application technology, sports skills, health assessment, application and demonstration of teaching methods, etc. Meanwhile, they insist that the course offering does not take the actual situation of middle school sports education into full consideration.

#### **74.3.4.2 Gym Teachers' Demands for the Content of the Further Education**

With the rapid development of science and technology and the progress of the society, the demands towards the teachers become higher and higher. To be a gym teacher with high proficiency, he should enrich and develop himself continuously. From the knowledge to skill, and technology to application, the teachers should continuously study and make progress. The analysis of the survey of the gym teachers in Hengshui turns out that: demands for the professional knowledge and skills, computer operation



and application knowledge, the understanding of new sports items and skills and information, learning and grasping of adjudication rules, understanding of the latest knowledge and relevant information of the sports course rank 1, 2, 3, 4, 5 respectively.

### ***74.3.5 Teaching Method Analysis of Further Education of the Middle School Gym Teachers of Hengshui***

The survey indicates that, as for the current further education, lecture method accounts for 42 %, the integration of giving lectures and practicing 42.9 %, special lecture 15 %, research and discussion 13 %. The main teaching method of further education in Hengshui is to give lectures. The teaching method is relatively single and the systematic teaching is more, which cannot attract people's attention. However, there are fewer ways of the integration of giving lectures and practicing, researching and discussing that people prefer being applied, which leads to less communication and discussion among the teachers and students. Many gym teachers hope that the theory of the classroom lecture is integrated with the reality, so that they can realize the practical value of the theory and arouse others' enthusiasm and initiative of study.

### ***74.3.6 Teaching Level Status of Further Education***

The analysis of the survey shows that: 20.8 % of all teachers hold that the teaching level of the teachers is quite high, 37 % relatively high, 23.4 % ordinary, 11 %, relatively poor, 7.8 % quite poor; 18.2 % hold the teachers' attitude is quite serious, 41.6 % serious, 20.8 % ordinary, 13.6 % relatively poor, 5.8 % quite poor. In general, Hengshui teachers having further education can ensure the accomplishment of the teaching task and relatively good teaching effect. Most teachers' attitude is accepted by the students, but some teachers' attitude towards teaching is not quite serious.

### ***74.3.7 Assessment and Evaluation of Further Education***

#### **74.3.7.1 Assessment Status of Further Education of Middle School Gym Teachers of Hengshui**

There are two kinds of assessment approaches of further education of middle school gym teachers of Hengshui—examination and investigation. Both approaches have their own advantages and disadvantages. Examination has its own advantages. It can comprehensively and systematically check students' learning status, but limit students' personality development. As for the investigation, it can provide free imagination space for the students and create conditions for the individual development of the students. However, it can comprehensively check students' learning effect.

### **74.3.7.2 Expenditure Source of Further Education of Gym Teachers**

The expenditure is the basis and guarantee of launching further education. How much expenditure invested in the education has direct relation with the development scale of the further education. Meanwhile, it is related to the objects of receiving further education and the initiative of the dispatched units or the units of running schools. The survey indicates that 52 % gym teachers receiving further education in Hengshui undertakes the whole expenditure, and the expenditure of 16 % teachers is undertaken by the school, and that the expenditure of 27 % teachers is shared by the individual and the school in certain proportion, and others accounts for 5 %. The reasons are as follows: for one hand, the schools have not conducted the relation between training and introduction well, and they attach great importance to the introduction and less to the cultivation; on the other hand, some schools do not do well in the economic benefit and they lack redundant capital to offer training to the teachers. In a word, the schools and governments should increase the investment of expenditure and gradually establish the training expenditure system undertaken by the three parties—government, school, and individual.

## **74.4 Countermeasures**

### ***74.4.1 Cultivating the Middle School Gym Teachers' Lifelong Learning Concept and Strengthening the Consciousness of Further Education***

It is necessary to integrate the profession characteristics of the teachers during further education and regard improving the teachers' comprehensive quality as the basic starting point of the job. The teachers should take initiative to participate in the various training activities organized by the units or administration institutions. Furthermore, they should formulate the study plans, confirm the endeavor direction and goals, and continuously improve their quality and ability according to their own reality and post requirements.

### ***74.4.2 Constructing Course System with Relatively Strong Practical Applicability***

The content of further education should be broadened and improved on the basis of the original theory of sports education. It is necessary to continuously deepen the study of professional basic theory and knowledge of sports, and make the professional level developed to the depth direction, and integrate the content of further education with the problems encountered during the teaching practice to achieve development and update.

#### ***74.4.3 Improving the Importance Degree of the Gym Teachers' Further Education and Putting the Activity Expenditure into Practice***

The insufficient further education expenditure will have impact on the quality of gym teachers' further education. Therefore, it is necessary to transform the concept and arouse the initiative of various aspects, and collect funding with many channels when increasing the government investment. Meanwhile, they should initiatively strive for the support from the society and government so as to broaden the channel of further education expenditure to meet the expenditure demands of the middle school gym teachers' further education.

#### ***74.4.4 Improving the Teaching Level of Further Education of Middle School Gym Teachers***

Establish a training team of middle school gym teachers with high quality, enhance ethics education, and establish new education concept. Besides, influence the trainees with modern and advanced ideological education. Moreover, establish the concept of new service and take initiative to study on the education problems, so as to make them adapt to the demands of sports career.

#### ***74.4.5 Constructing Scientific and Reasonable Assessment System***

The assessment goal of the middle school gym teachers' further education is to boost and improve the training quality of further education, to improve the gym teachers' comprehensive quality, and to cultivate a gym teacher team with high quality. It is necessary to enhance the consistency of the assessment of further education and teaching work, conduct the relation between study and assessment, study and application, and guide the teachers to attach great importance to the integration of theory and practical application ability.

## **References**

1. Wenfei B, Xu L (2002) Existing problems and improvement approaches of further education of middle school gym teachers of Beijing. *Further Edu* 1:89–94
2. State Education Commission (1991) Opinions on launching further education of primary school teachers, vol 12, pp 47–56
3. Ministry of Education (1999) Provision of further education of primary and secondary school teachers, vol 1, pp 341–347

# Chapter 75

## Research on Sports Consumption of University Students

Guomin Li

**Abstract** This paper has made investigation and research towards the sports consumption status of some university students of Baoding by adopting documentary analysis method and questionnaire method. It turns out that: a great majority of university students are willing to make sports consumption; their sports consumption goal is obvious; the motivation is healthy, as the material consumption is higher than others and the consumption level is relatively lower; the main factors influencing the sports consumption is relatively high consumption price, less consumption places and heavy learning task. The paper has put forward the development countermeasures to accelerate the sports consumption of university students of Baoding and guide them to establish correct sports consumption concept through analysis.

**Keywords** University students • Sports consumption • Status

### 75.1 Introduction

With the continuous deepening of our domestic economic system reform and sustainable rapid development of economy and the improvement of living standards, people's demand for the sports become more and more. The sports consumption has become the important constituent part of modern resident life consumption. The young university students are the main force of the future social development and also one of the main groups of sports consumption. This paper has made research on their consciousness motivation, level structure, sports items and influencing factors towards sports consumption, which is favorable for developing sports consumption markets of our domestic universities and accelerating the continuous deepening of sports reform. This paper has made non-tangible questionnaire survey by randomly selecting 1,000 in-school university students from eight universities in Baoding, so as to realize the current situation of Baoding university students' taking

---

G. Li (✉)

Physical Education Department, Hengshui College, Hengshui, China  
e-mail: blakehorse83@163.com

part in sports consumption and the problems existing in the process of sports consumption, and also discuss the development countermeasures of the behavior. All of these can guide them to make the sports consumption, accelerate the formation of lifelong sports and consumption behavior and the development of the sports consumption markets, especially providing reference basis for how to make commercial development aiming at the university students (a special consumption group).

## **75.2 Research Methods**

### ***75.2.1 Documentary Analysis Method***

It is to consult some research papers, magazines, and scientific research related to sports consumption, seriously make research and systematic analysis towards the collected material in order to establish theoretical basis for the structure framework of the paper.

### ***75.2.2 Questionnaire Method***

It is to issue questionnaire and make survey by randomly selecting 1,000 students from the eight universities of Baoding.

## **75.3 Research Results and Analysis**

### ***75.3.1 Intention Degree Analysis of the Sports Consumption of University Students in Baoding***

The survey shows that: 20 % university students are quite willing to make sports consumption; 42.41 % are willing to make the consumption; 22.33 % show indifferent attitude towards the sports consumption; 15.26 % are not willing. So, the number of the students who are willing to do so accounts for the most, which indicates that a great majority students shows positive attitudes and possess certain sports consumption concept.

### ***75.3.2 Sports Consumption Motivation of University Students of Baoding***

The motivation of sports consumption refers to a kind of internal drives of someone making sports consumption and also the direct motive power of accelerating the consumption [1].

The survey shows the ranking of the sports consumption motivation of the men are as follows in proper order: body building, hobby, entertainment, grasping the sports skills, improving sports ability, social needs, pursuing the appreciation of beauty. And the ranking of that of the women are as follows: body building, entertainment, hobby, pursuing the appreciation of beauty, grasping the sports skills and improving the sports ability, social needs. From the result, it can be seen that the former 3 of the motivation of the male and female are basically the same, which indicates that a great majority of students have realized the meaning of the exercise to the health. The goal of students' sports consumption is quite obvious, and their consumption motivation is sound, which is appropriate to the nationwide fitness campaign launched by our country. With the development of the living standard, the students face severe competition as well as the increasing of their study and life pressure. They hope to stay healthy and relaxed, and remove fatigue through sports activities. Therefore, if they are in good economic condition, they are willing to spend money buying health and happiness. With the development of the society and the implementation of the outline of the nationwide body-building plan, especially with the opening of Olympic Games in Beijing, the enthusiasm of doing sports and exercise becomes stronger and stronger. The sports activities are becoming more and more popular with the people gradually, especially that the students are the weatherglass of the social fashion. They stand for the new fashion of the times. An increasing number of people show interest in sports. Their willingness of sports consumption is the objective and necessary trend.

### 75.3.3 Current Situation of Sports Consumption Level of University Students of Baoding

Sports consumption level refers to the quantity of consuming various sports material products and labor to meet the life demands in a certain period. It reflects the level of personal sports consumption in a certain time from the aspect of quantity. Besides, it reflects the university students' actual satisfaction degree of sports consumption demands in a certain period [2]. The results of the survey shows that the sports consumption of the male and female is focused on the two levels-RMB100-200 and RMB200-300, presenting the saddle shape of "large portion in the middle and a small portion at both ends". However, the whole consumption of the male is higher than that of the female [3] (Table 75.1).

**Table 75.1** Sports consumption status of university students in each semester

Consumption level RMB	50-100 (%)	RMB100-200 (%)	RMB200-300 (%)	Above RMB300 (%)
semester				
Male	5.6	23.4	60.7	10.3
Female	10.7	52.7	31.4	5.2

### 75.3.4 Content of Sports Consumption of University Students of Baoding

The survey indicates that: the material-based sports consumption accounts for the most, such as sportswear, fitness equipment, etc.; the selection proportion of the male and female is relatively high. However, the labor-based sports consumption ranks after the essence-based one [4]. From Table 75.2, the most sports consumptions are sportswear, shoes, hats; the second one is taking exercise and training in the club; the third one is buying fitness equipment; the fourth one is sports journal, magazine, audio-visual products; the fifth one is appreciating the sports performance, competition and exhibition, etc. It shows that the exercise frequency and strength of the male and female have no obvious difference. As for that the sportswear, hat and shoes rank 1, the reasons are as follows: (1) each university requires the students to wear sportswear when they have P.E. lessons; (2) such consumption can be regarded as the dual-purpose function of exercise and daily life; (3) most students have realized the relation between the good sports equipment and exercise feeling and have certain pursuit of high-end and good-quality sportswear. They pursue fashion and follow the fashion. Besides, they possess certain Aesthetic appreciation ability. There is no doubt that the sportswear is in giant consumption potential. With the broadening of our domestic sports socialization and the increasing number of people doing sports, their cognition of the sports function has been improve gradually. An increasing number of university students take part in various sports fitness training activities and entertainment. Moreover, through the survey, the sports consumption of the university students is developed from the material-based consumption to the labor-based consumption. As the important constituent part of our sports population, the university students will be one of the main objects of sports consumption. Knowing the direction of sports consumption of the students and guiding them to make sports consumption will be favorable for the development of driving the sports industry [5].

**Table 75.2** Sports consumption structure of university students

Consumption items	Sportswear, shoes, and hats	Fitness equipment	Sports journal, magazine, audio-visual products	Appreciating the performance, competition and exhibition	Go to club and take exercise and training
Number of male making the selection	33.32 %	21.57 %	9.32 %	8.55 %	27.24 %
Number of female making the selection	42.33 %	19.42 %	7.64 %	10.25 %	20.36 %
Ranking	1	3	4	5	2

**Table 75.3** Main factors influencing the sports consumption of university students

Influence	Insufficient sports fields infrastructure	Personal economic structure	Showing no interest in sports	Little idle time	Sports value
Number of people making the selection	20.63 %	33.51 %	15.26 %	20.18 %	10.42 %
Ranking	2	1	5	3	4

### 75.3.5 Main Factors Influencing the Sports Consumption of University Students of Baoding

(Table 75.3).

#### 75.3.5.1 University Students' Economic Purchasing Power Ability Towards the Sports Consumption

The university students have no fixed source of income. During the investigation, it is acknowledged that the economy resource of the students during their school time is mainly from the support of their parents. A great majority of students finish various consumptions of study and entertainment by relying on the monthly living expense provided by their parents. Some part of the expense is from the scholarship, stipend and taking part-time job. It is difficult for them to make sports consumption when the economy resource is limited. Under the premise of the limited economic ability, although most students have their own imaginary sports products, the high price restricts their consumption behavior.

#### 75.3.5.2 The Sports Infrastructure Cannot Meet the Increasing Sports Demands

In recent years, the universities have enlarged the investment of the hardware so that the sports infrastructure has gained great improvement, especially the construction of the new campus, and the gym is made better, which basically can guarantee the training demands. However, the structure of the gym does not coincide with the tendency of sports exercise. Besides, the infrastructure is relatively poor and there is no complete service system. The number of the university students is increasing day by day, while the number of the school stadiums is relatively small. The non-coordination of the number of the stadium and the population gives rise to the decreasing of the people doing sports, especially the items that show relatively high demands for some stadiums, such as badminton, tennis, swimming, etc. The backward hardware infrastructure and the alternative sports consumption items are relatively fewer. It greatly restricts the activeness of sports consumption to a certain



extent. However, the simple sports exercise, such as running, cannot meet students' interest in various sports items. Therefore, the insufficient sports infrastructure of universities restricts the students to make sports consumption.

### **75.3.5.3 Less Idle Time and Busy Learning**

Less idle time and busy learning are other factors influencing the sports consumption of the university students. When they study in the campus and they will be affected by the school environment and their employment pressure will be increased, they have to spend their main energy learning scientific culture knowledge, taking part in social practice and getting rating certificate, so as to create various better conditions for the employment distribution.

### **75.3.5.4 Sports Value**

Different sports value will contribute to different sports consumption behavior. The results of the survey show that: most university students know the real meaning of "health" on theory, but they cannot get rid of the wrong thought of "no disease means staying healthy", and they insist that "they are healthy but they never take exercise". These viewpoints indicate that the students know quite little about the sports exercise, sports consumption, and "health" and no disease, which gives rise to weak initiative of university students' sports consumption.

### **75.3.5.5 Sports Hobbies and Interests**

Sports hobbies and interests is a significant factor influencing the sports consumption level. The interest is a special cognition tendency of human towards the things. Such tendency must have definite emotion and positive attitude. When the consumers are in need of some commodities or labor, they will show interest. Similarly, when someone is interested in sports, he or she will show great concern about the sports exercise. It mainly reflects on being sensitive to the sports information, watching sports programs, etc. Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you?

## **75.4 Conclusion**

Most university students are willing to make sports consumption. And the material-based sports consumption accounts for the most, such as sportswear, shoes, hats, fitness equipment, etc. The sports consumption is developed from the

material-based consumption to the labor-based consumption, and the consumption way is inclined to multilevel and diversity.

The sports consumption motivation of the university students of Baoding is relatively obvious, such as body building, interests and hobbies, entertainment, etc. As for pursuing appreciation of the beauty, grasping sports skills, improving sports ability and social demands, the male is a little different from the female. It shows that the university students' motivation of sports consumption is healthy.

The sports consumption level of most male is RMB200-300 per semester, while that of the female is RMB100-200 per semester. It indicates that the consumption of the male is relatively higher than that of the female, and most students' sports consumption is in the low-consumption phase, which has something to do with their financial resource which is mainly provided by their parents. It is impossible for them to spend the living expense on the sports consumption, so that such consumption is restricted.

The main factors influencing the sports consumption of the university students are as follows in proper sequence: personal financial status, insufficient sports infrastructure, less idle time, busy learning, sports value, sports interests and hobbies. The results are basically consistent with the survey results from other experts or scholars, and just the ranking is not the same.

## 75.5 Suggestions

The university sports should strengthen the cultivation of the students' sports consumption concept and consciousness. Besides, the school should make the students understand that the sports consumption is the main consumption form of satisfying the health demands and the main content of improving life quality. Moreover, students should learn to accept the modern sports consumption concept of "spending money in buying health", comprehensively realize the multiple-effect function, establish correct sports consumption concept and health consciousness, reasonably arrange the time of learning and recreational and sports activities, and cultivate scientific, civilized and healthy way and idea of living.

The schools should attach importance to the adjustment of the stadium structure when they enhance the construction of the stadium and improvement of the sports infrastructure. In addition, it is necessary to speed up the reform of the sports course and organically integrate the course with the students' sports consumption.

As the university students do not have fixed financial income, the sports market can cut down the price of the product so as to accelerate the price of the sports consumption products to adapt to the students' demand and stimulate the consumption. The operators engaged in sports consumption can adopt different marketing strategies and means. Moreover, they should take the students' bearing capacity of the sports consumption into full consideration, select different time to offer discount and favorable service, and create catchpenny diversified management items.

It is necessary to attach importance to the habit formation of the sports interests of the university students, the cultivation of lifelong sports concept, and encouraging the students to take initiative to participate in the sports activities, helping them form healthy and civilized way of living, developing sports consumption markets suitable to the university students and guiding them to make sports consumption spontaneously.

## References

1. Guoxiang P, Yayun Y (2006) Current situation analysis of sports consumption of University students. *J Hubei Sports Sci* 6:631–633
2. Xiaotian Z, Bin W (2005) Research on the sports consumption status of University students of Hefei. *J Anhui Sports Sci* 3:101–103
3. Xueming H, Changfa Y (2005) Current status, factors and development countermeasures of sports consumption of University students of Henan Province. *J Anhui Sports Sci* 16:83–89
4. Hong C (2006) Research on the sports consumption level and consumption structure of University students of Eastern China. *J Beijing Sport Univ* 32:18–24
5. Yan Z (1988) *Sports economics* vol 14. Sichuan Education Publishing House, Chengdu, pp 82–86

# Chapter 76

## Practical Teaching Research of College Art Design

Hua Liu

**Abstract** This chapter came to a conclusion that the problem of Art Design teaching practical training can be attributed to the matter of teaching and learning by the collection and analyses of history and current situation of Art Design teaching practical training. In response to this reality, this chapter through the relevant information and survey of actual situation of teaching, tried to reveal the problems existing in China's college Art Design Teaching Practice, in particular, the analysis about poor practical ability, weak ability of adaption caused by the unreasonable practical curriculum, a serious shortage of practical course, bias between practice direction and professional direction. Finally, it gives the suggestive ideas and education should first train the ability of creative thinking, second practical teaching link is the basis of cultivating creative thinking, precede the teaching reform to accommodate needs of social development.

**Keywords** Practical teaching • Research • College art design

### 76.1 Introduction

Into 21st Century, China's design art education should adapt to the global economic development into the important fields of national economic construction and development, and a formation of a design and creative-driven stage [1]. Due to the development of information technology, device and method of design changed and objective of design is getting wider. In this period, global economic pattern transferred from price competition to competitive design, developed countries gain the trading benefit by design output, design is one of the effective ways of developing creative economy and cultural and creative industries, intellectual property rights of design itself is also becoming increasingly prominent [2]. China's economy changed from initial manufacturing-based economy to creative economy,

---

H. Liu (✉)  
Art Institute, Xinxiang University, Xinxiang, China  
e-mail: liuhua12332@163.com

design already became the important link of industrial chain, but it still behind the development [3]. China's many industries are blindly imitating the foreign design for lack of original design, hard to advantage formation of brand, hampering the in-depth development of China's relevant design industry. It is widely recognized by the whole society to develop cultural and creative industry and improve the level of industry development relying on design.

China proposed the establishment of the new concept of 'Innovation-oriented country', under the guidance of this macro concept, the design art education of China usher in a new development opportunity [4]. The creative concept is gradually being introduced into the design arts education, university settings of design arts began to appear a lot of new terms, such as: digital art, information design, animation, modern arts and crafts, design management, dress arts, culture and creative, tourism product design etc. Integrated design art disciplines were gradually formed by professional integration and expansion of economic and cultural and creative industries. Many domestic design and art college form the diversified development pattern from the design art to service creative patter started by design and art education [5]. First, gradually enlarge the scale of the talent cultivation, by now, according to the rough statistics, more than 80 % college open the Art design Major, multi-layer design art education system of education, vocational education, adult education follows the general law of education and their own characteristics, formed co-existence school pattern of research university, teaching and research university, teaching university, teaching practice, universities, vocational universities; Secondly, the design art by its own characteristics decides that it is a practice-based, cross-discipline, and its development must take into account the diverse needs of the community design talent in the advanced design art education'. The practicality of design' is undoubtedly the important course or method of design teaching, but author found by the research literature and field visit that the development situation of China's Art design major teaching practical link is far behind the cultivate objective made by college, exist many problems like curriculum system need to be improved and completed. So it is an extremely essential meaning to discuss the problem existing in the practice of China's College Art design profession teaching.

## 76.2 The Development of Art Design Practical Link

Modern art design is a discipline developed along with industrial production and social modernization, and social and economic development, industrial development are inseparable, so the teaching practice of Art Design developed with the social development. According to the service objective change of China economic development, the author concludes its development into: pattern and technics-oriented stage (late 19th century to 1940s), craft and decorative dominant stage (the founding of the early 1970s) and decoration and design-led phase (1980s-present). The above made the detail description about the pattern and process-oriented stage, here we won't repeat it.

See the configuration of this curriculum from the perspective of art and design education, we can easily find the numerous curriculum and too broad. Practice-based skills training mostly stay in the drawing, dye painting, Chinese painting, fine art course teaches the basis, even if a serious professional courses are professional theoretical paper, Professor, in this way, the author is no exaggeration to say that, our art and Design professional teaching Practice is stuck in the painting pattern, painting design level. This pure art for the Art and Design Professional Teaching Practice-based “traditional phenomenon” is still widely in College of Art and Design education until this day.

Art and design professional related subjects and the corresponding training objectives, training requirements, the main course, one can see that almost invariably of the schools to develop training objectives, both high and large; Southern Art, art and design professional is covered by a very comprehensive, the consideration of the main curriculum is also very thorough, especially the professional practice course is a very rich, both in the school’s professional skills training, as well as outdoor social practice.

By the research of the author: the training objectives and national education policies to promote is no different, almost the same version of the copy, can be said to be one size fits all “target sample” at the National College.

Cultured target simply apply educational principles and fails to address the different professional characteristics of design education, in particular, is the professional nature of basic research of non-den-like design education, personnel training specifications, resulting in graduates in the face of the industry is highly sophisticated career development needs, are often incompatible with the embarrassing situation, for many graduates is difficult to adapt to job. And the training mode is also caused by denying their academic level and professional characteristics of the difference between the institutions, the formation of the monotony of personnel training specifications, from the long-term development perspective, is not conducive to the diversification of the design industry before the election needs to be more difficult to from this training mode to further enhance the professional quality of the talent and creativity to play.

This made the market economy against the background of Art and Design Teaching “practical education” is not mentioned in the traditional sense of the training of manual skills, Lancaster House, British educator system “process model” of teaching theory, an overview of the complete system. “Process model” of teaching theory emphasizes the design operation of the entire process on all aspects of design, such as preliminary research, the analysis of the environmental conditions, design scrutiny, panel discussions, not matter if the students’ final work is good or bad, more not only the students hands-on attention skills. On the contrary, more emphasis is a practice thinking exercise. Therefore, the design practice should mean designers use design theory to design activities and design of the value of practical activities. In summary, I believe that the University of Art and Design Professional Teaching Practice is common in the curriculum and the curriculum is too complicated, is not close enough contact between courses, teaching arrangements are relatively small, professional practice is relatively weak in

actual ignore the essence of practice, teaching and the focus on skills development and other issues.

### **76.3 The Problem Existing in the Art and Design Teaching Practical Link**

Specifically, colleges and universities in the professional setting of the professional division is too narrow, clear professional boundaries, the lack of cross-integration; professional classification is not quite appropriate, “seeking perfection”, the lack of feedback flexible operation mechanism and robust adaptive systems; even basic lessons vary from person to person, there are various degrees of one-sidedness in the quality of teachers, curriculum; curriculum system is very unreasonable, older educational content, teaching methods and means of relatively backward; lack heuristic lectures, lack of dialogue seminars, neglect to train students self-learning ability; teacher scarcity, outdated facilities, personnel structure is not reasonable; poor school conditions; scientific research is weak, the gap. As said in the introduction, art and design practice is the most important teaching of art and design, so I comb the context of the system of professional teaching practice in art and design education in China, summed up the following two reasons:

China’s University of Art and Design education unreasonable course structure, one of the reasons “mentoring grant” is teaching methods falling into habits, led to a large number of instrumental courses full of ‘style’, ‘workshop’, and even pure operation excessive and indiscriminate sexual skills courses, duplication, and knowledge of course the lack of ‘rational science’, ‘intellectual’ and ‘creative’. In the text, the author repeatedly emphasized art and design education with the development of socio-economic, political, at different times to play different roles, now the art and design education has long number of years ago specifically for the nobility to enjoy the workshops offered one-to-one words and deeds “type of education. Art and Design as a popularization of discipline, direct market-oriented, previously referred to the “process model” of teaching theories, emphasizing the whole process of the design operation of all aspects of design, such as preliminary research, environmental conditions, design scrutiny. Too much emphasis on the students hands-on skills training, to judge the quality of student achievement is based on their last job or bad; the contrary, the exercise of practical thinking is rarely taken seriously. Therefore, the learning of students in the class of professional practice largely imitate, imitate the teacher’s one of the wind. As a result, I think: students Perspective does not open, a breakthrough innovation is a relatively difficult to achieve the goal.

As mentioned above, the pioneer of art and design education germination period went east, or west, learned first, then transferred, has made pioneering contribution to our higher arts and crafts teaching, especially the outstanding results in the pattern of teaching materials and curriculum. But as we all know, the above teachers engaged in the education of arts and crafts, at the same time, most of

them are famous painter-Mr. Persky painted the new breed of painting and decorative painting, Mr. Chen specialized in flowers and birds, Mr. Shen drew oil painting and others. At this point, Art and Design education innate a close relationship with painting, and acquired development also failed to jump out of the palm of painting. Therefore, in the art and Design education of college in China, as previously cited, most of the institutions or faculties to follow the ways and means of art education in the teaching activities, the range of courses for the painting and numerous, of course, not to say the dilution of painting foundation, speaking from the direction of some professions, even need to intensify, but it is not the final target of Art Design discipline. So the modern Art Design education follows the routine of traditional art education weaken the design-conscious cultivation of the overall design education teaching course. For this, it made students focus the technology instead of art, even bias of practicality, made the art design a pure art works, lost the most fundamental practical value of art and design.

In the teaching of college art and design major, the overall level of teachers decide the development level of China's Art design, teacher group should have the rich profound knowledge, the ability of keen observation and individualization of education, continuously update the knowledge system, standing on the front of the marketing economy, master the psychology, Education, engineering, grasp the modern teaching method, accumulate the rich teaching practical experience. About the particularity of Art design major requires the discipline teacher with the following quality and ability: (1) High culture and professional theoretical level, strong teaching and research ability, quality; (2) with skilled professional practical skills, certain practical ability and the ability to guide students to practice.

## 76.4 Improvement of Art and Design Teaching Practical Link

Rationally designing the course structure of college art design education and it is a must to stand out professional teaching practice link and get rid of the 'painting' based course. We can't deny this point, now many design practical course are based on drawing and colour. School shall correctly recognize the nature difference of art design and drawing. There is the essential difference between the art design and painting; strictly art design should be a design activity, and systematic program. The designer is not a pure artist, from the perspective of the thinking mode, should be more close to the engineering and technical personnel or art applicator. So teachers in teaching bravely break the traditional "mentoring grant" mode and restrictions, set up an interactive platform, stimulate the creative potential of students, objectively leads the students to the training of creative thinking. Adjust and modify the teaching plan, pay attention to improve the quality of talent as the direction of professional education, promote the professional modules reform, curriculum reform, set up the course structure mode adapt to the professional quality and overall quality education, strength the cultivation of the knowledge application and creative ability. Stand out the key position of students; follow



the principle of education teaching design, students-oriented, emphasize the principle role of students, increase the internship experience.

Get involved in the social work and take use of the modern information technology to create the study environment of students as subject, and according to the needs, interest, and basis and their time, energy of students to arrange the study activity, let students feel and think, experience, more actively to set up the knowledge, and grasp the discipline teaching content, set up the ideas of lifelong study, constantly improve the overall quality. Art Design is also an activity of art and beauty creation, when school train students for the grasp of science and technology, also should pay much more attention to the cultivation of aesthetic cognitive ability and aesthetic creativity.

To construct the Art Design College with its own characteristics, each college should have its specialty, can set up the relevant majors with characteristics; do not pursue the “completion”, “big”, “prosperity”. This is the normal situation in China’s college that Art College constantly widen the majors to improve the discipline construction; comprehensive university add the Art majors for the completion of disciplines; at the same time, for the shortage of Art design talent, so the university focus on the Art major when they enlarge the majors. Many colleges especially brand college take the advantage of famous name, blindly expand the disciplines under the circumstance of no experience, insufficient hardware and software since the students can easily find a job by the graduation of famous university; also some Art university for pursue of ‘completion’ set up many newly born majors without the permission of decent conditions. But they are neglect of the fundamental purpose of sponsoring school, it is not for ‘completion’ but finally for the cultivation of quality students. So author suggests that each university should consider about their own based local condition, target future for professionals.

Art Design is a kind of behavior of economy, in popular, design should satisfy the needs of consumption and consumption oriented. The successful design means the good effect on the consumption or the win of market. Then the art education should be connected with the market. The economy-oriented design is also the important difference between and other pure plastic art.

It shows the destination of art, enlarges the characteristic of art, makes the art more daily life, and is connected with the economy in reality and actual usage. This is the one of the obvious features of highly developed modern civilization. Art design professional teaching can’t get out of the reality, and out of the market. Author think if the school can’t realize the economic behavior of design, and deviated from it that the design will be less effective. The designer is the applicator based on the practice, not just the operator in graphic computer, schools can not only teach the related computer design software operating as a practice course.

## 76.5 Conclusion

This chapter came to a conclusion that the problem of Art Design teaching practical training can be attributed to the matter of teaching and learning by the collection and analyses of history and current situation of Art Design teaching practical

training. In response to this reality, this chapter through the relevant information and survey of actual situation of teaching, tried to reveal the problems existing in China's college Art Design Teaching Practice, in particular, the analysis about poor practical ability, weak ability of adaption caused by the unreasonable practical curriculum, a serious shortage of practical course, bias between practice direction and professional direction. Finally, it gives the suggestive ideas and education should first train the ability of creative thinking, second practical teaching link is the basis of cultivating creative thinking, precede the teaching reform to accommodate needs of social development.

## References

1. Pan L (2007) Design education Jinan, vol 2. Shandong Art Publishing House, Jinan, pp 77–83
2. Wu L (2009) Design education research (3,4), vol 4. Jiangsu Art Publishing House, Nanjing, pp 111–115
3. Qing L, Chou H (2005) American contemporary art and design education series Beijing, vol 19. China Building Industry Press, Beijing, pp 333–338
4. Qing L, Chou H (2005) Brent Brook art college Beijing, vol 1. China Building Industry Press, Beijing, pp 22–29
5. Xi C (2005) Design Art classical works selected reading Nanjing, vol 59. Southeast University Press, Nanjing, pp 59–65

# Chapter 77

## Study on Ability of Undergraduate Scientific Research

Rongfang Wang

**Abstract** With the social economy development and period improvement, it is common to attend the colleges and universities. However, the quality education that aims at the undergraduate does not keep up with the times especially the scientific research ability. This chapter will aim at the scientific research ability about the modern undergraduate to develop the discussion and evaluate the reason. Moreover, the chapter will aim at the various problems to find out the solution and effective approaches.

**Keywords** Undergraduate • Scientific research ability • Present condition • Strategy • Prospect

### 77.1 Introduction

The modern undergraduates are the further manager of the society as well as the nucleus for the national development. Therefore, the undergraduate quality is very important [1–4]. The training of scientific research ability is the most important combination of comprehensive quality training. In addition, it is necessary to clear the responsibility in nation, society, and school [5]. They need to pay attention to the training of scientific research ability, suited for the time development, supply the high quality talent to the modern establishment, and make connections to the socialism with Chinese characteristic.

### 77.2 The Current Scientific Research Ability of Modern Undergraduate

Through the relative data and research, the comprehensive quality of the modern undergraduate has improved [6, 7]. On the contrary, the research ability is decreasing. This is the serious question in college education as well as the serious social question.

---

R. Wang (✉)  
Langfang Normal College, Langfang, China  
e-mail: rongfangwang1@yeah.net

### ***77.2.1 The Thin Consciousness***

With the education reform, the traditional education method has dismissed. However, the long-term traditional mind is still having been around including the college education.

The thin consciousness is not only the student sense [8]. The school consciousness influences the teacher's consciousness, and the teacher influences directly to the students. The cycle reduces the scientific research ability of undergraduate. From the research, there has nearly 80 % students did not attend any scientific research. The number is shocking by the sight [9, 10]. We have to ask, what undergraduate learned in the colleges. From this, we can find out the college education is extremely urgent.

The traditional education does not pay attention to the social practice ability. The traditional duck-stuffing types of teaching will leads the students have the only learning target for the exam. Therefore, the undergraduate will has the low scientific research ability as well as the social practice skill. They have no platform to increase the ability and the consciousness to improve the independent research skill.

### ***77.2.2 The Low Use Ratio of Scientific Research Materials***

From the research, there have nearly 30 % students that never study in the library during the 4 year college life. This is another astounded number. What are they doing during the college time? With the development, there has no longer the simple easy society. Various things in the society, the undergraduates have ranged self-control ability that cannot bear the temptation. This is the reason.

On the other hand, the research shows only 10 % students will read the scientific materials in the library. Other students are likely to read magazines, news, or interested literature. That is an important reason of the low research ability.

Furthermore, the modern scientific development makes students to search online or phone if they needed to. There have few people search materials in the paper references. The science development and innovation has a larger advantage than the disadvantage. Incontestable, this is one of the disadvantages. The convenient research decreases the practical ability at the same time.

### ***77.2.3 Insufficient Attention Degree***

At first, the undergraduates pay insufficient attention to the scientific research. Many students believe it is necessary to learn it. Although it might have not obvious practice function for the scientific research, the ability training is very important. It will provide great talent support during the employment and life choice. This is the ability training, skill training, rather than the subject learning.

In the second place, the school pays less attention to it. The ceaseless reformation and innovation of education has much disadvantage. The insufficient attention to the ability training is one of the reasons. The college has no policy to encourage teachers to train the students' ability. The single subject education means the teachers are lacking of training consciousness too. Otherwise, there has no improvement platform for the students to increase the ability.

#### ***77.2.4 The Own Limitation of Undergraduates***

The research shows most students do not have the consciousness that scientific ability has the positive effect on the independent improvement. Increase the scientific skill can develop innovation ability, social practice skill, and the manipulative ability. For the undergraduates, the ability of scientific research can establish base-ment for the further employment.

### **77.3 The Social Reason of the Low Scientific Ability in the Modern Undergraduates**

The reason of the low scientific ability in the modern undergraduate is the thinking. On the other hand, it is caused by the regulation lack and method outdated.

#### ***77.3.1 The Influence of Traditional Education Rules***

China has 5,000 years' culture. The education regulation starts from the ancient times. From the eight-legged essays to the college entrance examination, our education rules obtain the ceaseless development. However, some questions do not obtain the perfect settlement.

#### ***77.3.2 The Unreasonable Class Setting and the Improper Education Method***

The unreasonable class setting is one of the social reasons. Some colleges do not pay attention to the scientific research, and set it as the elective course. Although some school opens this course, there has no training. Therefore, students will believe this course is not important. Then, it will lead the weakness of scientific research ability among the modern undergraduate. Some students even do not know the research content and method.

## **77.4 Strategy of Present Scientific Research Ability**

Aiming at the current condition of scientific research ability, we should develop the undergraduate quality in order to increase the social adaptive faculty.

### ***77.4.1 Start “Young”***

For changing the current situation, we need to grasp the method. The students that just attend into the colleges, they are full of passion in the new environment. The school and teacher can take the advantage of this passion to publish and introduce the scientific research ability. Raise students' learning interest and passion from the very begging and establish the basement for further study.

### ***77.4.2 Increase the Course Open of Scientific Research***

The student of sophomore and junior can increase the interest through adding scientific research course. At the same time, we can set relative groups, increase the research subject. Students can select the interested subject. By this method, students will not feel boring, and they can train the research ability.

### ***77.4.3 Complete the Library Establishment***

Library is the symbol of college knowledge level and scientific research ability. At the same time, it is also the main location that students can absorb knowledge. The perfect library can provide learning power and abundant knowledge for the students. Therefore, the college library establishment is very important.

Aiming at this question, we can perfect the library establishment and bring some books or electronic materials about the scientific research instead of the simple and easy references. It mainly let students to bring the interest about the scientific research while reading the materials. The interest is the best teacher. If students have the interest, they will learn knowledge by themselves.

### ***77.4.4 Establish the Information Exchange Platform***

Information exchange is the important approach to develop the scientific research ability. The colleges can establish the perfect platform in order to improve students' ability about the scientific research. The main methods are establishing the network communication system. The students are familiar with the network during the modern education. Therefore, it is very important to build the information communication

platform. We can establish the trans-regional platform under the allowable condition. Then students will have more chances and common favor. Otherwise, if the colleges have resource limitation, we can organize the debate to involve the students. College is still the guide for developing the scientific research ability.

#### ***77.4.5 Develop the Various Research Activities and Raise Students' Learning Interest***

Teacher is the main body of the higher education in colleges and universities. Teacher can select some students to join into the personal scientific research. Otherwise, the school can organize the lectures and invite some popular workers in home and board. They can explain the importance and independent development function of the scientific research. This can arouse the consciousness of the scientific research then to increase the research ability of students.

### **77.5 Promote the Importance of Scientific Research**

#### ***77.5.1 Increase the Major Interest***

The college will open some natural society subject except the majors. Some students might lose the interest of their own major. If set up the project of some scientific subjects, deeply research the background, students can change the learning attitude, train the learning interest.

#### ***77.5.2 In Favor of Obtaining More Knowledge and Develop the Practical Ability***

The modern students are more relaxed than before. However, many students' thinking is under the limitation and lack of innovation. Therefore, the deeply scientific research can release the thinking. Students can practice the ability in the society instead of engaging in idle theorizing.

#### ***77.5.3 In Favor of Expanding the Knowledge Scope***

Scientific research is not only the subject learning. It is the social comprehensive subject, which need the various aspects learning and research. Therefore, develop the scientific research ability of college students is the best way to expand the knowledge scope and understand the different fields.

### ***77.5.4 Train the Scientific Research of the Undergraduate is the Necessary Requirement During the National Development***

The modern undergraduates will be the further master of this nation. Innovation is the cultural spirit. Therefore, training the scientific research of the undergraduates is concern about the future development and economic establishment. The increasing global competitions emerge in large numbers of high quality talents. Therefore, we have to advance with the times if we want to take part in the world. We need to innovate and develop, train the talents, increase the talents' manipulative ability and break in the international field.

### ***77.5.5 Increase the Scientific Research is the Requirement of Independent Development***

In the present competition, the employment of the undergraduates is the big problem. Therefore, stand out from the crowd there need to increase the independent quality. The scientific research ability is very important for the society, nation, and the undergraduate. We need to put it on the schedule.

## **77.6 The Ability Training of Undergraduate Scientific Research and the Foreground**

By the time development and the society improvement, people have paid attention to the scientific research ability. For the future development, we based on the current situation to absorb the quintessence. Abandon the old education method; we improve the cognitive competence of school, teacher and the society. Moreover, we follow the objective development and trust the future scientific research ability and the social practice skill of the undergraduates can obtain the ceaseless development. Our economy will becomes better and better.

## **77.7 Conclusion**

Through the evaluation of scientific research ability and comprehensive quality, we can find the knowledge structure and social practice ability of present undergraduate needs to improve more. Therefore, we should develop the students' comprehensive quality through the correct approach. The modern college students are



the master of the future. The national development direction is in the hands of this generation. In addition, improve the scientific research ability and comprehensive skill is very important. This is the decision of our future.

## References

1. Zhang Y (2008) Establish the mode of research teaching. The scientific research ability by undergraduate training. *Huangzhang* 53:11–13
2. Yang H, Yu A (2009) The comparison of students research training in home and board. *Res Higher Educ Eng* 17:134–143
3. Xuexi Z, Yimin Y (2008) The thinking of how to study well in the scientific research. *J Guangdong Univ Technol (Social Sci Ed)* 24:62–66
4. Yuanfen Y (2008) The simulation and training of scientific research and ability in the undergraduates. *Basic Theor Discuss* 73:26–32
5. Zhaoxue M (2009) The establishment research of training system in the undergraduate scientific research. *Educ Vocat* 73:257–258
6. Yanlan T, Mingshuo A (2008) The research of early scientific research and innovation training about the undergraduate. *Jiangsu Higher Educ* 158:473–475
7. Jianfeng Z, Yan Z (2008) The research and thinking of developing the inquiry learning. *Theor Pract Educ* 46:256–258
8. Hua W, Lilong J (2010) The scientific research functions and implement in the undereducated training. *J Guangdong Univ Technol (Social Sci Ed)* 9:46–48
9. Mulei Y (2008) The training method discussion of undergraduate scientific research. *J Dali Univ* 7:74–77
10. Tianlin Y, Yingbo L, Yanqing X (2010) The practice research of establishing the operation management system about the scientific research training. *Higher Educ Forum* 2:2–7

# Chapter 78

## Research on Quality of Full-Time Professional Degree Postgraduate Education

Chunjun Zhu

**Abstract** To investigate the characteristics of full-time professional degree postgraduate education, this article discussed some problems faced and corresponding measures in the deepening reform of graduate training mechanism. Thus the education quality of full-time professional degree postgraduate can improve by strengthening “double tutors” mechanism and students’ research practice.

**Keywords** Full-time postgraduate education • Training mechanism • The quality of education

### 78.1 Introduction

Professional degree system is a well-known practice in the world for application talents cultivation in which the ratio of professional master’s degree gainer account for more than half of the ones in American and from 2003 to 2008, Britain granted the postgraduate degree mostly for curriculum postgraduates [1]. Since 1991, our country already has three levels of professional degree education system for doctor, master, bachelor at present. And to optimize the education structure of postgraduate education, better adapting to specialized personnel with high-level professional skills need of national modernization construction, the ministry of education, since 2009, started to recruit the full-time professional degree postgraduates mainly from undergraduates, and plans to make the proportion between professional degree postgraduate and academic ones eventually reach to 7:3 [2].

---

C. Zhu (✉)

China University of Mining and Technology, Beijing 100083, China  
e-mail: zcj@cumtb.edu.cn

## **78.2 The Training Characteristics of Full-Time Professional Degree Postgraduates**

As one new postgraduates education form for adapting to social and economic development new situation, full-time professional degrees has the characteristics of “relatively independent education mode and specific career orientation”. It has merged the recruit and training system as full-time academic postgraduates, and recruits mainly undergraduates who lack of practical experience and professional skills, having higher foreign language level, strong accept ability, much time and energy. And it has clear career oriented training target in which enterprise and school teachers commonly guide students, and students complete their practice activities mainly through school experiment and enterprise scientific research.

## **78.3 Some Problems for Full-Time Professional Degree Postgraduate Cultivation**

At present in China, most of training units are still in groping stage for training full-time professional degree graduate student that relies mainly on the cultivation experience accumulation of academic graduate students and in service personnel applying for master’s degree.

### ***78.3.1 There is Deviation for Social Understanding and the Students’ Quality is Uneven***

On one hand, the current university, students and others do not enough understand the policies of training full-time professional degree graduate student and think it comparatively to the academic ones, has easy entrance and lacks sound training system, scientific practice process setting. On the other hand, the training quality, especially professional skill has not yet attained society’s expectations, and they have no obvious advantage on professional knowledge and research and development ability.

Influenced by the experience, the graduate student candidate most choose “mature” academic degree, while vocational students with professional skill, limited to the restriction of work year and the need for jobs, often lack the power and energy to study for graduate degree, which cause a great number of invisible lost for fine student source [3].

### ***78.3.2 Practice of Course Teaching is Poor***

At present undergraduates studying for full-time master’s degree are in lack of professional practice background. But cultivation units still adopted traditional teaching mode that emphasizes academic research, despises even lack of practice

training links. Limited to 2 years schooling, those full-time professional degree postgraduate, have only short time to participate in research practice and training. And units have difficulties for practice implementation, making the practice teaching facing unwinding condition, and leading to the students practice consciousness and ability cannot be fully cultivated.

### ***78.3.3 Weak Teaching Force***

Influenced by the education guidance, Chinese colleges and universities generally lack teachers who can cultivate high-level skills talents. Teachers mostly pay attention to science theory research and light practice technology application, and the young teachers usually lack of the corresponding teaching practice experience and means, thus surely going against the education training of full-time professional degree on the whole.

### ***78.3.4 Poor Connection Between Academic Achievements and the Professional Qualification***

Full-time professional degree graduate student is one degree type set for training high-level professionals with strong skills and professionalism, meeting to certain social career development. But the domestic professional qualification system has not been established systematically, which makes difference training target for professional qualification as for the training units and the training goal can't effectively define professional point and cover vocational skills training, and make students, lacking of work experience, can't achieve non-transitional cohesion between academic and professional qualification system.

## **78.4 Thoughts and Countermeasures**

Full-time professional degree graduate student coming mainly the full-time undergraduates, which has the target for training high-level professionals of mastering certain professional basic theory of knowledge, having higher professional quality and strong ability to solve practical engineering technical problems. Along with the continued expansion in the recruitment scale, as a transformation marker of graduate education structure, full-time professional postgraduate education will be limited by teachers' team, scientific research fund, experimental equipment, practical condition. So how to comb its directional training and characteristics, improve its outstanding academic level and professional skill is the reality faced for the graduate education institutions and workers. We should combine

requirement between professional training and professional skills in admissions policies, training mode, the curriculum, teachers, academic achievement, and highlight outstanding academic level and high skill level characteristics, ultimately reflects the social application value of full-time professional degree graduate students.

#### ***78.4.1 Actively Construct a New Training Mechanism and Platform of Graduate Student Training***

Talent training mode is the structure construction and its realization ways and approaches for student's academic knowledge, technical ability, and professional quality. As for the high level full-time professional master, advanced theory knowledge can improve their scientific research and innovation ability; good professional quality can promote their career healthy development. Based on those reason, a group of domestic colleges and universities have to develop full-time professional master's talent training mode with high maneuverability and practical application, on the basis of following social education rule, reflecting training characteristics, servicing training target. On one hand, strengthening the policy guidance. Because of short-time implementation for professional degree graduate student education, the relevant departments should actively complete role and function transformation, and take effective measures to strengthen and promote school-enterprise cooperation for creating a new training platform and mode. On the other hand, based on demand, classified cultivation. we should, fully drawing on mature experience from college graduate student and professional education, set up distinctive characteristics training plan and professional core courses, and strengthen the practice of vocational skills training. according to the different social needs and the training target of full-time professional degree graduate student.

#### ***78.4.2 Actively Expanding Student Source***

We should give clear-cut propaganda and organizational guidance work, for changing social prejudice, attracting more excellent undergraduates to study for full-time professional graduate degree exempting entrance examination with the good intercollegiate elect mechanism, but also give more opportunity for outstanding students with strong practice ability.

Aiming at professional degree students characteristics and training goal request, we should actively explore and perfect the re-examination way in which mainly evaluate students professional knowledge, application technology, practice ability.

### ***78.4.3 Enriching Course Content, Strengthening the Practice Experiment Content***

Course content, which organically combines the industry organization, training unit and individual career development requirements together, should fully reflect the personnel knowledge and function requirements for professional field, by compressing appropriately course credits of the syllabus, increasing the weight of practice ability and scientific research quality training. In the accumulation of teaching experience, and on the basis of reference industry skills standard, we should support teachers write a group of teaching material and cases according to industry skill studying for the full-time professional degree graduate student education, and encourage teachers to lecture with open form in which include classroom teaching and practice viewing. In the professional selective course, we increase the related frontier courses that have direct help for students in industry qualifications after graduation. And public experiment (practice) class rely on professional laboratory, the state key laboratory, engineering research center and the practice base, for increasing the students' practice experience background, shortening the employment time, improving the professional quality and the employment entrepreneurial skills.

### ***78.4.4 Introducing “Double Teachers” Mechanism, Strengthening the Tutor’s Practice Guidance***

A professional teacher team with high academic level and rich practical experience is key guarantee of the quality for full-time postgraduate education, also is the fundamental guarantee for its sustainable development. Therefore, the units must establish and improve the “double tutor” system, by setting up tutor responsibility system and mentor project funding system led by science and engineering technology research, promoting the comprehensive “double tutor” that with teachers' knowledge and ability, engineers' quality and skill [4].

First, hiring part-time practice guidance teachers, from the school-enterprise cooperation platform, we actively introduce high quality senior professional and technical personnel who have strong theory, business ability from the enterprise to take professional degree graduate training and thesis guidance work. Second, vigorously developing the school teachers training work, we regularly dispatch professional teachers with deep theory knowledge to exercise, practice training in corresponding industry or enterprise in different ways including engineering research, practice exercises, in order to enhance teachers' professional practice experience and ability, enrich them the double quality guidance of professional degree graduate students and academic ones.

### ***78.4.5 Completing the Practice Base Construction***

To make professional degree graduate students to practice at the same time in learning theory course, for the purpose “having solid theoretical foundation, that can be applied in industry practice and the development research, innovation and design”, the school should make full use of, improving and optimizing the existing teaching facilities, subject platform and all levels laboratory, research centers, school-based enterprises, university science and technology park, after overall consideration of the professional training, industry characteristics, scientific research strength, to realize the resource sharing, complementary advantages, construction of comprehensive practice training center for playing an active role in the professional degree graduate student practice teaching.

The cooperation education is one important measures of deepening and security professional degree graduate education in which the key is promoting real fusion between college and the enterprises around the core science and technology, research and development and building a cooperation platform for teacher, the graduate student and enterprise, in order to realize the seamless connection of study, production and research. Graduate student can organize their specific research degree thesis, which combine with specific problems through the scientific research cooperation with the enterprise staff and can directly solve some technical problems, produce innovation research results, and at the same time unit may recruit talents, and further promoting the enterprise influence and benefits, enhancing the ability of social service level.

### ***78.4.6 Building Scientific Quality Evaluation System***

The evaluation system should be built mainly around safeguard mechanism inside and outside training units, social benefits of talent cultivation [5]. The internal evaluation mainly, according to training system index of full-time academic graduate student, excepting basic course learning, research practical skills, combine with the training requirements and internship period and rely on scientific research process stage of the thesis. Social evaluation is mainly focus on phased evaluation for the school running conditions, the teachers level and training quality, social and economic benefits, and we actively encourage relevant industry gradually give priorities to professional degree as for the corresponding qualifications, to realize the goal of enriching the whole personnel training types, promoting the knowledge economy industry development, enhancing the social modernization.

**Acknowledgments** This paper is funded by the program of Chinese Academy of Engineering (Engineering Science and Technology of Coal Industry Training Innovation Research).

## References

1. Shan X, Gong Z, Xu J (2010) The history inevitability of the full-time professional degree graduate education development. *Chin High Educ Res* 11:34–37
2. Huang J, Lu X (2012) The value reflection and reconstruction of our higher education decision-making model. *Mod Educ Manag* 012(2):16–19
3. Lian X, Xiao F, Zhang L (2011) Revelation of education homogeneous between higher vocational education and full-time professional master's degree *Chinese adult education* 7:89–91
4. Ma Y, Zhao S, Li Y (2011) The tracking research thinking for full-time professional degree graduate student education. *Grad Students Educ Res* 01:74–75
5. Shi G, Xiang Y (2008) Management innovation of graduate education under the reform of cultivation mechanism. *Contemp Educ Forum* 7:62–63



# Chapter 79

## Virtual Artistic Training Scheme Based on Music

Xiaohong Zhu

**Abstract** At present, based on the perfect combination of art and the attention of aesthetic education, then a new concept of virtual training was proposed. And virtual training applied gradually in art field at the same time, combined with the opera stage show the effect. But in the opera, the key of aesthetic relates to the combination of performing arts and music. Therefore, using music drama guides the opera stage and studying music to the influences of opera stage with virtual art training. At the same time, the virtual art training model was constructed by using the perturbation principle and method, and the virtual art training samples was analyzed by using quadratic discrimination method, then the application effect of the music was excavated. The results showed that in the conjoint classification stage of opera and virtual art training, the convergence of art can be showed by music. A kind of aesthetic education is beneficial to the formation and development of people.

**Keywords** Music • Opera stage • Virtual training • Quadratic discrimination • Perturbation method

### 79.1 Introduction

Based on the common faith in the integrity of the demand of human education, aesthetic education or training and moral, intellectual and emotional education is looking for human citizens integrity education activities necessary, and can achieve the whole personal growth [1–3]. In this sense, through the report shows, UNESCO collected education performance of the four pillars, these are higher education must be directed to the human said, making human to be more perfect, choose the century of education goal, that is we have to learn how to

---

X. Zhu (✉)

Department of Culture Media, Zibo Vocational Institute, Zibo 255314, China  
e-mail: Xiaohong\_Zhu88@yeah.net

know, learn to do, learn to live together, learn to do what you want to do. In the article the action offline, the ability to based training is the text, this leads to the teaching dimension and it through the art stimulation and influence the education aesthetic [4]. In the process of aesthetic education, training in a virtual artistic wear insert it the reality of knowledge. However, a person’s education is whole, so it cannot be divorced from the rational teaching. In other words, for this reason to explain the study, it must first consider the teaching, which is a logical development of educational activities. For the exchange of artistic, contains a moral and ethical foundation showing clear communicative intent of the author or composer [5]. On the other hand, the opera that the key is to understand the music led by the relevant provisions of the scene as a different work of art. This is an element of the music leadership and continuity, dramatically unified analysis, pointed out the direction of each discipline to guide and participate in the held [6]. As grading opera, which helps, said the potential for a variety of music leaders. The same time, you can ensure that the scene of the visual perception play a lot of imagination and convergence to the reality of knowledge. Virtual artistic music training sample of secondary discriminates, and ultimately allow us to assess the stage of the musical style of leadership as a condition to ensure that the aesthetic direction of the opera [7, 8].

### 79.2 The Model of Music in the Opera Stage Training Principles

How to find the truth of the dramatic, it has since the birth of the study of evolution opera music theater, in a system of music and speech balance, and on the basis of using in the work necessary coherent art to express her true beauty. And the opera stage site management is people think how to run the dialectical music tensions between, and dramatic action, and always music as a unified the soundtrack of elements. But at other times, the stage manager must take this competitive benefits the opera’s dramatic unity. Then, through in the opera stage of virtual art training results to build an analysis of samples. First, the samples were generated by using perturbation virtual arts training. That is, Located N-dimensional characteristics space, have I, j samples. That is for  $X_{ij} = (X_{1ij}, X_{Nij})$ . The sample to eliminate the processing center, it has [9]:

$$y_{ij} = x_{ij} - \bar{x}_i = (y_{ij}^1, \dots, y_{ij}^k, \dots, y_{ij}^p) \tag{79.1}$$

Then, in the sample data with a disturbance [10]

$$y_{ijk} = (y_{ijk}^1, \dots, y_{ijk}^k + \Delta, \dots, y_{ijk}^p), k = 1, 2, \dots, p \tag{79.2}$$

Impact of assessment of a sample of the music applications based on training samples of the virtual art, the establishment of a data matrix [11]:

$$Y_i = \begin{bmatrix} y_{ij}^1 \cdots y_{ij}^k \cdots y_{ij}^p \\ \vdots \\ y_{ijk}^1 \cdots y_{ijk}^k + \Delta \cdots y_{ijk}^p \\ \vdots \\ y_{ijp}^1 \cdots y_{ijp}^k \cdots y_{ijp}^p + \Delta \end{bmatrix} \tag{79.3}$$

The simplified:

$$Y'_i = \begin{bmatrix} y_{ij}^1 \cdots y_{ij}^k \cdots y_{ij}^p \\ \Delta \cdots 0 \cdots 0 \\ \vdots \\ 0 \cdots \Delta \cdots 0 \\ \vdots \\ 0 \cdots 0 \cdots \Delta \end{bmatrix} \tag{79.4}$$

Formula model of the final sample analysis of covariance is [12]:

$$\widetilde{\sum}_i = \frac{1}{n_i + p \times n_i} \sum_{k=1}^p \left( y_{ij} y_{ij}^T + \sum_{k=1}^p y_{ijk} y_{ijk}^T \right) \tag{79.5}$$

### 79.3 Experimental Analysis

Through the establishment of the correlation model for the effect of music on the operatic stage, a virtual art training data analysis model method.

Table 79.1 shows, music on the operatic stage, a virtual art training through the RDA calculation results in the 90–100 range. That is favorable to the integrity of the education of the art music application. And the opera stage site management is people think how to run the dialectical music tensions between, and dramatic action, and always music as a unified the soundtrack of elements. But at other times, the stage manager must take this competitive benefits the opera’s dramatic unity. Then, through in the opera stage of virtual art training results to build an analysis of samples. First, the samples were generated by using perturbation virtual arts training (Fig. 79.1).

In order to establish the comparative analysis, we have established a different number of samples, and data analysis of the music, the best results. Data results into Table 79.2.

Comparative analysis based on the algorithm and the RDA algorithm, the music of which application method is the most ideal, based on the opera stage and the model of the virtual arts training, select three characteristic dimensions for analysis. And the opera stage site management is people think how to run the dialectical music tensions between, and dramatic action, and always music as a

**Table 79.1** The algorithm of virtual art training, the RDA and RDA optimization algorithm disturbance rate (%)

Parameter $\lambda$	0.1	0.2	0.3	0.4	0.5	0.8	0.7	0.8	0.9	The proposed algorithm
RDA	$94.4 \pm 1.95$	$94.44 \pm 2.01$	$94.8 \pm 1.92$	$94.4 \pm 1.98$	$94.34 \pm 1.88$	$94.3 \pm 1.87$	$94.2 \pm 1.82$	$94.3 \pm 1.81$	$94.3 \pm 1.74$	
RDA optimization algorithm	$98.24 \pm 1.29$	$94.2 \pm 1.29$	$94.8 \pm 1.45$	$94.44 \pm 1.45$	$94.24 \pm 1.45$	$94.3 \pm 1.83$	$94.74 \pm 1.78$	$94.34 \pm 1.98$	$94.3 \pm 1.97$	$94.94 \pm 2.05$

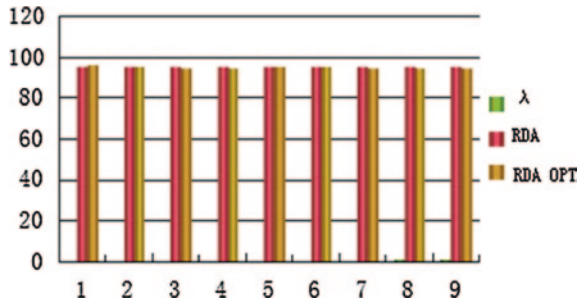


Fig. 79.1 The chart of the algorithm of the virtual artistic training, RDA and the RDA optimization algorithm comparison

Table 79.2 Appropriate rate (%) on different virtual art training and testing samples

Number of samples	3	4	5	8	7
The best results	84.17 ± 2.88	87.79 ± 2.82	88.25 ± 2.44	90.50 ± 2.48	92.18 ± 2.29
The closest	85.88 ± 2.39	91.37 ± 2.71	94.13 ± 2.50	95.94 ± 2.19	98.58 ± 1.43
RDA	88.03 ± 2.32	92.25 ± 2.54	95.80 ± 1.98	98.81 ± 1.08	97.35 ± 1.04
The proposed algorithm	88.39 ± 2.10	92.70 ± 2.39	95.95 ± 1.40	98.87 ± 0.97	97.58 ± 1.45

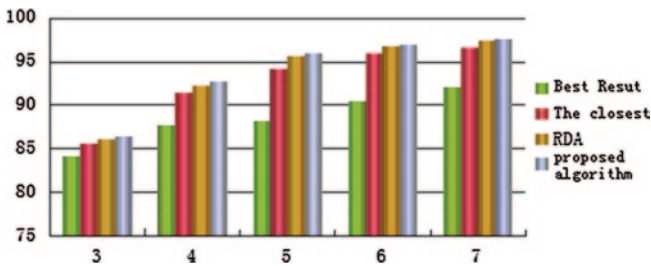


Fig. 79.2 The contrast diagram of virtual art training and testing samples

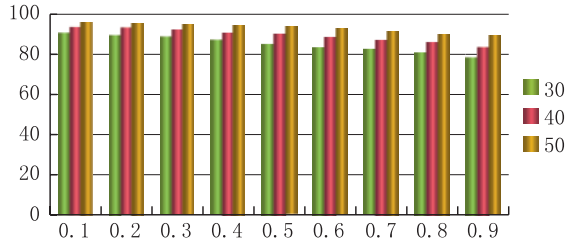
unified the soundtrack of elements. But at other times, the stage manager must take this competitive benefits the opera’s dramatic unity. Then, through in the opera stage of virtual art training results to build an analysis of samples. First, the samples were generated by using perturbation virtual arts training (Fig. 79.2).

Table 79.3 showed that the calculation method applied to the virtual art training sample data will have the problem of instability and the result is music in the opera stage and the effect of virtual art training applications cannot effectively determined. Disturbance occurred as a sample of data is optimized by quadratic discriminates function, making music opera does not require any parameters to optimize the conditions obtained internal association.

**Table 79.3** The proposed algorithm with the RDA algorithm effect ratio (%)

Characteristic dimension	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	The proposed algorithm
42	92.4 ± 5.72	89.41 ± 4.94	88.28 ± 4.91	87.7 ± 5.51	84.97 ± 7.27	84.41 ± 7.17	82.4 ± 7.75	82.58 ± 8.21	78.4 ± 8.57	91.54 ± 4.74
42	94.24 ± 4.45	92.47 ± 4.28	91.75 ± 4.72	92.78 ± 4.72	89.75 ± 4.41	88.44 ± 5.27	87.8 ± 5.97	85.48 ± 7.72	84.45 ± 7.72	94.91 ± 2.88
52	95.58 ± 2.21	94.92 ± 1.72	94.48 ± 1.72	94.98 ± 2.14	94.11 ± 2.72	92.41 ± 4.45	91.5 ± 4.41	89.98 ± 5.28	88.78 ± 7.27	97.42 ± 1.24

**Fig. 79.3** The contrast diagram of algorithm and the effect of the RDA algorithm c



## 79.4 Conclusion

Therefore, the use of Music and Drama to guide the opera stage, through virtual art training, study music to analysis the influences of opera stage. Use of perturbation theory and methods to build the model of the virtual arts training, virtual art training samples of music can be effectively control, and the virtual arts training can be analyzed by quadratic discrimination. The results show that, in the conjoint classification stage of opera and virtual art training, the convergence of art can be showed by music. So the music can became a way of aesthetic education as an individual. The unity relationship of stage performance and music drama is a non-negotiable way, and became a unified and coherent system. Therefore, the installments to promote arts integration will help the opera, and the key is the musical expression, to produce the aesthetic experience of audience directly. Through this experience way, a kind of aesthetic education is beneficial to the formation and development of people (Fig. 79.3).

## References

1. Lin H (2005) Psychology course of music appreciation, vol 23. Shanghai Music Publishing House, Shanghai, pp 643–710
2. Zhang HX (1983) The psychological analysis of music appreciation, vol 44. People's Music Publishing House, Beijing, pp 382–386
3. Yao TS (1985) The description of aesthetic psychology, vol 30. China Social Sciences Publishing House, China, pp 717–718
4. Golub GH, Fanlon CF (2001) Matrix computing, vol 22. Science Press, Beijing, p 66
5. Sun JG (2001) Matrix perturbation analysis, vol 20, 2nd edn. Science Press, Beijing, p 204
6. Hong ZQ, Yang JY (1991) Optimal discriminate plane for a small number of samples and design method of classic on the plane. Pattern Recogn 24(4):317–324
7. Fukunaga K (1990) Introduction to statistical pattern recognition, vol 65, 2nd edn. Academic, New York, pp 1423–1425
8. Schramm W (1988) The modernization of media and education, vol 33. Higher Education Press, China, p 8226
9. Qin DX (1989) The elements of music education, vol 22. Nanjing University Press, Nanjing, pp 445–447

10. Guo SJ (2004) The theory of music education, vol 47. Hunan Literature and Art Publishing House, Hunan, pp 816–818
11. Liao NX (2005) Music pedagogy of the Central Conservatory, vol 55. Music Press, New York, pp 237–239
12. Qu BK, Zheng JT (2005) China education research progress, vol 78. East China Normal University Press, Shanghai, p 8226



# Chapter 80

## Research on Environment Construction of University Harmonious Campus Based on Cultivation of Innovative Talents

He Xiao

**Abstract** In 21st century, the competition of world can promote the talented person's competition, particularly is the competition of creative character talented person. Consequently in order to set up harmonious campus environment, make higher request to these talented person's development. This text is according to the standpoint like this, then set up harmonious campus environment, stir up creative thinking, improve the university student's creative ability, author get conclusion, we should make great effort to create the environment of health, harmony and innovation, availably raise harmonious academic atmosphere and always insist the management principle for making people the center.

**Keywords** Creative harmonious campus • Innovative talents • Environment construction

### 80.1 Introduction

The innovation is the abyss of time topic of mankind's activity, is the mankind progress of not Jie power. Thou the key that discussed that the mankind develop a problem of once numerous scholars is development to create a character talented person now. Training the creative type talented person is that the construction innovates the demand of type nation, this world belongs to a person who own creative consciousness. Currently the creative type studied the talented person's development, among them big parts of concentrations in train the method set up for fostering a target or from macro view to the research of tiny view, but few concentrations airing at the harmonious campus environment of. Therefore, this text signs on the foundation of promoting the creative talented person and finds out some concrete measures that set up harmonious campus environment.

---

H. Xiao (✉)

Department of Social Sciences, Xinxiang University, Xinxiang 453000, China  
e-mail: hexiao\_xxc@163.com

## **80.2 The Significance of Cultivating the Innovative Talents by Constructing Harmonious Campus**

### ***80.2.1 The Construction of Harmonious Campus Environment is the Need of Cultivating Innovative Talents***

On the psychology, the person's personality from personal mental stability and the tendency characteristics constitute, this includes the person's qualities, benefits, demand, will, personality, emotion, faith, and motive...etc., among them, these factors are with talented person of innovation closely-related. It is the essence of the creative character talented person to innovate and reform spirit, it is innovating, behavior organization and various non- intelligence adjusts to control in have predominance and power function. The great man once said: While person is creating environment, the environment also created a person. The harmonious campus environment can encourage the student's emotion and motive, equally for forming the university student's creative character talented person to provide may, It can also stir up the student's endless imagination and guide them to search and pursue and struggle at the same time, thus for formed the university student of innovation characteristic to create condition. Harmonious campus environment at with his/her strong influence and permeate a dint help student gradually establishment rise correct philosophy of life, value, and construct one actively upward of creative character.

### ***80.2.2 Constructing Harmonious Campus is the Needs of the Creative Talent***

Train a creative type talented person to need open, democracy, freedom, harmonious campus environment. Only in a harmonious campus environment, the student's creation thinking can correct development, but innovate the talented person of ability, can with maximum limit develop their creation potential; Only in a harmonious campus environment, and produce more creations from here achievement. The harmonious campus environment can bring the free discussion of the student's and make the school manages of more democratization, all these can produce active thinking, and the student's the fusion for toughing, promote the creation of creating character thinking thus. Promote so-called 100 blossomy academic environments of a harmonious campus environment atmosphere assertion, the encouragement student's, the friendly relation establishment of the teachers and the students' encourage that teacher and student together discuss a problem. For understanding the factor of influencing the relation of teacher and pupil, this text did logic regression analysis, namely.

Establish  $y$  in order to measure  $X_1$  because of changing,  $X_2 \dots X_k$ s for from change to measure, and from change and measure with because of change to measure of its line characteristic behavior, then diverse linear regression model can be:

$$Y = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_k x_k + e \tag{80.1}$$

Among them,  $b_0$  is the constant item,  $X_1, X_2 \dots X_k$ s are regression coefficients,  $b_1$  is a  $X_1, X_2 \dots X_k$  fix,  $x_1$  increase an unit's effect for  $y$  each time, namely  $x_1$  being partial to of a rightness of  $y$  regression coefficient; Together manage  $b_2$  is a  $X_1, X_2 \dots X_k$  fix,  $x_2$  increase an unit's effect for  $y$  each time, namely,  $x_2$  being partial to of 2 rightness's of regression coefficient. The parameter of diverse character regression model estimates that the same linear regression equation is similar, also is requesting error margin square and  $(\sum e)$  is under the minimum premise, solve parameter with minimum two multiplications. Solving the following equation can be  $b_0, b_1, b_2$  numbers.

$$\begin{cases} \sum y = nb_0 + b_1 \sum x_1 + b_2 \sum x_2 \\ \sum x_1 y = b_0 \sum x_1 + b_1 \sum x_1^2 + b_2 \sum x_1 x_2 \\ \sum x_2 y = b_0 \sum x_2 + b_1 \sum x_1 x_2 + b_2 \sum x_2^2 \end{cases} \tag{80.2}$$

By logic regression analysis, at of in the factor of influence relation of teacher and pupil, what to have a decisive function is the student's age, character and ego fixed position, namely the student of higher class and teacher relates to intimate proportion Gao. This enunciation, the age rises very important influence. And character and ego position to also have to the relation of teacher and pupil bigger influence, namely the boy and teacher relate to intimate proportion Gao; To the fixed position of the ego more tall student and teacher proportion Gao of the relation intimacy.

### 80.3 The Methods of Cultivating Innovative Talents in the Harmonious Campus Environment

#### 80.3.1 *The Harmonious Campus is the Fundamental of Cultivating Innovative Talents*

The environment that any talented person's development needs is the soil of its existence and development, innovation the talented person's development is no exception, his growth needs one vivid, be rich with the campus environment and atmosphere that create character and harmony, this kind of environment should encourage that they express their own viewpoint and opinion, this will contribute to potential of full development individual, and stir up creative human resource. The actively harmonious atmosphere is to encourage a creative method, it is a

creative spirit home, can stir up the creative idea of the student's innovation consciousness and exaltation student to read. The harmonious education environment can raise the thinking between teacher and student intelligent degree and stir up the inspiration of teacher and student. The harmonious education environment is equity, there is preface, reasonable of the environment is to improve student's quality and strengthen study knowledge intensive degree and raise student's ability and make them more careful with pragmatic warm and fragrant harmonious campus atmosphere. We not only need to insist taking student as origin of principle, concern the student's health, and think that the square tries the problem of solving the student and contributes efforts to their growths as far as possible and creates a harmonious and healthy education environment in the campus at the same time, also need to value an of teacher and student of friendly relation, give teacher and student of the active of and full exertion of the creation, form a mutual study, mutual cooperation and elevated good environment mutually; Continue to construct a campus environment of harmonious stability hard, carry out of school and peripheral environment, student and surroundings harmonious environment [1].

### ***80.3.2 The Harmonious Culture Atmosphere is the Basis of Cultivating Innovative Technical Talents***

Harmonious innovation culture is the immaterial assets of campus, and the university student can keep on one of the important factors of development. Again, it is harmonious to innovate the cultural form passed the university humanities spirit atmosphere, this special magic power that embodied to teach a person. Construct harmonious education atmosphere, promote the student's spirit state, build healthy character, and guide a student to use a harmonious mode of thinking, availably promote a creative type talented person development. While constructing harmonious cultural environment, we have to insist a correct cultural direction. The total secretary of Hu Jintao says: "We want to put the development of advanced culture in the very outstanding position, is fixed attention on to the character of raising the person, promote people's overall development, strengthen to thought morals construction education. At the same time, creative harmonious cultural environment the construction don't can complete between a night, contrary, we should draw up the development strategy of a long term and the development target of the university to combine. For letting full exertion of the leadership function of students' organization and organization with raise the student's culture and morals character, need to develop to enrich colorful, elegant, cheery cultural activity. The level of these activities directly influences education and the university to come together function. Therefore, raise the level of campus cultural activity to seem to be count for much.

The harmonious academic atmospheres the key of the cultivation of innovative talents to strengthen harmonious campus cultural construction carry out environment to teach a person, the campus is the big classroom of student's study.

Constructing harmonious campus culture is the target and means that the harmonious campus constructs, the soul of green campus ecosystem [2]. A harmonious and good school tradition and atmosphere of a school are campus spirits cultural core and of one of the essential condition. It can establish a kind of latent academic style in the whole campus; can biggest influence the university student's mode of thinking, morals thoughts and feelings, the value choose, with their behavior and habit. The academic atmosphere that forms harmony in the high school can guide the research that the student emphasizes science, climb science high peak and cultivate good campus and campus style spirit. Under the new situation, the high school should hard construct excellent academic atmosphere and hard develop dependably, diligence, careful, the talented person of innovation. Meanwhile, we should insist taking essential culture as predominance. Socialism advanced culture included essential culture in campus culture; it was the essence of our national time spirit and campus spirit. Is to can't get away from the essential and cultural in harmonious campus cultural construction process, because it is to construct harmonious campus cultural foundation and assurance. Because the world is already diversified, present coming trend of not-essential culture of in campus culture currently, and have a lot of university students to mean favor to it, not-essential culture has already blown to have a warning to essential culture. Therefore, we have to want to take essential culture as a main force, don't abandon and don't neglect not-essential culture of beneficial one side; Our beard is diversely led with essential culture not-essential culture, in all aspects foundation on encourage blending of not-essential culture [3].

The people-oriented harmonious campus environment is the security of cultivating innovative talents.

The principle for "make people the center" comes from a German philosopher fee Er Bach, the thought contents making people the center has to make people the center, with the artificial premise. To always insist the harmonious management for making people the center carry out the overall development as target, maintenance the student's basic benefits respect the student's corpus position; always pay attention to the student's healthy growth. The harmonious campus environment means respect and serves and comprehends a person and concerns a person and only has so, construct a harmonious campus environment to just can be expected soon. The management principle of school is to insist making people the center, this main performance in order to take student as center and allow by teaching artificial F, with push forward education for all-round development completely for lord line, virtuous, Zhi, the body, the United States and Lao "five teach" and raise, guide, help the student body to develop completely. And this is opposite should, the school still needs with the teacher develop into premise, in aid of person, encourage artificial foundation, just can make all teachers display a he or she's real strength like this. The school needs to solidify the all teacher's group and well makes a show of each teacher's working talent, just can attain to teach the effect of teaching the person like this. Meanwhile, the school should be begun to establish more completely, more well-found student's study, the teacher work of environment, strengthen teachers and the students' employee's ownership feeling,

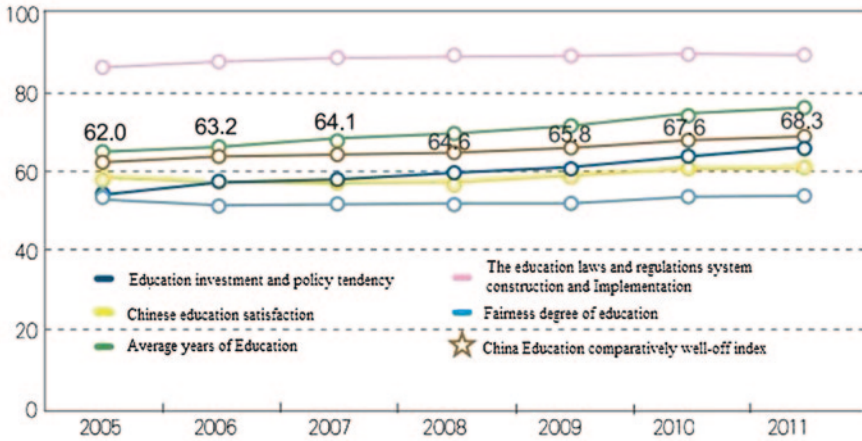


Fig. 80.1 The national average education level gradually improve process

construct more easily pleased of atmosphere, finally raise all the happy index number of teachers and the students’ employee; Promulgate in the system in, have a foothold at the legal rights of guarantee teachers and the students’ employee, the management system of continuously perfect school democracy; On the post system, insist setting up talented person the first, and handle the benefits relation of good teachers and the students’ employee, promote all personnel’s creative ability, construct the most beautiful good harmonious campus [4]. Develop a view in science as follows under, citizen on the average teach to teach level from 2005 to 2011 years gradually raise of process, seen as Fig. 80.1 [5].

### 80.4 Conclusion

Nowadays, the competition of world returns a root to exactly would be the talented person’s competition, especially innovated talented person. The campus is the place of induction knowledge, technique and talented person, therefore has responsibility development the innovation type the talented person. The harmonious campus environment is the ideal place of growth that behaves just, it is the important battlefield of the creative talented person’s development. In order to foster an innovation talented person, the harmonious campus atmosphere developed a more and more obvious function in the training, it has become a kind of important education resources and talented person develops of core. Therefore, build on the foundation of harmonious campus up, for development innovation type talented person come to say, this is an extensive huge engineering, involve the way of thinking, principle of overall reform, concept and high education teaching and management, this needs the working talent of researcher and constructor study and creation is together (Table 80.1).

**Table 80.1** In 2005–2011, China Education comparatively well-off index

Level evaluation index	Weight	2005	2006	2007	2008	2009	2010	2011	Than in the previous year
Education investment and policy tendency	20	54.3	56.8	58.0	59.2	61.0	63.5	65.6	2.1
The education laws and regulations system construction and implementation	20	85.8	87.5	88.2	88.5	88.7	88.9	89.0	0.1
Chinese education satisfaction	25	58.4	56.8	57.1	57.4	59.1	61.0	60.9	-0.1
Fames degree of education	20	52.8	51.3	52.0	51.8	51.8	53.6	53.7	0.1
Average years of education	15	64.1	65.8	67.6	69.3	71.2	74.0	75.8	1.8
The china education comparatively well-off index	100	62.0	63.2	64.1	64.6	65.8	67.6	68.3	0.7

## References

1. Jiang QD (2007) How to construct a harmonious campus. *J Changchun Univ Sci Technol* 10:33–35
2. Ren Q, Xie N (2008) To construct the harmonious campus, to cultivate students' healthy personality. *Occup Edu Res* 7:43–45
3. Li M, Wang P (2007) Six elements of constructing harmonious campus. *J Jiangxi Agr Univ* 3:15–17
4. Wang Y (2010) The construction of harmonious campus under the scientific outlook on development. *J Hubei Radio TV Univ* 3:21–23
5. Wang L (2010) Chinese comprehensive well-off research center. 2010–2011 Chinese education comparatively well-off index: 68.3. *Well-off J* 11(30):55–57

# Chapter 81

## Research on Ideological and Political Education of College Students in Mobile Phone Environment

He Xiao

**Abstract** The cell phone as a “fifth media” with its information and e-commerce is being used by individual and social enterprises. For the community enters into the E era, the phone provides a cost-effective, low-cost mobile application platform and provides a convenient and flexible two-way channels of communication between people. College students as an important group to use mobile phone, mobile phone brings college students convenience, but also brings more challenges to the university education. How to make full use of mobile phones to better serve the ideological and political education, we need to consider the problem. This chapter is based on the characteristics of mobile environment, makes field research on college students’ use of the phone, and conducts descriptive statistical analysis of college students sending SMS usage and the main reason for using the phone’s content, etc., in order to find a more reasonable and effective way to strengthen ideological and political education and to pioneer the application of mobile phones in the new field of ideological and political education.

**Keywords** Descriptive statistical analysis • Phone environment • Ideological and political education • The fifth media

### 81.1 Introduction

The mobile phone as a new media gradually gains widespread use among college students, and the phone has been used by college students to the pursuit of fashion consumption. Phone as a product of rapid social development, technological progress, full-featured, in various forms, compact, easy to carry, and other features brings convenience to people’s lives, facilitates communication between people, and provides information access and stylish pursuit and so on. But everything is

---

H. Xiao (✉)

Department of Social Sciences, Xinxiang University, Xinxiang 453000, China  
e-mail: hexiao\_xxc@163.com



double-sided, and it also gave rise to the troubled convenience, such as the existence of spam messages, telephone harassment, fraud, etc. It also brought more big challenge to the ideological and political education of college students [1, 2]. Students in the classroom answering the call and sending text messages to interfere with the normal classroom, but also reduces the quality of the classroom, while the mobile phone entertainment features are strengthened, but also caused college students to spend a lot of time in this. Image processing (image processing) is the analysis of the image by the computer to achieve desired results. Usually image processing refers to the digital image processing, and digital image is defined as to use images got by digital cameras, video cameras, scanners. Through sampling and digital what we get is a two dimensional array, and the array of each element called pixel; its value is an integer, called the grey value. Image processing technology includes image compression, description, and recognition, strengthen and recovery. Image restoration, image segmentation, digital image, image coding, image enhancement, and image analysis are common ways to do it. The image of the transformation between is the key to emphasize the image processing. Although people commonly use image processing to mean all kinds of image technology, narrow sense of image processing means to meet the image processing and improve image visual effect, and for automatic identification or to do image compression to reduce the storage space required or transmission access, transfer of time requirements.

So how to take full advantage of the phone to be better used in the ideological and political education, making the ideological and political education better, more convenient and easier means of communication is very important [3].

## 81.2 Research Methods

In this chapter, a questionnaire survey is conducted in Wuhan University with 1,500 questionnaires, and 1,300 valid questionnaires were recovered, while the efficiency reached 86.7 % [4]. In this chapter, there is a descriptive statistical analysis of research data to understand the students using mobile phones as well as the usage of college students using mobile phones to analyze and explore the full application of the phone in ideological and political education. Students basically cannot leave the phone, so how to make it fully play its role will be worthy of our deep thinking.

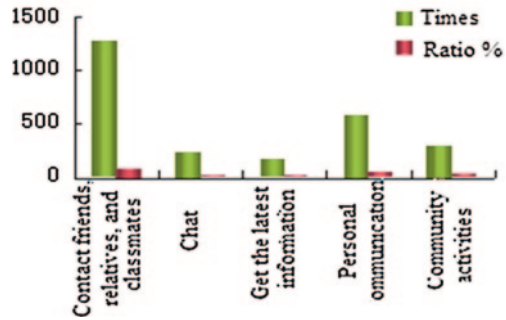
## 81.3 Data Analysis

According to the research result showing in Table 81.1 and Fig. 81.1, we can see clearly that the main use of college students sending SMS is still the contact friends and classmates, which accounted for 84 % of the proportion, and the

**Table 81.1** Purpose of students sending SMS (multiple choices)

Purpose	Times	Ratio %
Contact friends, relatives, and classmates	1,273	84
Chat	236	10.5
Get the latest information	165	9.8
Personal communication	578	33.6
Community activities	300	21.2

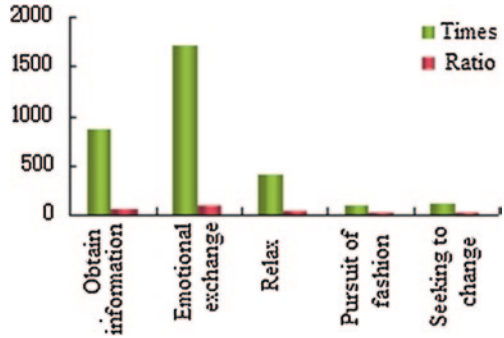
**Fig. 81.1** Purpose of students sending SMS



second is interpersonal communication, accounting for 33.6 %; ranking the third is community activities needs, accounting for 21.2 % of the proportion, which fully shows that college students have part of the phone for personal ability enhance; chat uses accounted for 10.5 %, while access to the latest information, the smallest proportion was only 9.8 % less than the proportion of small talk [5]. Common image processing software is very extensive, Adobe Photoshop is a top image processing software in terms of name recognition and utilization rate. Image processing software has to be fast, efficient and will be in accordance with established image requirements of processing, also can get very good effect. But the software must have a foundation to use, if not after learning they still can't image processing. Other requirements of the image processing is for professionals to complete, so to set up a simple, easy, easy to operate and able to adjust the function of image processing simulation technology is very necessary. By using the virtual instrument technology, based on image processing Lab VIEW software simulation system establishment, we can complete the simple processing of image, human interface, simple and quickness, and can meet the needs of the people. This fully shows that college students still do not realize the importance of mobile phones, or using the phone in the entertainment point of view, which did not give full play to the information value of the mobile phone.

Mobile phones can now realize communication at anytime and in anywhere, but it is efficient for the latest information and the quickest way, so we should fully take advantage of it and the college students should give full play to the

**Fig. 81.2** The main reason for students sending SMS



**Table 81.2** The main reason for students sending SMS (multiple choices)

Purpose	Times	Ratio
Obtain information	855	39.6
Emotional exchange	1,703	80.4
Relax	400	20.3
Pursuit of fashion	89	3.4
Seeking to change	103	5.7

function of communication at anytime and anywhere to get the latest information and to fully grasp the limited time to enhance their own knowledge and skills and improve themselves.

It can be seen from Fig. 81.2 and Table 81.2 that the main reason for college students sending SMS is the emotional exchange, accounting for 80.4 %, followed is to obtain information, accounting for 39.6 %, the third main reason is to relax, whose proportion reached 20.3 %. Seeking to change accounts for 5.7 %, and the pursuit of fashion accounts for only 3.4 %; these two accounted for a total of not more than 10 % [6]. It also reflects the students send SMS is mainly for the exchange of feelings, to obtain information and to relax.

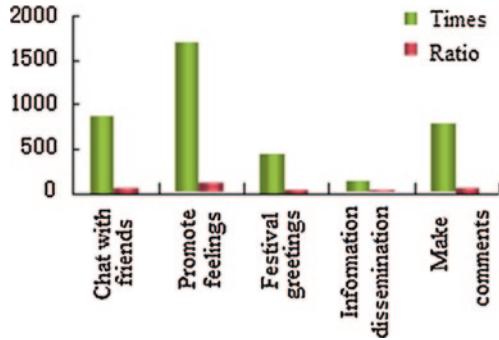
Figure 81.2 shows the second main reason is that the college students to send SMS in order to obtain information, but we have learned that college students sending SMS to obtain the latest information only accounting for the minimum shown in Fig. 81.1, which means college students using mobile phones in the first place and real purpose does not match: it was originally used to get information, but they are still concerned about small chat, emotional communication, as well as entertainment, but ignored the main purpose of the latest information. So we need to guide college students on this and fully make the use of mobile phones to guide students to obtain the latest information. They need to understand the real-time dynamic, and at the same time, continue to strengthen contact with the outside world, make themselves more on pace with the times, and get ready to learn to master and learn.

From Table 81.3 and Fig. 81.3, we know that the most important reason for students using the phone is to promote good feeling, accounting for 78 %. Secondly, chat with friends, accounted for 40.1 %; once again make comments accounting

**Table 81.3** Contents of students using the phone

Purpose	Times	Ratio
Chat with friends	865	40.1
Promote feelings	1,683	78
Festival greetings	434	18
Information dissemination	120	9.8
Make comments	786	36.7

**Fig. 81.3** Students using cell phone



for 36.7 %. The blessing of the festival is also only 18 %; the lowest proportion is dissemination of information, only 9.8 %. This fully shows that the students using phone in information dissemination and access is a serious lack. They do not strengthen access to information, and they don't have awareness of dissemination, and do not take full advantage of the cell phone for access to the latest news and information.

From the above Figs. 81.1, 81.2 and 81.3, it is clear that students use phone for very little new access and dissemination, and this is also not being utilized efficiently and give the biggest role of the mobile phone; they just use them as the most general function. In this simulation system design, first find the need for processing image, and then begin as users to choose to deal with the designated pictures, and display in the front panel, then image processing the images chosen and the realization of the images before and after at the same time, and finally complete processing and exit system [7]. The software operation though is not complex, the data acquisition is real-time; image processing speed is faster; the computer's memory demand is relatively high, so in programming to arrange the control calls and executing order is very important. In the program using a theory is very necessary, and its the only way to ensure continued operation of the program, and then in the internal we can call other procedures, but we had better use sequence structure, so that the operation of the simulation system can be efficient and fast. In the image processing, you will have to put the image into an easy-to-find computer hard drive or mobile storage equipment, and then operate

simulation system by inputting user password according to the instructions to enter the interface, and then locate the objects according to the system interface hints. By this time the image in the original images will be displayed in the window; process according to the contrast and adjustment tool of brightness; make sure the image post-processing will go for real-time display. If there is need to save it, choose the save path and saved it. Finally quit the system and complete the operation. Therefore, we should strengthen the guidance of college students, play out the anytime and anywhere activity of news and information function of the phone. And at the same time, make the ideological and political education of college students run through them, being guided correctly, and making college students to enhance time management for efficient learning, improve themselves. While knowing domestic and international current affairs, they can have access to interested professional knowledge, enhance their professional knowledge, and actively develop their own hobbies, give full and effective use of their own time, not waste their time, enhance learning, improve themselves and enhance individual accomplishment, in order to become the all-round talents required by the society.

## 81.4 Conclusion

From researches in this paper, we can see that in modern society, college students using mobile phones are generally for the most basic emotional need to communicate, essentially for gossip and judgment, etc., which did not really play the phone's functions. The ideological and political education not only is limited to classroom teaching, should really go deep into college students daily life communication, and give full play to the advantages of mobile phones, or the latest campus dynamic by group sending SMS, and in other forms, so that we have real-time attention to the dynamic, real-time understanding of the information, and also fully aware of the real use of mobile phones, to increase the propaganda of the phone on the ideological and political education, and guide people in understanding the formation of mobile phones to promote the moral quality of university students as well as good social behavior, and emphasizing its important role in the shaping of human accomplishment, to make real the phone carrying the mission of human civilization, and the phone as a rational and efficient carrier of spreading civilization and shaping moral character.

## References

1. Chen SS (2005) Conflict and balance between SMS and undergraduate education. Henan Judicial Police Vocational College, vol 23(4), pp 46–80
2. Zhang JG (2006) Students SMS education and its management strategy. Henan Vocational and Technical Teachers College (vocational education), vol 12(4), pp 72–75

3. Ding Y, Shen RF (2003) SMS: a new cultural proposition. *Chin Youth Res* 11(3):55–66
4. Liang JX (2006) Ideological and political education's hot spot problem research, vol 24(6). Shandong University Press, Jinan, pp 135–137
5. Zhang YC, Zheng YT (2006) Modern ideological and political education Beijing, People's Publishing House, vol 44(30), pp 249–300
6. China internet network information center. Chinese mobile media report: the impact of the development trends of mobile media [EB/OL]. <http://tech.sina.com.cn/i/2009-02-17/shtml>
7. Xu ZX (2007) New media: opportunities and challenges in ideological and political education. *Ideological Political Educ Res* 23(6):64–66

# Chapter 82

## Teaching Reform of Advanced Mathematics

### Teaching Practical

Fu Shujuan and Zhao Hui

**Abstract** Currently, Numerous mathematics educators are striving to summarize the basic theory of education science from the educational experience of all times and revealing the objective laws of the educational process, only from the start with the fundamentals can we make our education achieve major reforms. This chapter is talking about the teaching research and teaching reform in specific class combining teaching practice of our adult education in recent years.

**Keywords** Teaching research teaching reform • History of mathematics • Constructive way of thinking • Counter-example teaching • Mathematical model

## 82.1 Introduce the History of Mathematics to the Class

In actual teaching, the advanced mathematics' class is more content and lesson time is relatively less, many teachers attach importance to training logical thinking in the teaching process, but they can't attach enough importance to stimulate students' interest in learning to teach students to seek truth and discover the truth of the ability, so they can't develop students' creativity better. Use of the material of the history of mathematics, to explain the mathematical theory, not only will not waste time, but also often receive very good results. Students study the teaching of the history of mathematics, they can know the ins and outs of the key ideas, not only depend on the understanding of the concept, but also learn the scientific way of thinking, experiencing the thinking skills of mathematics masters is of great benefit for the achievement of our educational and teaching purposes.

For example, when speaking infinite series, we are speaking of infinite series has been an integral part of a part of the calculus. Newton study series is inseparable from the method and the number of stream (variable rate of change), In his study of complex algebraic functions and transcendental functions, only

---

F. Shujuan (✉) · Z. Hui  
Langfang Radio and Television University, West Road No. 101, Hebei Province, China  
e-mail: lcyhbb@sina.com

develop into an infinite series and the itemized differential or integral but to deal with them. So, students soon know why we study series and series role., Gives the students such a simple case: consider the series  $1 - 1 + 1 - 1 + 1 - 1 + \dots$ , it has caused a great controversy in the seventeenth century, the first idea: The series was written  $(1 - 1) + (1 - 1) + (1 - 1) + \dots$ , its sum was 0. Can you tell us that the world can be created from the empty? The second idea: The series was written  $1 - (1 - 1) - (1 - 1) - (1 - 1) - \dots$ , its sum was 1. The third idea: In the expression  $\frac{1}{1+x} = 1 - x + x^2 - x^3 + \dots$ , let  $x = 1$ , then  $\frac{1}{2} = 1 - 1 + 1 - 1 + \dots$ . Immediately with this simple example can inspire students to great interest, the passive learning with the purpose and interest is much better than the usual "Feed the ducks" [4].

## 82.2 Attach Importance to Develop the Thinking Training

The state and the government advocate for us to create the innovative society currently, colleges and universities should attach importance to the students develop the thinking training, because the process of human cognition is a historical process, nature is the repeat between the theory and the practice. The existing theories make us understand the things that we know known and inspire us to discover the unknown. But thinking is inertial, when the old theory has prevented discovery, we should breakthrough in the original theoretical framework, Opening up thinking and training in mathematics class is theatre of war of Students' creative quality training.

The structure of the mode of thinking is the most important in mathematics creative thinking, it is important to the mathematical theory of creative development and problem solving, because this is the creative process from scratch, the structure of the method focuses on the thinking structure of practice, It is to obtain results and the results structure, This construction process is very difficult, So it has prominent value creation and value [3].

For example, hypothesis  $f(x)$  is differentiability in  $(0, +\infty)$ , and  $0 \leq f(x) \leq \frac{x}{1+x^2}$ , then there exists point  $\xi > 0$ , make  $f'(\xi) = \frac{1-\xi^2}{(1+\xi^2)^2}$ .

Prove: consider the function  $F(x) = \frac{x}{1+x^2} - f(x)$ , then  $F(x)$  meets

1.  $F(0) = 0$   $\left( \because 0 \leq f(x) |_{x=0} \leq \frac{x}{1+x^2} |_{x=0} = 0 \right)$
2.  $\lim_{x \rightarrow 0^+} F(x) = 0$   $\left( \because 0 \leq \lim_{x \rightarrow 0^+} f(x) \leq \lim_{x \rightarrow 0^+} \frac{x}{1+x^2} = 0 \right)$   
 $\lim_{x \rightarrow +\infty} F(x) = 0$   $\left( \because 0 \leq \lim_{x \rightarrow +\infty} f(x) \leq \lim_{x \rightarrow +\infty} \frac{x}{1+x^2} = 0 \right)$
3.  $F(x)$  is continuous in  $(0, +\infty)$ , And constant  $F(x) \geq 0$
4.  $F(x)$  is derivative in  $(0, +\infty)$ , and  $F'(x) = \frac{1-x^2}{(1+x^2)^2} - f'(x)$  Only need to prove the existence of two point  $x_1, x_2 \in (0, +\infty)$  make  $F(x_1) = F(x_2)$ .



If  $F(x) \equiv 0$ , It is clear that the conclusion.

If  $F(x) \neq 0$ , Then there exists  $x_0 > 0$ , make  $F(x_0) > 0$ , Continuous function of the intermediate value theorem, There must be  $x_1$ ,  $0 < x_1 < x_0$ , and  $F(x_1) = \frac{F(x_0)}{2}$ . And because  $\lim_{x \rightarrow +\infty} F(x) = 0$ , then exists  $X > x_0$ , when  $x'_0 > X$ , make  $0 < F(x'_0) < \frac{F(x_0)}{2} < F(x_0)$ , by the intermediate value theorem, Then there exists  $x_2 \in (x_0, x'_0)$ , make  $F(x_2) = \frac{F(x_0)}{2}$ . So in  $[x_1, x_2]$  Rolle theorem conditions are met, exists  $\xi \in (x_1, x_2)$ , make  $F'(\xi) = 0$ , that is  $f'(\xi) = \frac{1-\xi^c}{(1+\xi^2)^2}$  [2].

The proof is given a constructive method; Make  $F(x)$  to meet the conditions of the Rolle theorem. And a revelation to the students: Rolle theorem can be extended to the infinite interval.

### 82.3 Held a Counter-Example is the Mathematical Way of Thinking

Mathematician Olmsted once said: "Mathematics is made up of two categories—Proof and counter-examples, mathematical discoveries but also towards two main goals—certificate and construct counter-examples", counter-examples in mathematics usually refers to the overthrow of the established example of a proposition. for instance, if  $P, Q$  are Simple proposition, we know from the truth table, the compound proposition: "if P then Q" is false, if and only if P is true and Q is false. Thus overthrow of the compound proposition "if P then Q" you can set up the counter-example: the P is true and the Q is false in an example. Clearly, the substance of the counter-example is falsification. Obviously, the counter-examples can be found in the central plains mathematical limitations and shortcomings of the theory, to promote the continuous development of mathematical thinking. Secondly, the counter-examples to the students' conceptual understanding and deepen a good role. Looking for a special case to construct counter-examples is a commonly used method, [1] for instance: Assume  $f(x)$  has continuous derivative in  $[a, b]$ , For each point  $\xi$ , Whether there are two points  $x_1, x_2$  ( $x_1, x_2, \xi \in [a, b]$ ),  $x_1 < x_2$ , make  $\frac{f(x_2)-f(x_1)}{x_2-x_1} = f'(\xi)$ ? the answer: Give counter-examples:  $f(x) = x^3, \xi = 0$ , then  $\forall x_1, x_2, x_1 < \xi = 0 < x_2$ ,  $\frac{x_2^3-x_1^3}{x_2-x_1} = x_2^2 + x_1x_2 + x_1^2 = (x_1 + x_2)^2 - x_1x_2 > 0$ . But  $f'(\xi) = f'(0) = 3x^2|_{x=0} = 0$ , so  $\forall x_1 < 0 < x_2$ ,  $\frac{f(x_2)-f(x_1)}{x_2-x_1} = f'(\xi)$  are not set up.

### 82.4 Unifies the Actual Problem to Carry on the Classroom Instruction

With a mathematical model to strengthen the links between theory and practice. The so-called mathematical model Refers to something system characteristics and quantity of relationships built up with the mathematical language symbol system.

A narrow speaking, The mathematical model refers specifically to reflect a specific problem or mathematical symbols of things, Use mathematical equations (Such as functions, graphical, algebraic equations, differential equations, integral equations, differential equations, etc.) to describe (represent, simulate) the research objective object or system in a particular aspect of the existence of laws, so is designed to solve specific practical problems. The emergence and development of any one discipline, are inseparable from the practical application of the driving, The history of the development of higher mathematics itself is history, For example, Kepler summed up by the observations of the planets Kepler’s three laws, Newton tried to discover for themselves that the laws of mechanics to explain it, but existing mathematical tools are not enough, which prompted the invention of calculus. In the actual teaching process, The teachers only describe classical theory ignoring the course itself and the outside world, ignoring the actual sources and uses of the direction and method of mathematical objects In particular, The students learn a lot of definitions, theorems and formulas, but not clear why to learn higher mathematics, school is finished can do things. With the process of teaching advanced mathematics to build mathematical models, not only highlights the practical courses, but also to mobilize the enthusiasm of the students.

For example, there is such a real problem: there is a standing and the cylinder jug, it is 6 m in height and 4 m in diameter, A radius of  $\frac{1}{12}$  m of the hole in the bottom of the tank, Reservoir filled with water tank, how many time will all the water discharged?

The answer: In order to address the issues raised, we need to use formula  $v = \sigma\sqrt{2gh}$ ,  $v$ : Speed of the water,  $h$ ; depth of Surface to the water hole,  $g$ : Acceleration due to gravity,  $\sigma$ : constant coefficients, of water,  $\sigma \approx 0.6$ .

At the beginning, ( $t = 0$ ) Horizontal height  $h_0 = 6\text{m}$ , Set up after a time  $t$ , Plane height of the water left  $h = h(t)$  m, from time  $t$  to  $t + dt$ , The surface of the water to reduce  $dh$  m, Here to seek the volume of water flowing  $d\omega$  after infinitesimal time  $dt$ :

On the one hand,  $d\omega$  Equals the volume of Small cylindrical whose Height is  $|dh|$  and Bottom radius equal to the radius of the tank bottom  $r = 2$ ,  $d\omega = \pi r^2 |dh| = -\pi r^2 dh$ ;

On the other hand,  $d\omega$  is equal to the cylindrical volume whose end of the radius equal to the low hole radius of  $\rho = \frac{1}{12}$  m and height of  $v dt$  m, so  $d\omega = \pi \rho^2 v dt = \pi \rho^2 \sigma \sqrt{2gh} dt$  the two expressed the same volume, so  $-r^2 dh = \sigma \rho^2 \sqrt{2gh} dt$ , After separation of variables,  $dt = -\frac{r^2}{\sigma \rho^2 \sqrt{2g}} \cdot \frac{dh}{\sqrt{h}}$ ,  $t = C - \frac{2r^2}{\sigma \rho^2 \sqrt{2g}} \sqrt{h}$ .

When  $t = 0$ ,  $h = h_0 = 6$  m, so  $C = \frac{2r^2}{\sigma \rho^2 \sqrt{2g}} \sqrt{h_0}$ . Then, we get the equation of and  $h$ :  $t = \frac{2r^2}{\sigma \rho^2 \sqrt{2g}} (\sqrt{h_0} - \sqrt{h})$ , let  $h = 0$ , we can get the water outflow from the tank all time  $T$ :

$$T = \frac{2r^2 \sqrt{h_0}}{\sigma \rho^2 \sqrt{2g_0}} \tag{82.1}$$

On behalf of the data into the formula ( $r = 2, h_0 = 6, \sigma = 0.6, \rho = \frac{1}{12}, g = 9.8$ ) get  $T \approx 1062$  Second  $\approx 17.7$  Minute.

Another example is the differential one section, it can be introduced by area variation model, let the student summarize the basic concept after the language to speak the essential method again, differential export of mathematical models, such as population model, give the application point of view to the students, acquired knowledge to solve practical problems, students feel that higher mathematics is not a dogma, but vividly present in the real world.

Subtotal: by the above four aspects of the practice of classroom teaching in higher mathematics, well change the traditional mechanical way of teaching, focusing on a combination of theory and practice, knowledge and professional knowledge to students and to stimulate students 'interest in learning, cultivate students' creative ability, practical ability and creative spirit as much as possible so that the higher mathematics, received good teaching.

## References

1. Xi Z (1993) Mathematical way of thinking. Jiangsu Educ Press 10(3):370–377
2. Zhang Y (1993) Mathematical analysis of 600 cases of typical question. Henan Educ Press 12(4):58–62
3. Jianwu W (1995) Mathematical way of thinking introduction. Anhui Educ Press 14(5):570–578
4. Klein M (1985) Ancient and modern mathematical thinking. Shanghai Sci Technol Press 09(11):830–836

# Chapter 83

## Study on Teaching Quality of Music Teachers in Colleges Under Quality Education Background

Na Wang

**Abstract** Aesthetic education is the important component of the character building education, but music education is an important means to implement character building education, train more university students with quality of aesthetic education today when could be recommending character building education in a more cost-effective manner, the music teacher's quality is the key point. The main visual angle of this text is in term of training university student's character building education; canvass the teaching quality which the music teacher of the university should possess under the character building education background.

**Keywords** Aesthetic education • Teaching quality • Ability

### 83.1 Introduction

Twenty first century is the period that China makes great efforts to advance character building education in an all-round way. It is deepened that the ones that are accompanied by educational reform are gradual; the whole society pays more and more attention to students too, especially university students' character building education. If you want to do a good job of university student's character building education, should strengthen university's teacher's teaching quality first, because quality and level educated depend on the teacher's quality and level.

Aesthetic education, educate aesthetically, it follows the basic principle of aesthetics, according to the objective law of pedagogy, through to the intersection of art and American social the intersection of life and American, feeling, appreciation, displaying and creating of natural beauty, train people's estheticism, make people establish the correct aesthetic standard, develop healthy aesthetic temperament and interest. The educational work of our country is taking

---

N. Wang (✉)

Music College of Beihua University, Jilin 132013, China

e-mail: nawang211@126.com

character building education as prerequisite at present. Character building education is in order to overall qualities of improving students in an all-round way as the education of the goal. The proposition of character building education is an evidence of to policy for education of overall development and promotion, it relies mainly on student, the education that pays attention to the development of individual character and the creativity trains, and it is the universal education facing all students too at the same time. It includes thought quality, cultural dynamics, psychological quality, body constitution, quality of working. Any period emphasized the character building education to university students even more than in the past in the university at present, and the one that train university student Germany, intelligent, body, the U.S.A. and China [1] “Aesthetic education”. It is one of the music teacher’s important duties. Music lesson is an important field of people literature; it is one of the main routes to implement aesthetic education. The main task of aesthetic education is to train student’s correct aesthetic standards and improve them to appreciate beauty, display beauty, and create beautiful ability. It is the most basic properties of music education to be aesthetic, in the aesthetic education of the music, the psychology that the focal point is of training students to like to be beautiful, should distinguish beauty uglily [2]. The cultivation of the psychology not merely concerns the question of the aesthetic conceptions to like to be beautiful, concern questions such as moral concept, outlook on life, values, etc. [3]. Students have a correct understanding and appreciation on U.S.A. through educating aesthetically, and have noble morals sentiment and aesthetics temperament and interest. Students through educating training are aim to pursuit the desire of for beauty and creating beautiful ability aesthetically. The aesthetic education of the intact meaning is through grasping and using “The beautiful law”. In with transformation naturally, transform mankind of society, practice in the every educational work that the activity is closely related with, through certain behavior, realize the goal of certain education. Aesthetic education is it is to bring up people overall for harmonious development, last Germany, intelligently, body all-round developing builders and the means important of successor socialist. Aesthetic education includes art to educate, as to other subjects, artistic discipline is in the form of having substantial aesthetic feeling content, vivid aesthetic feeling, to realize that bring home to one’s heart, gladden the heart and refresh the mind, shake the aesthetic educational function of soul. As the music education in artistic discipline, regard through the ages colorful music as the content, appreciate and sing, play the activity for the content with living the intersection of wave and vivid flexible music, give play to it to foster lofty thought morals, mould noble sentiment, inspire intelligence, improve one’s own overall qualities in an all-round way, promote the monobasic functions that grow up healthy and sound in all respects of teenagers. Therefore music education is one of the main content and route to implement aesthetic education [4]. Music teacher, as the implementer of music education’s one’s own quality and training, must play a decisive role. If so, the music teacher wants to afford to bear the qualified music teacher of character building education as one, professional ethics training, improving one’s own professional quality in an all-round way of soon constant completion, there

should be noble character, it is learned and versatile to also want, bring in constant renewal in and improve the educational idea, initiative spirit, creativity and ability to organize rich in teaching.

In the music teaching of the university, every music teacher should pay attention to the artistry of teaching of music, study classroom instruction art while following one's own law of music art according to the characteristic of every course of the music, music theory of letting students know the skill of the music, understand, having a taste of the artistic intension of the works. University's music teacher can be divided into teacher, technological theory lesson teacher, music skill lesson teacher of basic theory lesson according to taught. The lesson teaching of the basic theory is theory and foundation of all course teaching of music, the lesson teaching of the basic theory must be based on the fact that students have certain practice moves about, fully experiences the music. In teaching, know, consummate application basic theory knowledge that the teacher should instruct students how to know progressively while the music is practised. In addition, the knowledge of basic theory has very strong systematicness and science, the music teacher should analyse in depth, understand the content of courses, know the concept, term, symbol of theory knowledge involved in the teaching material conscientiously, unity of explaining wanting, and keep unanimity in every subject teaching. The technological theory lesson is the theory and technical course that combines, its teaching is to carry on technical creation and appreciation on the basis of basic theory lesson, as the intersection of specialized course and Mr. of Jiao person Shi deal with, compose music harmony in the theory, reply transfer, musical form, the intersection of song and the intersection of person who make, orchestrate and the intersection of knowledge and the intersection of skill and sufficient understanding and master, get hold of the key of every subject teaching at the same time. The music skill lesson mainly includes vocal music lesson, instrumental music lesson and solfeggio lesson. The music is art of the sound, the grasping of skill lesson serves for displaying the music. The vocal music lesson includes to grasping and two respects of manifestation to the music singing the knowledge, skill. And two respects to the manifestation of the music that instrumental music lesson including play knowledge of various musical instruments, skill etc. is mastered.

### **83.2 Future Developing Trend of Teacher's Teaching Quality of University's Music**

The music teacher's quality of ethics of the teaching profession is the first place. The music teacher should have noble professional ethics. The so-called professional ethics, professional people, ethical principle and code of conduct that should follow while carrying on the job and moving about that refer to engaged in sure properly. The music teacher should possess outstanding job quality, because teacher's personal ethical quality is strong education factor and educational

strength. As a music teacher of university, should have firm political orientation, should have firm faith of communism, love the educational work of music, loyal music educational undertaking, dedicate oneself to the music educational undertaking, it should be willing to be lonely, sweet ladder, have lofty devotion and unselfish spirit of utter devotion. In the real work, love students for being the concrete behavior which love educational undertaking, it is key content of the ethics of the teaching profession to love students, it is the important educational principle proved by a lot of outstanding teachers' successful experience too. An outstanding music teacher is sure to establish a good teacher-student relationship with students, the enthusiasm by having one's bosom filled with, the high-level sense of duty, not only strict with students but also care about, respect, believe in students, strive to reach respecting to believe in with that of strict requirement organically and unify. The music teacher should love the teacher for the teacher's collective at the same time, respect the parents of student, handling well between a teacher, the teacher and relation between the parents. The music teacher should be strict with oneself at the same time, set an example, a model for others, make the example for students. So, the music teacher wants the moral training of constant enhancement, constant improvement one's own ideological and ethical standards.

Teacher's professional knowledge of university's music is its primary condition that finishes a duty job with high quality. There should be systematic music discipline professional knowledge at first. The professional knowledge of discipline is teacher's professional theory knowledge corresponding to subject taught, as to music teacher, require its understanding that the professional knowledge which teach subject have sturdy foundation and deep, know the basic theories, rudimentary knowledge and corresponding skill of the department taught systematically, familiar with history and current situation of this discipline, find out about its newest scientific findings and development trend, understand a discipline learning method and research approach, can impart with the skill to students by way of suring, and understanding and acceptance that can make students real. Secondly there should be solid education professional knowledge. If you want to become a qualified music teacher, must have education, psychology scientific knowledge training. It requires the teacher to understand thoroughly and teach the discipline professional knowledge of subject, as well as understand general education and gain knowledge, such as education, psychological basic theories, history of education, educational psychology, educational managerialics, relatively educating etc. Music Mr. systematic science grasp educational professional knowledge only, could the speciality taught toward oneself accomplishes to do a job with skill and ease, can be chosen the rational teaching method to different contents, and then promote the development of student, strengthen students' character building education. The intersection of music and Mr. pays attention to the accumulation of one's own practicality knowledge and experience in actual work in addition, it is the outstanding music teacher's experience characteristic to practise knowledge in solid grasping and skilled application teaching.

University's music teacher should be learned and versatile have wide scientific cultural knowledge, understand the educational teaching law. In the face of the

highly split up as well as highly comprehensive characteristic of scientific development, require the music teacher to have abundant knowledge to store, the range of knowledge should be wide, big, rich, deep, want extensive dabbling every discipline knowledge, train and develop one's own interests in many aspects, by "study all the life". Ideology it is one's own reasonable construct knowledge structure, can spend by teaching of music. Strengthen the cultural and educational intension of music discipline in teaching, emphasize the mutual infiltration between every discipline, teacher's wide knowledge of the music can make the teaching of music launch in the pluralistic background. Meanwhile, the music education in new period requires the music teacher to understand the educational law promptly, also study the teaching method, use knowledge of science of education such as pedagogy, psychology, as in order to builder and developer of course, make one's own music rich and colorful in teaching, promote the overall development of student's overall qualities and improve. Meanwhile, the music teacher is regarded as one of the main force of contemporary quality educational reform and development, must and educate the new achievement known according to the needs of requirement of times and educational development, form the scientific education idea, this require music Mr. have one brand-new understanding to music education with relation, the intersection of music education and relation with people's physical and psychological development of social development, and establish scientific education values, student's view, teaching view and gate of the quality monitoring of teaching on this basis.

Music teacher, as the university is besides possessing the modern's basic capacity quality, this historical mission of better completion character building education that want, must also possess and engaged in teacher's job of the music peculiarly from teaching ability. Teaching ability is a basic quality which music teachers must possess, teaching ability is through the effective means, the ability of accomplishing the task of teaching that give full play to the role of the teacher's leading role and students' subject in teaching, the ability the intersection of oneself and good singing play what competence can substitute absolutely not. This is that we often say "A good music educationist can be an outstanding singer or accomplished performer but an outstanding singer or accomplished performer may not be a good music educationist". University's music teacher's teaching ability is many kinds of ability such as a synthesis, it including knowledge, skill, managing, analysing and judging, this kind of ability is that exercise came out in long-term teaching practice. It is the ability of language expression at first and analyzes judgement. The language is that the teacher teaches knowledge and links up the main carriers and tools of the contacts with students to students. Czech educationist praises the American knob Sri Lankan for saying "the teacher's mouth has been a source, can produce the brook of knowledge from there". The ability of language expression is teacher's most important ability accomplishment, it is the teacher that is engaged in education, teaching and scientific research, taught important tool and essential condition of knowledge and skill to students. As the music teacher, only know the skill of the music is incompetent, so must possess the ability to express of the language, strengthen the training



in ability of language expression voluntarily by oneself at ordinary times, strive to make the oral language to express popularly, succinctly, vividly, lifelike; The written language expresses the view accurately, read smoothly. In addition, the music teacher should discover the problems, analyse and judge the problem, ability to solve problem, this kind of ability is strong guarantee of accomplishing the task of teaching. Germany famous orff, educationist of music, through experiment, observation, analyze, have created the education system of one orff of music. Need to accumulate the knowledge experiences of various fields, correct analysis and judgement and solving the problem as university's music teacher. Secondly it is the classroom that organizes teaching and uses the education skill ability of present information. Quality of a class, can achieve the goal of teaching, finish the set teaching goal, it guarantees the measure is that the teacher will good at organizing teaching. Organize teaching to be a very important link in the teaching of music. The music teacher should be according to the request of train objective during the course of preparing before music lesson, on the basis of studying the tutoring system characteristic, specify music teaching purpose task, content of music teaching, music teaching means. Music Mr. launch stage want, cause student study interest in lesson, stimulate the intersection of student and initiative, enthusiasm of study, and study the purpose, it makes students experience, understand teaching material that teacher explains the music through demonstrating, form image in studying the content, through practising making students' knowledge, skill deepened, developed and improved repeatedly. The music teacher should analyze, summarize the phased result to the teaching course at the summary stage of the lesson. With the function in the field of educational teaching, the modern science and technology have changed the requirements for teacher's quality of teacher's job. This requires music teacher not merely wants to possess to utilize modern information technology to obtain the ability of the most advanced knowledge, and should learn to use modern information technology to carry on teaching and guide the ability of students. Music Mr. must understand the intersection of multimedia and computer and the intersection of network and the intersection of teaching and form of expression of media and commit form, know the basic working technique, learn the making of different coursewares, in order to meet demands of teaching of music. The third is the teaching creativity. The teacher is known as the artist of soul, the teaching of university's music teacher has been already following the law, while creating the law constantly. The so-called creativity refers to development and innovation on the basis of universal law, the ones that are for the detailed conditions and make are favorable to student's study measure, its characteristic is with strong points, attractive, can arouse students' thinking.

At present, of our country the intersection of music and as to have certain disparity with other high-speed teaching body of discipline of development quality of teaching body of university, teacher should carry on the music constantly "The self-perfection", Improve professional skill. One of the main tasks of the institution of higher learning is just engaged in scientific research. The characteristic of music education and scientific research is objectivity, theory and original idea. It is

to the summary of educational practice, the development of music education proposes imagining, thus promote constant completion and progress of music education and make music education give play to the role of its oneself better in the course of implementing character building education.

### 83.3 Summary

One that is with character building education energetic to recommend, people already careful to know, get important function on character building education, Mr. of music, 21st century, the requirements for job quality and personal training of the music teacher are higher and higher. As the music teacher, only comply with the trend of development of era, follow the era paces closely, in the real work and one's own work is combined, improve one's own overall qualities in an all-round way, only constant study, constant self-perfection, could undertake the important task entrusted in era, could become an outstanding music teacher.

### References

1. Cao L (2005) Discipline pedagogy of the music, vol 4(15). Capital Normal University Publishing House, Beijing, pp 9–14
2. Guo Y (2009) Music aesthetics educates several question discussions. The 6th issue of 2009, vol 11(2), pp 38–43
3. Jiang D (2007) Retrospect and prospect of music educational practice of ordinary higher learning school. The third issue in 2007, vol 2(3), pp 76–86
4. Cao L (2006) Ordinary school music pedagogy, vol 20. The educational publishing house of Shanghai, Shanghai, pp 3–12

# Chapter 84

## Study on Chinese Painting Freehand Brushwork

Rong Zhuang

**Abstract** In art of the canvas, the brush stroke in Chinese painting and calligraphy is one of the important behavior means of the canvas, have independent aesthetic value at the same time, contemporary, one that is with pluralism, varied painting idea and painting skill and technique of art is great and abundant, traditional in the canvas works “The brush stroke in Chinese painting and calligraphy”. Already not merely can be spoken to the limit by the simple scribbling and wiping of pen, and Chinese comfortable brush stroke in Chinese painting and calligraphy, technique of writing incorporate visual language and spiritual intension created that can enrich the picture greatly in the canvas is created. This paper attempts to canvass the canvas and create the feasibility that incorporated into comfortable brush stroke in Chinese painting and calligraphy and expansionary from two respect factors of cultural idea and skill and technique and tool material.

**Keywords** Chinese canvas • Freehand • Brushwork

### 84.1 Introductions

Canvas art introduce China to, grasp and use for Chinese, own to have a history of more than 100 years. Through several generations’ efforts, art of the canvas is to grow and yield positive results in China healthy and strongly, become the part that China’s modern culture is indispensable. Chinese canvas begin with Europe, write or paint realistically, study Russia canvas Su to will it be the fifties last century, it was realistic picture of writing or painting realistically wind that was accepted. For many years, China is because of the pattern of art education and influence of the political factor, writing or painting realistically has it like the mainstream that has been occupying Chinese art education and graphics art all the time [1]. Make a large number of canvas works styles, ideas and forms outmoded and single,

---

R. Zhuang (✉)

School of Art, JiangSu University, Zhenjiang 212013, Jiangsu, China

e-mail: rong19dzhuang@126.com

level of having a competition on the skill that oil painters just write or paint realistically in particular mode, but not explored and given play to style and individual appearance. Art of the canvas expresses a kind of art form of thought and emotion as the mankind, although it comes from Europe, this will be never meaning there should be mode of the fixed western type in the artistic expression language of the canvas [2]. Various nationalities can certainly choose, absorb and transform according to the need such as being aesthetic of this nationality while accepting this art form. Others' language and melody were difficult in order to express and issue Damien's our own passion and feeling heartily after all [3].

As to the past, the contemporary canvas is developed until today various informatively, abundant in content, the technique of expression is changed infinitely, a large amount of works of excellence has appeared. Among them, "comfortable" of the canvas It is one important art of Chinese oil painter that explores the road even more, the ones that spoke of the canvas are comfortable, the ones that will involve Chinese painting will be comfortable soon, because comfortable originated from Chinese painting, what is called comfortable, it is lyrical to borrow things, it is artist's description to the objective world and organic integration that the subjective emotion of the heart displays, heart and product that thing blend, this intersection of China and long history and cultural inside information forms different from western mode of thinking and aesthetics, mean, so comfortable to emphasize one artistic conception, one the intersection of painting and technique of expression, it is a kind of aesthetic activity too, Chinese painting getting comfortable to contain among every key element that is paint, from generality, form of the pen and ink, symbol of indistinct, content of the style of implied meaning, image of drawing materials, etc. Among them the pen and ink, brush stroke in Chinese painting and calligraphy are one of the aesthetic most important languages that expresses in Chinese painting and canvas, spoke in the whole relation of the picture from the brush stroke in Chinese painting and calligraphy, a successful canvas work was mutually combined and produced from a great deal of manifestation languages such as patterning, model, color, brush stroke in Chinese painting and calligraphy, can try purpose best in only brush stroke in Chinese painting and calligraphy that far from, under the common construction of all factors, have just produced the beautiful shape of the works. But we can separate and canvass the value of the brush stroke in Chinese painting and calligraphy, we cannot exaggerate the function of the brush stroke in Chinese painting and calligraphy in the whole picture excessively, can't ignore the aesthetic value of its independent existence either.

Contemporary, one that is with pluralism varied painting idea and painting skill and technique of art is great and abundant, pay attention to shape, color, the intersection of model and language of pen with great impact in the kind as to traditional picture. Traditional in the canvas works "The brush stroke in Chinese painting and calligraphy". It has already not merely been by the scribbling and wiping and can be spoken and tried best of the pen, and Chinese comfortable brush stroke in Chinese painting and calligraphy, technique of writing incorporate visual language and spiritual intension created that can enrich the picture greatly in the canvas is created. Certainly, if we gave up technique of writing of the

traditional canvas it was excellent and long, copied the traditional form of technique of writing in China mechanically briefly in the canvas is created, if substitute water Mexico with oil color briefly, imitate the chapped law with the brush stroke in Chinese painting and calligraphy, will make art of the canvas go on the narrow road and limit oneself. So, this text attempts to be from two respects to explain that creates to incorporate the feasibility and expansionary of the comfortable brush stroke in Chinese painting and calligraphy of China in the canvas.

## 84.2 Factor of the Cultural Idea

In the long-term artistic practice, the oil painters of China realize gradually, comfortable brush stroke in Chinese painting and calligraphy, technique of writing of Chinese painting are incorporated and mainly reflected in cultural idea and spiritual integration at first in the canvas is created wanting the deep layer. If only make an issue of formal skill and technique, does not actually work hard in spirit, the canvas is far from having a real one “Comfortable”. Certainly this idea, this spirit, there should be corresponding formal skill and technique and behave. The formal skill and technique is not important, but it is the second’s. What is called idea, spirit, has been determined by the depth understood to the reality described by the artist and training and culture background with national culture and arts.

The Chinese canvas is comfortable, because of the philosophical idea and embodiment of China’s traditional culture in the canvas of aesthetic view of China’s image at first, it is comfortable and modern on China’s traditional culture the west emphasizes the artist’s self-expression, have difference essentially, this it stems from to be totally different spiritual culture pattern both. Western culture distinguishes material with spirit that come very early, form the world outlook of the dualism. But Chinese culture receives influence and infiltration of Lao Zhuang’s philosophy and aesthetic thought of “Zhou Yi” for a long time, put emphasis on the contradictory mutual transformations of both sides, the negative and positive is raw each other. These two kinds of opposite respects or inclinations, the change of everything is because overcast and open mutual transformations, they are all here finally “angry” China is unified. So, “angry” it is the important category in China’s ancient philosophy, it is very extensive to influence. On this basis, Xiehe proposed “the flavor is vivid” in the Southern Qi Dynasty View, and it become it is past dynasties requirement of graphics art and one of the factors important of commentaries. A picture should not only display in the portraying vividly of shape to the object, reflect in the expression used for portraying the object expression and technique of writing especially, make technique of writing imbued with imposing manner and strength of emotion and life. It and “bone law use pens” Complement each other, need to portray the physique of the object accurately and as well as reflect the beauty of using pen. This kind was different from western painting with U.S.A. of the pen “The brush stroke in Chinese painting and calligraphy” Beautiful, it has special aesthetic value independent of

image, form a aesthetic an important condition that requires of China's painting. So the result of picture whole technique of writing, Chinese ink of Chinese painting, pay attention to the flavor, imposing manner very much, put emphasis on having a well-thought-out plan, accomplish without any letup, reach stressing and pen force that the musical sound of pen, intended conception, pen, style of painting and handwriting, pen are interesting with the pen specifically, pursue romantic charm and intelligence of the pen and ink. And the traditional western drawing one serves physique, stress more truly reproducing with the color with the pen, reflect its aesthetic thought, even nowadays behavior painting of the west independently, because of paying attention to the visual intensity of the material and displaying freely but there are few cultural factors that the skill and technique reflects. The ones that review in China's painting pay attention to the pen correctly further "The spirit" Janitor, it is simple that objective world reproduce, getting more subjective purely manifestation, but host and guest mutually ooze, the thing my integrating "image", This is a supreme realm of China's painting spirit.

So, with "comfortable" or "image" Merge the breakthrough point of the traditional Chinese Painting as the Chinese canvas, make canvas, China's traditional culture and aesthetic spirit agree with, will get to the canvas to melt the pen and ink in China's traditional painting, will let the canvas have vivid "write" Interest and charm. "Write" It is a mood, an attitude, very calm, it is trickling naturally in the abyss of the mind, cherish and explain the painter's sex emotion thoroughly even more. Wuji Zhao, artist of Chinese, see like that with works of DeQun Zhu while being abroad like us, display Chinese sophisticated appeal and makings far different from classical abstract art of the west in pure and abstract technique of writing of canvas, brush stroke in Chinese painting and calligraphy; Satisfaction on that such Chinese artistic conception of drawing a picture can totally bring soul and spirit to painter enormously, also should be the goal that a lot of Chinese oil painters pursue all one's life. But we have little oil painter understand to the intersection of Chinese culture and factor especially philosophy, aesthetic idea few or deepen enough in inherent factor that diagrammatic skill and technique form at present, this has been causing Chinese canvas in all sorts of constraint all the time or following the western fashion blindly or emphasizing the visual effect of image and narrow idea of the west.

### **84.3 Factors of Skill and Technique and Tool Material**

Creation idea, artistic conception, image, patterns and color in any painting, should be with finishing with pen skill and technique by various tool materials finally. The tool material is and means to realize graphics art with the pen skill and technique, but lacking it, all has become the empty verbiage. Comfortable brush stroke in Chinese painting and calligraphy, technique of writing of Chinese painting should be incorporated in the canvas is created, must have deeper understanding to the tool material of Chinese painting and with the pen skill and technique,

first of all, it is a factor of the tool material. Because pen, Mexico, paper, color special tools and materials in Chinese painting, make Chinese painting demonstrate the characteristic different from canvas in the course of creating and displaying. It was rich and varied that Chinese painting used the pen. No matter writing brush big or small soft to keep, spend the pen flexible and changeable while being hard, suitable for expressing various lines of change. In addition the material texture that the traditional Chinese Painting uses is relatively thin, draw a picture on materials such as the paper, silk, silk fabric, etc. more, there is certain oozing the melting, have greater contingency and randomness while drawing a picture. Secondly, Chinese painting stresses the pen and ink very much, the rice paper has good hydrosopicity and contaminating, after the painter starts writing or painting, it is very difficult to have leeway of large change, so it should be very definite to require the painter to start writing or painting, demand to know black performance of water well, could guarantee in this way picture result is satisfactory. So painters must accomplish "Have a well-thought-out plan" Can start writing or painting, and before starting writing or painting, also need to learn "luck". And the canvas tool material is stronger and durable, the oil paints on the durable linen, texture solid and picture easy to revise, can use painting brush, scraper, mix colors oil, shave, scribble, wash repeatedly. So, the traditional canvas one is mainly the tactics of scribbling, wiping, shaving, copying etc. with the pen skill and technique, its material has determined the canvas can be shaved except that and covered at will with the pen, the painter has more chances to revise in the same picture. But because of the reason of the tool material that the canvas uses at the same time, use the shape of the pen to be opposite to expression China's painting should be dull and mechanical by application and change of the pen. Because the paying attention to writing or painting realistically even more with the pen skill and technique of traditional canvas, is good at to each, space, mere shadow, expression of the feel.

The techniques of writing of technique of writing and Chinese painting of the Western canvas, though belong to two kinds of different artistic expression systems between east and west, its artistic law is different, but with "comfortable" Or "image" As the Chinese breakthrough point of localization of canvas, open the nationalized road to an canvas, it should be feasible. So, it can be analyzed from angle of technique of writing of painting, use the technique of writing of Chinese painting to arouse model and color in the canvas in the canvas in a large amount on one hand, can supplement and enrich the skill of technique of writing of the canvas as a kind of skill and technique. On the other hand, reduce the imitation of the real world and reproduce in the canvas gradually, pay attention to the intersection of technique of writing and expression of oneself, pay attention to the intersection of pen and musical sound, intended conception and author's own emotion displays and unites to use the intersection of pen and canvas gradually. Make the brush stroke in Chinese painting and calligraphy produce characterized sophisticated appeal and different aesthetic inclination, someone calls that "canvas of the image". All these are not the empty talk in theory, over 100 years, oil painter of a lot of the older generations of ours, Chinese and Western painting merged the



respect to do a large number of fruitful test and exploration. They circulate the comfortable factor of China's traditional painting in their own canvases are created by different means, innovate and break through to some extent on material and skill and technique of the canvas. Previous the 20th century, Haisu Liu, DaYu Wu, etc. try hard introduce "Comfortable" in the canvas language, the overstating of pen and intended conception that the picture pays attention to heartily, to the intersection of water and black application of oil color of type, unrestrainedness of brush stroke in Chinese painting and calligraphy make the intersection of picture and high-level simplicity take already, have special Chinese sophisticated appeals. The 20th century middle and later periods, Wu Guanzhong, Tianci Su grant and wait for someone to bring aesthetic way and pen and ink connotation of Chinese painting into the canvas, thus has imparted their canvas with very strong Chinese aesthetic characteristic and cultural and educational characteristic. Mr. Wu Guanzhong is a more representative painter. The greatest characteristic of his canvas is having "The pen and ink", For example his gray tune and Chinese ink of water have relations, the pen is "written" Appear, but not scribble and copy out. He explores that uses many kinds of modern tools such as nylon pen, scrubbing brush, the brush stroke in Chinese painting and calligraphy in order to tile, the method to tow, sweep makes the picture extremely rich and writes the free and easy and elegant feeling of the flavor, the picture pursues the integration result like Chinese ink of water. Su great to grant canvas of gentleman, emphasize getting comfortable very much too, he use western brush stroke in Chinese painting and calligraphy model combined with pen line imposing manner of China, the picture forms a kind of black sophisticated appeal of water heartily, his comfortable canvas uses the calligraphy of China in the canvas with the pen too at the same time, Chinese calligraphies such as forming the withered pen, astringent pen, flying white, etc. one is aesthetic and interesting. A lot of the South landscape paintings that Su is bestowed by heaven reflect this kind means with the pen. The interest and charm in the East that what he attempted to display in the works is, "western true feeling; the western one is in riotous profusion, eastern empty fairy".

Through the exploration of several generations of canvases artist, the Chinese canvas has already embodied the strong region characteristic and individualized to create. The exploration of the artistic expression of the brush stroke in Chinese painting and calligraphy of works of a lot of contemporary oil painters is bold and innovate, picture of them through to deal with tactics, go on creation of person who display various art of overstating, choosing, decomposing, recombination, making a variation etc., form a kind of strong, novel picture result, these will inevitable bring and use the perceptual and formal production of pens with new skill to explore and try, but this kind of innovation needs deep cultural artistic accomplishment and untiring art to be practiced, have just produced unique form of expression of picture and intension.



## 84.4 Conclusions

In sum, realize the value of the brush stroke in Chinese painting and calligraphy in art of the canvas correctly, hold its application in artistic practice, there are very long practice roads to go. First of all, while giving play to the canvas to have artistic language and expression originally, what comfortable spirit and pen and ink interest and charm that incorporated into China, need further exploring and trying. Especially China's painting is characterized "Pen and ink" Sophisticated appeal, how to reflect, it is an important subject that we face in canvas behaves. Secondly, should strengthen to the research and understanding of traditional quintessence of culture, the comfortable deep intension that comprehend the image deeply, Chinese canvas one "Comfortable" The concept is not defined with the tool material, it is not that the speed of the speed reflect in order to drawing a picture, not even the simple design is imitated, it is by "comfortable" The intension of spirit determines. May make the brush stroke in Chinese painting and calligraphy move towards coming to the surface otherwise, it causes the quintessence of two kinds of painting to lose to the limit to draw Chinese painting with the canvas material. So, inherent spirit has substantive value and meaning, really reflect that "comfortable" True meaning of spirit. All these, need us to overcome the difficulty, dare to explore, give through the practitioner's efforts.

The artistic charm of the canvas with new brush stroke in Chinese painting and calligraphy, has added more abundant aesthetic intension for art of the canvas.

**Acknowledgments** This article is the Jiangsu University teaching reform (2011JGYB1 16) research results.

## References

1. Meng B (2009) Comfortable while creating in terms of the Chinese canvas, *Southern literary world*, vol 18, pp 389–399
2. Songtao F (2008) Comparative study of China's traditional ink and wash painting and western tradition canvas, *Forum of association for science and technology*, vol 12, pp 390–399
3. Zhang W (1998) Introduction to social work, vol 34(4). Beijing University Press, Beijing, pp 74–79

**Part V**  
**Bioinformatics and Applications**

# Chapter 85

## Molecular Cloning and Sequences Analysis of Chalcone Synthase Gene from *Fagopyrum Tataricum*

Huangyuan She, Shaohong He, Zhi Zhou and Qitang Zhang

**Abstract** One of the most important key enzymes Chalcone Synthase (CHS) gene was cloned from *Fagopyrum tataricum*. Based on cDNA sequence conserved domain of CHS, a pair of primers were designed and used to amplify a fragment of FtCHS gene (GenBank accession: EU715255) using RT—PCR and RACE technique. A 1,463 bp full-length cDNA sequence was obtained. Analysis of CHS cDNA indicated that it encoded a peptide containing 393 amino acids. The sequence identity to palm leaf rhubarb (*Rheumpahlmatum* L.) species was all about 83 %. It is predicted that secondary structure of FtCHS contains  $\alpha$ -helix (41.73 %), layers (16.28 %) and random coils (41.98 %); further research on three-dimensional modeling of FtCHS contains 11  $\alpha$ -helixes and 15  $\beta$ -layers, which showed that protein was able to fold to a typical three-dimensional structure of CHS protein highly similar to that of MsCHS 2. The predicted tertiary structure demonstrated that FtCHS has combination sites.

**Keywords** *Fagopyrum tataricum* • Chalcone synthase • Gene cloning • Sequence analysis

---

H. She (✉)

School of Chemistry, Biology and Agronomy, Anshun University, Anshun 561000, China  
e-mail: huang\_yuanshe@163.com

S. He

Ethnic teachers' training school, Anshun 561000, China

Z. Zhou

Bureau of Education, Duyuan 558000, China

H. She · Q. Zhang

School of Life Sciences, Southwest University, Chongqing 400715, China

## 85.1 Introduction

*Fagopyrum tataricum* (Linn.) Gaertn is an annual polygonaceae fagopyrum herbaceous plant which belongs to minor cereals and is mainly produced in high-altitude areas [1, 2]. Tartary buckwheat is rich in flavonoids compounds which have functions of lowering the blood sugar level and the blood fat and can be used to prevent and assist treating diseases such as diabetes mellitus, hyperlipidemia and high pressure [3]. Chalcone synthase (CHS, EC 2.3.1.47) is a polyketide synthase which catalyzes the first rate-limiting step of flavonoid biosynthesis, i.e., catalyzes termolecular malonyl-CoA and 4-coumaroyl-CoA and produces 4, 2', 4', 6'-tetrahydroxy chalcone [4, 5]. Genome sequence and cDNA sequence of CHS gene in some plants such as alfalfa (*M. sativa*) have been cloned and studied. The crystal structure of protein of alfalfa CHS 2 gene for prokaryotic expression has been reported [6], which has provided convenience for studying substrate specificity of CHS protein in vitro and hereditarily transform the biosynthesis of flavonoids compounds.

In this research, in order to get the construction of buckwheat plant expression vector and transformation prepared, to realize the supersession of buckwheat flavonoid, and to establish the foundation for the achievement of new materials or new species with high flavonoid concentration through transgene, buckwheat seedling 'JK No. 2' is selected as the object for research, and RT\_PCR and RACE are adopted to clone the CHS gene of buckwheat on which the analysis of bioinformatics is conducted.

## 85.2 Materials and Methods

### 85.2.1 Material

The material is 'Jinku 2' seedling, which is provided by Professor Chaiyan of North West Agriculture and Forestry University.

### 85.2.2 Obtainment of Tartary Buckwheat CHS Gene

Design core primers based on the reported CHS nucleotide sequence such as *Brassica napus* (ABF60661), *Arabidopsis thaliana* (AAM65101), *Vitis vinifera* (CAA53579), *Ipomoea batatas* (BAA75309), *Solanum tuberosum* (AAX63401); design 3 RACE and 5 RACE primers based on the acquired core fragment sequence of tartary buckwheat CHS gene; and then design full length primers (Table 85.1) through core fragment sequence, 3' race sequence and 5' race sequence electronic matching. The primer is synthesized by Shanghai Invitrogen Biotechnology Co., Ltd.

**Table 85.1** Primer sequences

Primer	Primer sequence	Primer interpretation
CHS-f	5'-AARGARAARTTYARGCGCATGTG-3'	Core forward primer
CHS-r	5'-ACRCANGCRCTYGACATRTTVCC-3'	Core reverse primer
CHS-3'-1-f	5'-CGCGGATCCTCCACTAG TGATTAC- TATAGG-3'	3' race inner primer
CHS-3'-2-f	5'-TACCGTCGTTCCACTAGTGATTT-3'	3' race outer primer
CHS-5'-1-r	5'-GCCCCATTCCCTTGATAGCCTTC-3'	5' race inner primer
CHS-5'-2-r	5'-CGCTAACCACCATATCCTGGCGG-3'	5' race outer primer
CHS -fl-f	5'- ACACCAACAAGGCAAACTC-3'	Full length forward primer
CHS -fl -r	5'- TTCGAGCTTTATTCAATCAACACC-3'	Full length reverse primer

RNA is extracted according to the instruction of the kit (Beijing Tiangen). The first strand synthesis of cDNA is conducted according to the instruction of RNA PCR (AMV) Ver. 3.0 (TaKaRa Company). Augment using Touchdown—PCR with the first strand of cDNA as the template and the core primer CHS-f and CHS—r as primers; pre-denature under 94 °C for 4 min; denature under 94 °C for 45 s; anneal under 55–65 °C for 45 s; extend under 72 °C for 1 min; 20 circulations with 0.5 °C decreased during each circulation; denature under 94 °C for 45 s; anneal under 62 °C for 45 s; extend under 72 °C for 1 min; 20 circulations; finally extend under 72 °C for 10 min to get the core fragment.

Pre-denature under 94 °C for 5 min with CHS-3'-1-f/CHS-3'-2-f as the primer and the first strand of cDNA as the template; denature under 94 °C for 45 s; anneal under 60 °C for 45 s; extend under 72 °C for 1 min; 35 circulations for the secondary augment of 3' RACE; then denature under 94 °C for 30 s with CHS-5'-1-r/CHS-5' -2-r as the primer; anneal under 68 °C for 30 s; extend under 72 °C for 3 min; 25 circulations for the secondary augment of 5' RACE.

Conduct PCR reaction with the full length primer CHS-fl-f and CHS-fl-r as primers and the first strand of cDNA as the template and denature under 94 °C for 4 min; denature under 94 °C for 45 s; anneal under 58 °C for 45 s; extend under 72 °C for 1 min; 35 circulations for augmenting the full length sequence. PCR products are cloned by methods of Sambrook [7] and Liao [8], etc. PCR is sent to Invitrogen Company for sequencing after inspection.

### 85.2.3 Bioinformatics Analysis

The sequence analysis of nucleotide of CHS homologous gene and amino acid of CHS makes a BLAST comparison in NCBI between the nucleotide sequence of

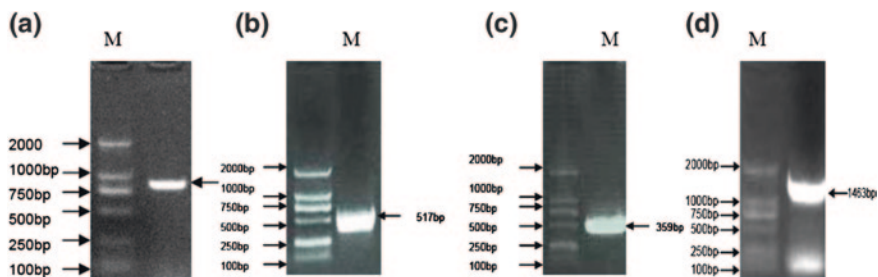
tartary buckwheat CHS and its translated amino acid sequence and conducts bioinformatics analysis; then use Vector NTI 8.0 to conduct multiple matching and analysis for the amino acid sequence of tartary buckwheat CHS and other plants CHS.

**FtCHS Protein Structure Analysis.** Predict its molecular weight, isoelectric point and molecular formula in Expasy ([www.expasy.org](http://www.expasy.org)); conduct subcellular localization analysis on TargetP (<http://www.cbs.dtu.dk/services/TargetP/>); conduct secondary structure [9] analysis on GOR ([http://npsa-pbil.ibcp.fr/cgi-bin/npsa\\_automat.pl?page=npsa\\_gor4.html](http://npsa-pbil.ibcp.fr/cgi-bin/npsa_automat.pl?page=npsa_gor4.html)); conduct 3D modeling of CHS structure on SWISSMODEL (<http://www.expasy.ch/swissmod/SWISS-MODEL.html>) and then edit the sequence in ViewerLite 4.2 software and obtain the tertiary structure model of tartary buckwheat [10].

## 85.3 Results and Analysis

### 85.3.1 *Obtainment of Tartary CHS Gene Coding Sequence and Bioinformatics*

Use degenerate primers CHS-f and CHS-r to augment tartary buckwheat cDNA reversed, thereby obtain a tartary CHS gene core fragment with a length of 868 bp; upload this fragment sequence to NCBI for BLAST comparison. The result shows that this sequence originates from *Polygonum hydropiper* (80 % identity) and Rosa hybrid cultivar ‘Kardinal’ (75 % identity) and that it has successfully augmented to Ft CHS core fragment. Design 3’RACE primer CHS-3’-1- f and CHS-3’-2- f and 5’RACE primer CHS-5’-1- r and CHS-5’-2- r based on the acquired sequence information of Ft CHS core fragment and respective augment to 3’ race of about 517 bp and 5’ race of about 359 bp; joint the acquired core fragment, 3’ race and 5’ race to get a full length of 1,463 bp and design and augment the primer CHS -fl- f and F CHS -fl- r based on the sequence information, thereby obtain a full length sequence of cDNA (Fig. 85.1) named Ft CHS (GenBank accession number EU715255).



**Fig. 85.1** Electrophoresis of PCR products of FtCHS

```

1      gacaccaacaaggcaacactcagttctctctttgaacaccaaccaactctacccaaa
58     ATGGCACCGTCGGTTGAGGAGATCAGAAAGGCACAAAGGGCOGACGCCCGCCACCGTT
      M A P S V E E I R K A Q R A D G P A T V
118    CTTGCCATOGGAAGCGCTACCCOGCTAAGTGTATCTAOCAGCGGACTACCCGGACTC
      L A I G T A T P P N C I Y Q A D Y P D F
178    TACTTCAAGGTCACCAACAGCGAGCACATGACOGAOCCTCAAACAGAAGTTCACCGCATG
      Y F K V T I N S E H M T D L K Q K F K R M
238    TGTGACAGTGCATGTCGAGAAAAGTTTCATGCATTTAACAGAAAGGGTTCTCAAGGAG
      C D K S M I E K R F M H L T E E V L K E
298    AATCAGAAATATGTGTCATACATGGCTOCATCAGTAGATTCCCGCCAGGATATGGTGGTT
      N Q N M C A Y M A P S L D S R Q D M V V
358    AGCGAGGTTCGCCGGTAGCGAAAAGAGCGCGCACAGAAGGCTATCAGGAATGGGGCAA
      S E V P R L G K E A A Q K A I K E W G Q
418    TCTAAATCTAAGATCAOCCAGCTCATCATGTG TACCACCTCCGGTGTGACATGCCCGC
      S K S K I T H V I M C T I T S G V D M P G
478    GCTGACTAOCAGCTAOGAAGCTCCTCGGCCCTTCGOCCTTCOGTTGAGCGTTTCATGATG
      A D Y Q L T K L L G L R P S V K R F M M
538    TACCAGCAAGGTTCCTTTGCGCGCGCACGTGCTCCGGCTAGCAAAGGACTTGGCCGAG
      Y Q Q G C F A G G T V L R L A K D L A E
598    AACAAACAAGGGTGCTCGGGTTTGGTGGTG TG TCCGAGATCAGCGCTATATGTTCCGT
      N N K G A R V L V V C S E I T A I C F G
658    GGACCAACCGAGACTCACTTGGACTCTATGGTGGACAGGCCCTGT TITGGTGATGGTGCT
      G P T E T H L D S M V G Q A L F G D G A
718    GGAGCGGTATTAITGGAGCGGACCGGACTTGTGATGAGAAGCCTATCTTCGAGTTG
      G A V I I G A D P D L S I E K P I F E L
778    GTCGTGACGGCTCAAACCATCTTAOCGGACTCOGAAAGGTGCTATCGATGGTCACTTAOGC
      V W T A Q T I L P D S E G A I D G H L R
838    GAGGTGGACTCAAGTTCATCTACTTAAAGATGTCCCGGGTGTACTCGAAGCAATA
      E V G L T F H L L K D V P G L I S K N I
898    CACAAAAGTCTTGATGAGGCTTCTCTCTCAATATTCOGATTGGAATCCCTCTTT
      H K S L D E A F S P L N I S D W N S L S
958    TGGATGCTCATCCCTGGTCCGCGATCCTAGACCAGGTGGAGAGTTAGGACTG
      W I A H P G G P A I L D Q V E E K L G L
1018   AAGCGGAGAAGATGAAGGOGACGAGGCAAGTATTGAAACGATTACGGAAACATGTCAGT
      K A E K M K A T R Q V L N D Y G N M S S
1078   GCGTGTGTTGTTTATTATGACGAGATGAGGAAGAAATCGTGGAGAACGGTCATGCC
      A C V L F I M D E M R K K S L E N G H A
1138   ACGACGGGAGAAAGGGCTAGAGTGGGGAGTCTTGTTOGGTTTGGACCGGGTCTAACCGTT
      T T G E G L E W G V L F G F G P G L T V
1198   GAAACTGTGGTCTACACAGTGTACACAGTGTGCTCAATAAATgatatacaaaacttgtacc
      E T V V L H S V P V V A Q *
1258   tttgtgatccatgacatcctgatggtgtctctccacat atcgagctgttccggtttgcttt
1138   aatgattgatgtttgtcgtctgttttcttttattctgtattttgtatttttctatt
1378   tggagaagt aagtgaat gat atgtatgtgaaatgcaat atggtgttgattgaataaagc
1438   tcgaatctttat atcaaaaaaaaaa
    
```

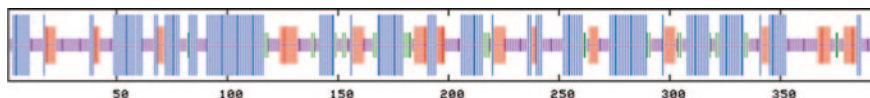
Fig. 85.2 The FtCHS of *fagopyrum tataricum* and its deduced amino acid sequence\* means the stop codon

The DNAMAN software analysis shows that Ft CHS cDNA sequence includes a completely open reading frame (58–1,239 bp), 5' non-coding region of 56 bp and 3' non-coding region of 228 bp (Fig. 85.2). Ft CHS codes 393 amino acids and has a AA TAAA tailing signal at 18 bp before 3'poly (A) + region. The termination codon is TAA, which conforms to the characteristics of gene full length cDNA effectively translated. The isoelectric point is predicted to be 5.86, molecular weight 43.156 kD and molecular formula C1955 H2889N491 O553 S14. The protein is hydrophilic and the subcellular localization is predicted to be in the cytoplasm.

Multiple Matching of F3H Protein Sequences of Part Plants

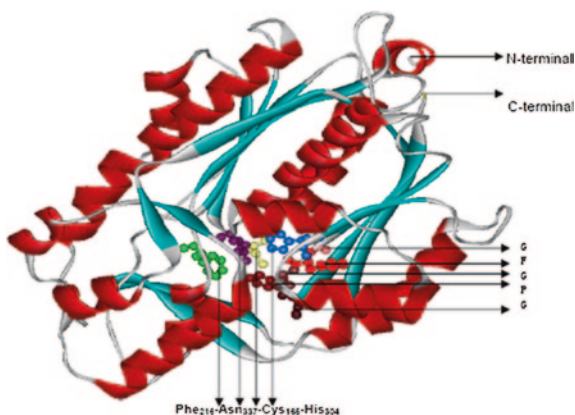
According to the results of multiple alignments of amino acid sequences in buckwheat CHS and other plants' CHS by Vector N TI 8. 0, the similarity of Ft





**Fig. 85.3** The secondary structure of FtCHS generated by SOMPA

**Fig. 85.4** Three-dimensional model structure of Ft CHS



CHS with *Rheum palmatum* Linn (DQ205353), *Gerbera* hybrid cultivar (Z38096), *Malus x domestica* (DQ026297), *Medicago truncatula* (AC146683), and *Petunia x hybrida* (X14597) are respectively as 83, 82, 82, 81, and 80 %. And Ft CHS contains a few conservative active sites such as C, F, H and N. And GFGPG is the tag sequence of CHS. What above described further indicates that the cloned gene is exactly the buckwheat CHS.

### 85.3.2 Protein Structure Analysis of FtCHS

The predicted secondary structure of Ft CHS states that, such protein contains 41.73 % of  $\alpha$ -helix, 16.28 % of extended strand, 34.1 % of random coil, and 7.63 %  $\beta$ -turn (Fig. 85.3).

According to the forecast of three-dimensional structure, there are N-terminal and C-terminal in FtCHS; GFGPG is the lag sequence of CHS; and there are such conservative active sites as Cys165, Phe216, His304, and Asn337 such as CoA binding site, bag-type cinnamyl binding site, and bag-type cyclization sites, of which the functions are to participate in and regulate the protein supersession, and modification and processing after translation which are very important to the protein activity (Fig. 85.4).

M. DNA marker; (a) PCR product of the core fragment of FtCHS; (b) PCR product of 3'-RACE; (c) PCR product of 5'-RACE; (d) PCR product of the full-length Cdna.



The identical and conserved amino acid residues were denoted with black and gray backgrounds, respectively.

The longest vertical bar represents Alpha helix (41.73 %), the second longest one represents extended strand (16.54 %), and the third longest one represents the random coil and the shortest one represents Beta turn (7.63 %).

Such model is predicted by SWISS-MODEL. The three-dimensional model of FtCHS monomer is represented through WebLab viewer, in which Alpha helix is in red, Beta turn in blue, and corners and rings in grey.

## 85.4 Conclusion

Catalysis by CHS is the first essential step to the biosynthesis of flavonoids. Through extension of the conservative fragment in the middle of FtCHS, and in combination with RACE, the overall length of cDNA sequence of FtCHS is obtained, of which the length is 1,464 bp and 393 amino acid residues are coded. The protein from other plants has high similarity with FtCHS protein and has all active sites essential to CHS, such as CoA binding site, cinnamyl binding site, and cyclization sites and so on. Three-dimensional model of FtCHS protein is developed by homology modeling methods, which has high similarity with that of MsCHS2. FtCHS gene obtained through extension plays a directive role and has directive functions in the biosynthesis of buckwheat flavonoids and has laid a certain foundation for later genetic improvement of buckwheat flavonoids metabolic pathway with FtCH.

**Acknowledgments** The paper is the research results of the fund project of science and technology of Guizhou Province [NO. QKH J (2012) 2001], Key Laboratory of Chemistry for Performance and Resource of Anshun College [NO. QJGF (2011) 278], Natural Science Research Project under Department of Education of Guizhou Province (NO. QJK 2010070).

## References

1. Chen QF (2001) Karyotype analysis of five fagopyrum species native to China. *Guihaia* 21(2):107–110
2. Lin RF, Zhou YN, Wang R, Li JY (2001) A study on the extract of tartary buckwheat, Toxicological safety of the extract of tartary buckwheat. I. *Adv Buckwheat Res* 27(11):602–607
3. Meng ML, Wang HZ (2000) Function of flour from tartary buckwheat on lowering blood—glucose in diabetes mellitus. *J. Pract Diabet* 8(3):22–23
4. Holton TA, Cornish EC (1995) Genetics and biochemistry of anthocyanin biosynthesis. *Plant Cell* 7(7):1071–1083
5. Tanaka Y, Tsuda S, Kusumi T (1998) Metabolic engineering to modify flower color. *Plant Cell Physiol* 39(11):1119–1126
6. Ferrer JL, Jez JM, Bowman ME, Dixon RA, Noel JP (1999) Structure of chalcone synthase and the molecular basis of plant polyketide biosynthesis. *Nat Struct Mol Biol* 6(8):775–784

7. Sambrook J, Russell DW (2002) Molecular cloning: A laboratory manual, vol 2, 3rd edn. Science Press, Beijing, pp 636–643
8. Liao H, Zhou JY (2008) Molecular cloning and analysis of a chalone synthase gene of cassia tora. *Acta Bot Boreal Occident Sin* 28(9):1728–1733
9. Wang H, Chen R, Chen M, Sun M, Liao ZH (2006) Cloning and analysis of strictosidine synthase in *Rauvolfia verticillata*. *Acta Bot Boreal Occident Sin* 26(6):900–905
10. Wilmouth R, Rupert C, Turnbull, Jonathan J, Welford WD (2002) Structure and mechanism of anthocyanidin synthase from *Arabidopsis thaliana*. *Structure* 1(10):93–103

# Chapter 86

## Automatic Isolation of Carpal-Bone in Hand X-Ray Medical Image

Shengnan Hao, Yuhe Han, Jide Zhang and Zhanlin Ji

**Abstract** A general segmentation method for automatic isolating the carpal-bone in an X-Ray DICOM medical image was proposed in this paper. As the recognition and separation of individual carpal-bone from the image is a difficult task, to achieve this, the main algorithms in our solution include edge detection, region of interest area extracting, segment the bones and count the carpal-bone. The results show that the general segmentation methods can provide a robust and accurate method for automatic segmentation the carpal bone in x-ray hand images.

**Keywords** X-ray medical image • Segmentation methods • Carpal-bone

### 86.1 Introduction

Segmentation of bone structures in X-ray medical images is used to extract anatomical structures for diagnosing or treating bone diseases propose. i.e., fracture diagnosis and treatment, evaluation of skeletal maturation, bone densitometry, hip replacement, etc. It runs important role for computer-aid diagnosis, surgery and treatment.

The general medical image segmentation including following approaches: manual segmentation, semi-automatic segmentation and automatic segmentation. In those

---

S. Hao (✉) · J. Zhang · Z. Ji  
Information College, Hebei United University, Tangshan, People's Republic of China  
e-mail: Hshengnan@126.com

J. Zhang  
e-mail: Zhangjidets@163.com

Z. Ji  
e-mail: Zhanlin.Ji@ieee.org

Y. Han  
Hebei United University, Tangshan, China  
e-mail: Yuhe.han@gmail.com

**Fig. 86.1** X-ray medical image of hand



approaches, the automatic segmentation is usually used on computer-aid applications. It does not require any user input thus cause difficult to obtain accurate results.

In this paper, we are focus on a hand X-ray DICOM image (Fig. 86.1) carpal-bone automatic isolating. The recognition and separation of individual carpal-bone from the image is a difficult task. There is completely different degree of calcification and overlapping with soft tissue, since different regions are of little gray level variations and the borders of individual carpal-bones are hardly visible. Several studies have focused on the carpal-bones isolation [1–3], the snake algorithm usually used to segment the image. Different from the other studies, the general segmentation methods, i.e., threshold, edge and region detection, classification, graph-based and deformable model, etc., was used for automatic isolating the carpal-bone of the hand DICOM image.

## 86.2 Proposed Methods Overview

The methods to isolate the carpal-bone need several steps since the wrist bones are very hard to distinguish even with the eyes on the original X-ray image. The methods used to extract the carpal-bone need follow three major parts:

1. Outline markers on the image. Edge detection is the main algorithms.
2. Extract the region of interest (ROI) automatically. The main algorithms include Blob detection, threshold, and-operation, and noise-remove.
3. Segment the bones in the ROI. The segmentation and sub-operation are the main algorithms.
4. Count the carpal-bone. It includes a single count algorithm.

Figure 86.2 shows the above isolating methods procedure.

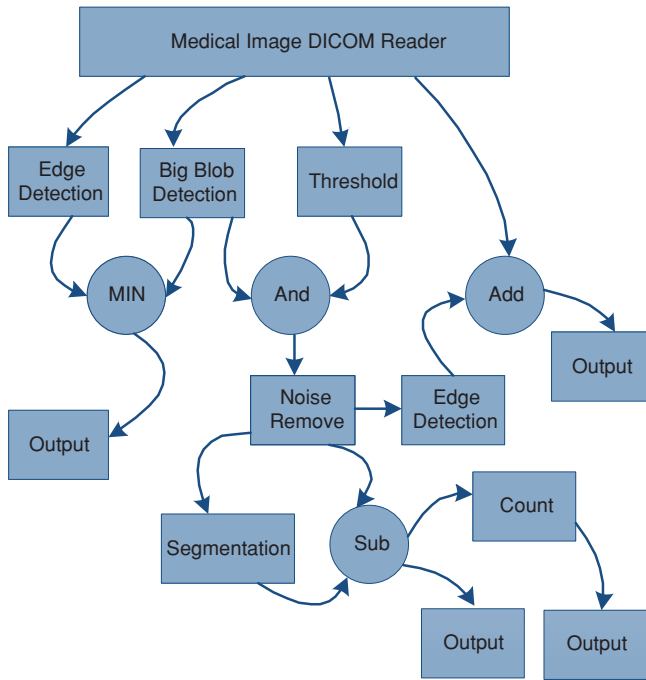


Fig. 86.2 The isolating methods procedure

### 86.3 X-Ray Carpal-Bone Images Processing and Results

The pure Java image processing APIs was selected to isolate the capral-bone in this paper.

The medical image was first read by a DICOM Java reader, then processing with four major steps (Section two), the details show as following.

#### 86.1 Edge Detection

The SOBEL algorithm was selected as the edge detection in this part. A sharpen filter, single threshold and border algorithms were used for generating the border of the x-ray image [4], shows as in Fig. 86.3a, the result shows as in Fig. 86.4a.

#### 86.2 ROI Extracting

The novel procedure design is shown as in Fig. 86.3b. To exact the ROI part, a double threshold algorithm following ERODE, OPEN, BIGBLOB modules was

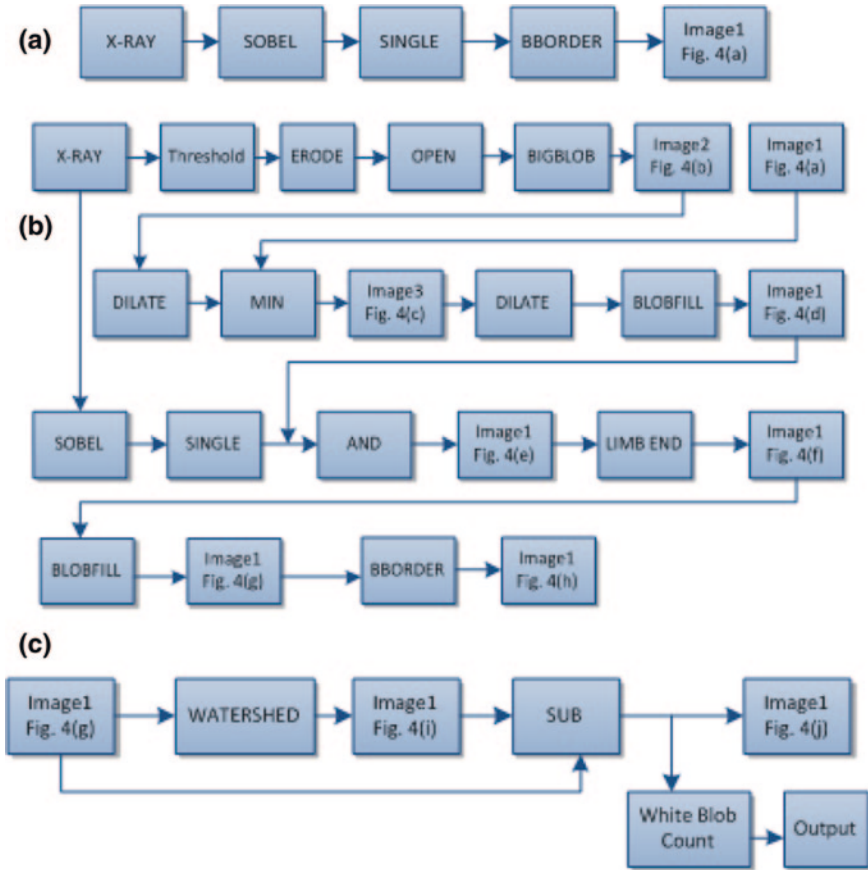


Fig. 86.3 The isolating algorithms. **a** Edge Detections; **b** ROI extraction; **c** Segmentation and counting

used to find the big area, after DILATE, BLOBFILL, AND-operation modules, the ROI edge is detect, the LIMBEND algorithm is used to remove noise (Fig. 86.4b), then runs BLOBFILL (Fig. 86.4c), and finally using BBORDER algorithm to get (Fig. 86.4d). The ROI is automatically obtained.

### 86.3 Segmentation and Counting

With previous algorithms, the output of ROI (Fig. 86.4c) is segmented with WATERSHED algorithm (Fig. 86.4e). Then SUB operation with the Fig. 86.4c. Figure 86.4f shows the final result. The White Blob Count algorithm is used to calculate the number of bones.

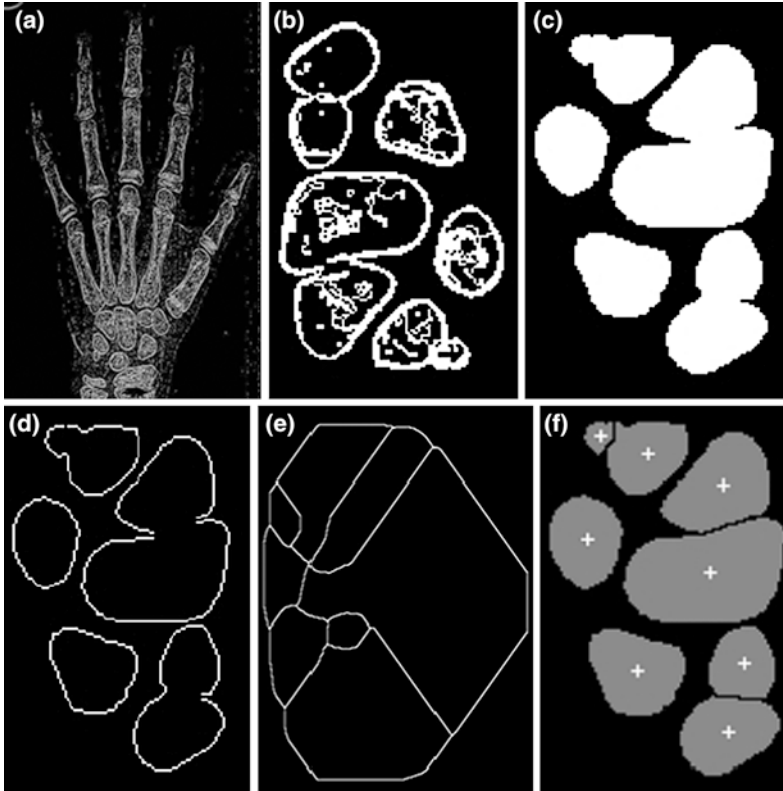


Fig. 86.4 The isolating algorithms output images. a SOBEL algorithm; b LIMBEND algorithm; c BLOBFILL algorithm; d BBORDER algorithm; e WATERSHED algorithm; f SUB operation

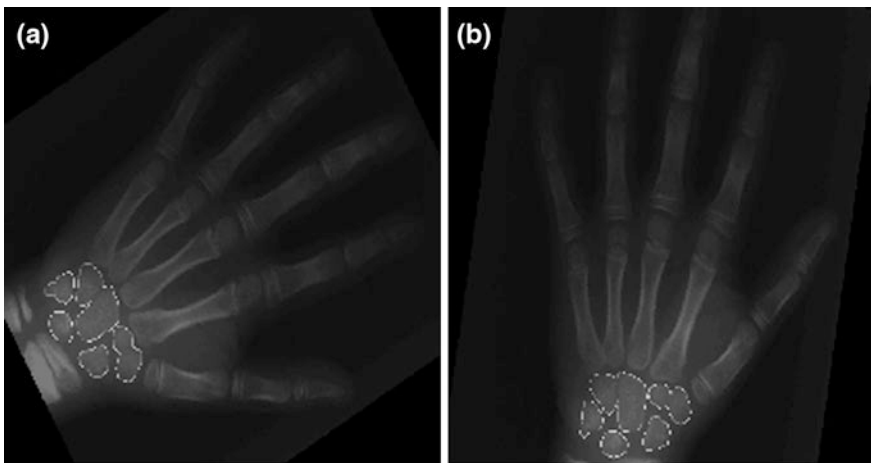


Fig. 86.5 The rotate testing. a 30°; b 80°

## 86.4 Robust Testing

As there is no filter design in the system, the rotate testing is the main criteria to verify the designing. Figure 86.5a, b shows the outputs when the original image rotate 30' and 80' respectively. The carpal bone is automatically detected.

## 86.4 Conclusions

In this short paper, a general segmentation algorithm to isolate carpal-bone from the X-ray hand medical image is proposed. The novel method developed can correctly extract the carpal-bone feature from the image.

## References

1. Pietka E, Kaabi L, Kuo M, Huang H (1993) Feature extraction in carpalbone analysis. *IEEE Trans Med Imag* 2(1):44–49
2. Snel J, Venema H, Grimbergen C (1998) Detection of the carpal bone contours from 3-D MR images of the wrist using a planar radial scale space snake. *IEEE Trans Med Imag* 17(6):1063–1072
3. Giordano D, Spampinato C, Scarciofalo G, Leonardi R (2010) An automatic system for skeletal bone age measurement by robust processing of carpal and epiphysial/metaphysial bones. *IEEE Trans Instrum Meas* 59(10):2539–2553
4. Whelan PF (2006) Computer aided detection of polyps: A medical application of image processing and analysis. In: *IET Irish signals and systems conference*, vol 22. IEEE press, New York, pp 5–8



# Chapter 87

## Study on Medical Education Based on E-Learning

Yujuan Zhou

**Abstract** Electronic learning is using Internet technology to improve the knowledge and performance. Control technology to provide the student learn content, learning sequence, the rate of learning, time and often the media, let them tailor their experience to meet their individual learning goals. All kinds of medical education in the background, learning seems to be at least as effective as traditional methods of instructor-led lecture. Electronic learning is the student did not see instead of traditional instructor-led training, but as a complement to it, form a blended days-part of the strategy. Electronic learning puts forward many research opportunities for college, with the great challenge for the record the scholarship. Modern distance education process technology innovation education guide a revolution, make learning become personalized (adaptive learning), the learner's interactions with others cooperative learning, the role of teacher change. The integration of electronic learning to medical education can promote transformation theory of adult learning, based on the application of educators will no longer as the main contents of the vendors, but will become more involved in the study of the jury and the coordinator ability.

**Keywords** Medical education • E-learning • E-portfolios

### 87.1 Introduction

Today's medical education workers face challenges than their predecessors different teaching tomorrow's doctor. Change the website health care, from acute care Settings, community based chronic care need to change education places [1]. Find time to teach the "new" fields, such as genomics, palliative care, old age, supplementary medical school course is difficult physical examination has challenged

---

Y. Zhou (✉)

University of South China, Hengyang 421001, Hunan, China

e-mail: zhouyujuan@cscsi.inof

the traditional materials cover [2]. The traditional instructor-centered occupy a learner-centered teaching mode; make learners in control of their own learning. Recently to ability course emphasizes the standard of the result of study change, not process, education.

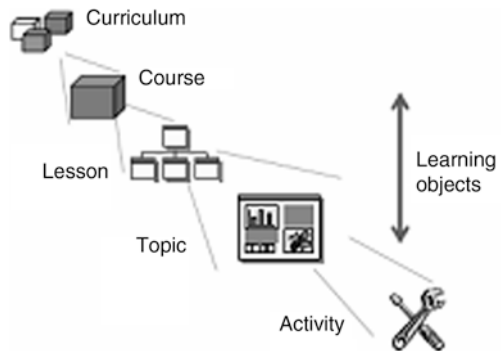
Electronic learning refers to using Internet technology to provide a wide range of solutions, improve knowledge and performance. Electronic learning can be used in medical education workers to improve the efficiency and effectiveness of education intervention facing society, science and education challenge mentioned above. Already gain popularity, in the past ten years, but its use is highly variable medical schools and seems to be more common clinical basic science courses [3, 4] at public expense. In this chapter, we review the current medical education in the learning state, summarizes the following: the key terms, teaching content, teaching effect, the teacher development need to implement online learning and assessment strategies and its technology, and potential of the content of the content is considered evidence of academic achievement.

### 87.2 Components of E-Learning

Digital information including the following parts: once the content development is created, it need to management, delivery, and specifications. Contents contain all of the teaching material; can separate complex project scope to more teaching modules. A digital learning object defined as any combination of digital materials and structure in a meaningful way and a education goals.

Learning object represents a single, control unit teaching material reassemble, around specific goals, this is used to build more education materials, such as the course, course module, or fully meet the requirements of the certain course. Examples include tutorials, case studies, media, simulations, and game-based learning modules. Content creators use teaching design and principle of teaching and teaching material produces learning objects (Fig. 87.1).

Fig. 87.1 Units of E-Learning



Content management includes all the administrative functions (e.g., storing, indexing, cataloging) needed to make e-learning content available to learners.

Examples include portals, repositories, digital libraries, learning-management systems, search engines, and e-Portfolios.

A management system, for example-days, network software, easy to transport and tracking electronic learning a institution in [5, 6]. A management system can provide days-some function of the scheme, but not only the study contents. It can be simplified and automation management and supervision of the work product, and the tracking learners ability, as well as the teaching resources storage 24 h a day. Familiar with medical education management system days-workers WebCT® or the blackboard®, but more than 200 commercial system, and the number is growing fast. Content delivery can be synchronous or asynchronous [7].

The delivery is refers to the synchronous real-time, teachers, guided by the digital learning, where all the learners and to exchange information and accept directly with other learners. Examples include remote video, audio, meeting (or both), Internet chat BBS, and instant messages.

In addition to establish and management, to provide content, the fourth component is part of learning equation. These standard compatibility and availability of the product promotion across much computer system facilitate the widespread use of electronic learning materials. Several organizations have been engaged in the electronic learning standard aroused widespread. Though not specifically for medical education, these standards provide medical education worker's important advantage. The most famous set of standard is advanced distributed learning:

SCORM is a group of criterion development through online learning institutions co-operation fund by the us defense department of [8]. Electronic learning materials specifications SCORM exchange built conformant learning management system that allows the learners' learning experience prescription and tracking performance. In medical education, MedBiquitous consortium of academic, government and health, health care industry organization, is developing SCORM for medical education standards compliant-and specifications.

### 87.3 The Evidence for Effective and Efficient E-Learning

The effectiveness of the electronic learning mainly through the research has shown that the higher education, government, business and military environment. However, these studies have limitations, especially because of the value of the scientific design. In addition, most include several different teaching and delivery, complex analysis method. But three aspects discuss digital learning has been: product use, cost efficiency, learners' satisfaction. Utilities is refers to the electronic learning effectiveness method. Outside the several studies have found that health care most often study at least is as good if not better than, traditional instructor-led methods led to lecture learning [7], and Fair weather cited several studies from the era of the Internet there before, including two meta-analyses,

compare the utility of the computer aided teaching and traditional teaching methods with variety of designs. Research in two training and academic environment, prognosis is not consistent with the results. However learners' knowledge, pre-test scores, showed improvement. In addition, the learners to use computer instruction more effective learning, showed better retention. Recent comments (especially learning network learning in different literary context reveals medical education similar findings).

About one-third of the research, most use assessment from knowledge multiple-choice test, although the standardization of the patient is used to write learning. The two studies evaluating the learning efficiency, only a evidence, the more through the network teaching learning efficiency. A lot of evidence that nonmedical literature in, on the basis of complex analysis, cost of electronic learning can lead to serious cost, sometimes as high as 50 %, compared with the traditional instructor-led learning. Savings and instructor training time, reduce the cost, and labor costs, reduce travel system construction, and may expand plan of the new education technology. We found printing and distribution of education materials cost less than create and the spread of digital content. To improve the students' interest rates of satisfaction than traditional electronic learning, as perceived ease of use and access, navigation, interactive and friendly user interface design.

## **87.4 Evaluating E-Learning Processes and Outcomes**

The online learning and its technology requires a lot of investment in teachers, time, money, space, need reasonable management and leadership skills. And other education materials, there are two main ways of the evaluation of the learning process, and outcomes.

Electronic learning process evaluation and the advantages and disadvantages of the review process and the result of it, usually to provide information, and this will allow others to copy it. The peer review is a kind of process evaluation. Traditional peer-reviewed journal chapters validation of the quality of content.

Electronic learning can be a valuable component evaluation of the comprehensive evaluation of medical school curriculum.

## **87.5 E-Learning as Academic Scholarship**

In the literature about electronic study the teacher development or ascension as evidence of the academic pursuit hardly exists, our knowledge. However, as mentioned above, the digital teachers basic requirements of the traditional teaching activities beyond.

In addition, by its nature, digital learners and teachers provide extensive use of possibility, access and share compared to other types of guidance. Assessment data

**Table 87.1** Medical education organizations supporting E-learning

Definitions	Characteristics
MedEdPortal, Association of American Medical Colleges (AAMC) ( <a href="http://www.aamc.org/meded/mededportal/">http://www.aamc.org/meded/mededportal/</a> )	Repository all digital content types material linked to educational competencies peer reviewed “virtual patients” bank
End of Life/Palliative Education Resource Center (EPERC) ( <a href="http://www.eperc.mcw.edu/">http://www.eperc.mcw.edu/</a> )	Repository digital content in end-of-life issues peer reviewed links to other online resources
The Health Education Assets Library (HEAL) ( <a href="http://www.healcentral.org">http://www.healcentral.org</a> )	Repository large number of learning assets growing number of learning objects peer reviewed
Multimedia Educational Resource for Learning and Online Teaching (MERLOT) ( <a href="http://www.merlot.org">http://www.merlot.org</a> )	Repository for higher education links to other online resources with peer-review comments growing science and technology section
International Virtual Medical School (IVIMEDS) ( <a href="http://www.ivimeds.org/">http://www.ivimeds.org/</a> )	A consortium of medical schools setting standards in medical education repository for member schools partnerships blended learning

management days-peer review and the system tracking and monitoring the use of online learning can provide evidence of the quality and effect Table 87.1.

## 87.6 Integrating E-Learning into Medical Education

In the integration of the existing medical study results should be devised plan, demand is started in a needs assessment, conclusion and use digital teaching the decision. Although some institutions have tried to use electronic learning as stand-alone solutions to update or expanding their course, we believe that this is the best start a integrated strategy, think the revision of the benefits and burdens of blended learning courses before. Undergraduate medical education, online learning provides learners as instruction and collaborative learning-material. Graduate medical education the authentication committee for graduate medical education set up six core competitions for electronic learning can be used. Electronic learning materials suitable for each of these skills can be integrated into the education of residents and partners, and the other replacing lectures synchronization method of guidance. Asynchronous learning can be effectively used in demand, especially clinical nursing rotating work time is limited, but the curriculum requirement is still very high. Continuing medical education, and in our daily clinical physicians medical “e-conferences obligation to take part in the” use electronic learning.

Complexity and width of the medical education content, with experts and the lack of resources, make modern distance education process create excellence digital learning center of a reasonable suggestion. The internal working group on information technology research and development center of the proposal to set

up a new teaching mode “physicians and provide education discussion continuing medical education”; Electronic learning with clear description. This center can offer a wide range of services, including the system deployment and management, training teachers and administrative staff, assist the development, the design of the contents of the way to learn and procedures, marketing and support, supervision, maintenance, research and consulting.

## 87.7 Conclusion

Online learning and development of the basic technology to create a revolution, education, make learning become personalized (adaptive learning), improve the learners interactive cooperation study each other (change), the role of teacher (from disseminator of facilitator).

Adaptive learning to use technology to evaluate students' knowledge, skills and attitudes, in order to provide online at the beginning of the training education material level best suited for each learner. In the network environment of the adaptive learning is possible content, through the recognition, personalized content, learners and personalized tracking and monitoring, support, and evaluation. Adaptive learning is the final learner-centered experience, because it is a personality of a unique learning path, this may be each learner goal to his or her learning needs and ability. Potential cooperation study break quarantine learners modern distance education of the process to realize technology.

For synchronous distance education progress and collaborative technologies, like blogs, message board, chat, email, and telephone conference is such cooperation study, the more easily. The quantitative and qualitative research in medical proof, cooperative learning in higher levels of learning satisfaction, improve knowledge, ego, the concept of understanding, and realize the objective, and change in practice.

A key in medical education of the evolution of the lifelong learning and ability standard education has forced education workers to its traditional role. In this changing the paradigm, educators no longer as the only distributor, but was let content of study and the ability of the jurors. Learning to let we have the opportunity for educators role evolved into this new provides a set of online resources to promote the process of learning.

## References

1. Nair BR, Finucane PM (2010) Reforming medical education to enhance the management of chronic disease. *Med J Aust* 179:7–59
2. Ozuah PO (2009) Undergraduate medical education: thoughts on future challenges. *BMC Med Educ* 2:8–10
3. Moberg TF, Whitcomb ME (1999) Educational technology to facilitate medical students' learning: background paper 2 of the medical school objectives project. *Acad Med* 74:1146–1150

4. Masie E (2009) Blended learning: the magic is in the mix. In: Rossett A (ed.). *The ASTD E-learning handbook*. McGraw-Hill, NY 09:58–63
5. Johnson CE, Hurtubise LC, Castrop J et al (2004) Learning management systems: technology to measure the medical knowledge competency of the ACGME. *Med Educ* 38:599–608
6. Phelps C, Michea YF (2003) Learning management systems' evaluation focuses on technology not learning. *AMIA Annu Symp Proc* 969
7. Wentling T, Waight C, Gallaher J, La Fleur J, Wang C, Kanfer A (2000) E-learning: a review of literature 2000 (<http://learning.ncsa.uiuc.edu/papers/elearnlit.pdf>). Accessed 15 June 2006. University of illinois national center for supercomputer applications, Urbana-champaign, IL
8. Fallon C, Brown S (2003) *E-learning standards: a guide to purchasing and deploying standards-conformant E-learning*. St Lucie Press, Boca Raton

# Chapter 88

## Research on ACE Gene I/D Polymorphism of Men and Effects of HiHiLo on SPO<sub>2</sub>

Duo-qi Zhou, Yang Hu, Yan-chun Li, Long-yan Yi and Jing Nie

**Abstract** *Purposes* To explore the association between Insertion/Deletion polymorphism of the angiotensin converting enzyme (ACE) gene and the effects of Living High-Exercise High-Training Low (HiHiLo) on arterial oxygen saturation (SPO<sub>2</sub>), so that sports practitioners comprehend better individual hypoxia training effects, coach can constitute individual training program. *Procedures and Methods* 71 healthy men of Han nationality in northern China underwent HiHiLo training for 4 weeks. Training programme was as follows: exposure in hypoxic environment (14.5–14.8 % O<sub>2</sub>, 10 h/day), three times hypoxic training per week (15.4 % O<sub>2</sub>), and training at sea level. Resting, exercising and resuming SPO<sub>2</sub> were measured before and after the protocol, and the ACE gene I/D polymorphism was detected by PCR. *Results* There was no significant differences were in the baseline SPO<sub>2</sub> among groups before HiHiLo. Exercising and resuming SPO<sub>2</sub> both increased significantly in total and II, ID after training than those before the training ( $P < 0.01$ ), but no significant changes showed in DD ( $P > 0.05$ ). *Conclusions* HiHiLo could be helpful for developing individual exercising and resuming SPO<sub>2</sub>. Moreover, SPO<sub>2</sub> of men carrying 2 and ID probably were more sensitive to the hypoxic training than those carrying DD.

**Keywords** ACE gene polymorphism • Living high-exercise high-training • Arterial oxygen saturation

### 88.1 Introduction

The human renin–angiotensin–aldosterone system (RAS) maintains circulatory homeostasis and melody some organs development as cardiac muscle with fat. As part of the RAS, ACE degrades vasodilator kinins and generates angiotensin II.

---

D. Zhou (✉)

Department of Physical Education, Anqing Teachers college, Anhui Anqing 246011, China  
e-mail: duoqizhou@163.com

Y. Hu · Y. Li · L. Yi

Center of Science Research, Beijing Sport University, Beijing 100084, China

J. Nie

Department of Physical Education, Jiangxi Normal University, Jiangxi Nanchang 330022, China



A polymorphism in intron 16 of the human ACE gene has been identified in which the presence (insertion, I allele) rather than the absence (deletion, D allele) of a 287 bp fragment is associated with lower serum and tissue ACE activity [1]. George thought I allele could help reduce ACE and depress ACE activity, leading to alleviate blood vessel resistance, enhance cardiac output and capillary vessel, increase blood supply, improve physical performance [2]. There were significant differences between subjects reside at high altitude and resident lowlanders about ACE genotypes, the subjects reside at high altitude had significantly greater numbers of the II homozygotes and the ID heterozygotes than the DD homozygotes, the II genotype could be associated with altitude adaptation [3]. Woods [4] and Bigham [5] found that I allele of ACE could help individuals maintain high Arterial Oxygen Saturation ascending to High Altitude. But there were significant differences between Chinese Han population and those in Europe and America in genotype and allele frequencies about ACE gene I/D polymorphism [6].

We explored the association between Insertion/Deletion polymorphism of the ACE gene and the effects of HiHiLo on SPO<sub>2</sub> by observing SPO<sub>2</sub> changes before and after four weeks HiHiLo protocol. This would helpful for forecasting Hypoxia training effect and exploring individual Hypoxia training project.

## **88.2 Participants and Methods**

### ***88.2.1 Participants***

The sample consisted of 71 biologically unrelated healthy male volunteers from northern China, who had no experience of hypoxia exposure. The mean (standard deviation (SD) age was 21.10 (0.9) years, the height was 177.93 (5.26) cm and the weight was 69.80 (7.80) kg. Written informed consent was obtained from each participant.

### ***88.2.2 HiHiLo Training Protocol***

Subjects had rested in hypoxia condition (O<sub>2</sub>:14.5–14.8 %, about 3,000 m altitude) for 10 h per day. Hypoxia training were carried out (O<sub>2</sub>:15.4 %, about 2,500 m altitude) 3 times per week for 4 weeks. The participants exercised on Monark 845E bicycle with an intensity of 75 % VO<sub>2</sub> max for 30 min, ordinary aerobic training was carried out in plain.

### ***88.2.3 Arterial Oxygen Saturation Testing***

SPO<sub>2</sub> was measured before and after HiHiLo by NONIN 8,500 (America). The procedure was as follows: first, subjects had been rested on cycle ergometer (Monark 845E, Swden) until their HR, SPO<sub>2</sub> level off in hypoxia condition (O<sub>2</sub>:15.4 %). Then, resting

SPO<sub>2</sub> were measured every minute for 5 min. Next, subjects warmed up, and after their HR were in 90–100 b/min, subjects exercised on cycle ergometer with an intensity of 75 % VO<sub>2</sub> max with 60 cycle/min for 15 min. At last, subjects recovered on cycle for 5 min. Their SPO<sub>2</sub> every minute during exercise and recovery were recorded.

### **88.2.4 Blood Index Testing**

Elbow vein blood was selected one day before HiHiLo and the last date. The RBC, HB and HCT were measured by automatic blood corpuscle instrument (Bayer ADVIA120, Germany).

### **88.2.5 Genotype Analysis**

DNA was extracted from blood cells by a protocol recommended by the kit manufacturer (Promega, Madison, Wisconsin, USA). Primer pairs for polymerase chain reaction (PCR) in accord with Rigat [7] were synthesized. Forward primer: CTG GAG ACC ACT CCA TCC TTT CT, reverse primer: GAT GTG GCC ATC ACA TTC GTC A. The amplification protocol was (1) one cycle of denaturation at 94 °C for 5 min; (2) 30 cycles of denaturation at 94 °C for 40 s, annealing at 50 °C for 40 s and extension at 72 °C for 60 s; and (3) one final elongation cycle at 72 °C for 5 min. Preventive contamination measures were taken by the inclusion of PCR mixture without DNA (negative control). The resulting fragments were separated by horizontal electrophoresis on 2 % agarose gels. Each gel was run for 45 min at 100 V, stained with ethidium bromide and photographed under ultraviolet light.

### **88.2.6 Statistical Analysis**

Pearson's  $\chi^2$  test was used to determine whether the observed genotype frequencies were in the Hardy–Weinberg equilibrium. The paired t test was used to examine the differences in variables before and after training. Differences in variables between the three genotypes were tested by one-way analysis of variance and retrospective multiple comparisons. These tests were performed with SPSS software for Windows 11.5 package. P Values < 0.05 were considered significant. The results are presented as mean (standard difference).

## **88.3 Results**

The observed genotypic frequencies of ACE in men of Han nationality in northern China were 39.4 (II), 50.7 (ID) and 9.9 % (DD), in agreement ( $p > 0.05$ ) with those expected under the Hardy–Weinberg equilibrium.

**Table 88.1** The variables before and after HiHiLo

Variables	Before	After	P
Resting SPO <sub>2</sub> (%)	94.97 ± 1.57	94.91 ± 1.33	NS
Exercising SPO <sub>2</sub> (%)	90.46 ± 2.37	91.74 ± 1.91 <sup>a</sup>	0.000
Resuming SPO <sub>2</sub> (%)	92.42 ± 1.44	93.52 ± 1.95 <sup>a</sup>	0.000
RBC (× 10 <sup>12</sup> cell/L)	4.89 ± 0.03	5.02 ± 0.03 <sup>a</sup>	0.000
HB (g/L)	152.72 ± 1.02	157.69 ± 1.05 <sup>a</sup>	0.000
HCT (%)	43.56 ± 0.23	44.92 ± 0.27 <sup>a</sup>	0.000

<sup>a</sup> Means p < 0.05

### 88.3.1 Arterial Oxygen Saturation Change After HiHiLo

Table 88.1 shows that exercising SPO<sub>2</sub>, resuming SPO<sub>2</sub>, RBC, CHB and HCT increased significantly after training (p < 0.05), but no significant difference was found in resting SPO<sub>2</sub> (p > 0.05).

### 88.3.2 Arterial Oxygen Saturation Change After HiHiLo Among ACE Genotypes

Table 88.2 summarises the association between the ACE genotype and SPO<sub>2</sub> variables. No significant differences were observed in baseline resting, exercising and resuming SPO<sub>2</sub> and RBC, CHB, HCT among three genotypes before training (P > 0.05). After HiHiLo, the exercising and resuming SPO<sub>2</sub> and RBC, CHB, HCT all increased significantly in II and ID genotypes (p < 0.05), but no significant difference was found about those in DD genotype (p > 0.05). Meanwhile, no significant difference was found about resting SPO<sub>2</sub> among ACE genotypes (p > 0.05).

### 88.3.3 Effects of HiHiLo on Arterial Oxygen Saturation

Arterial oxygen saturation is arterial oxygen arterial oxygen percentage of arterial oxygen capacity, which reflects state of physiological oxygen supply. Study reported that individual arterial oxygen pressure and arterial oxygen saturation depressed gradually meanwhile increase of intensity [8, 9]. Furthermore, individual VO<sub>2</sub> max is association with his SPO<sub>2</sub>. VO<sub>2</sub>max decreased by 4.4 % during SPO<sub>2</sub> depressed by 4 % [10]. SPO<sub>2</sub> is an important factor which limit performance. Thus, individual SPO<sub>2</sub> during exercise in hypoxia condition could reflect how subject adapt to hypoxia environment.

We found that subjects' exercising and resuming SPO<sub>2</sub> in hypoxia condition increased significantly after HiHiLo, which implied that HiHiLo could increase

**Table 88.2** The variables before and after HiHiLo among the genotypes

Variables	Genotypes			P
	II (28)	ID (36)	DD (7)	
Before resting SPO <sub>2</sub> (%)	95.17 ± 1.71	94.89 ± 1.54	94.57 ± 1.25	NS
Exercising SPO <sub>2</sub> (%)	90.49 ± 2.56	90.34 ± 2.37	90.96 ± 1.37	NS
Resuming SPO <sub>2</sub> (%)	92.26 ± 1.67	92.39 ± 1.25	93.23 ± 1.37	NS
RBC (×1012 cell/L)	4.96 ± 0.05	4.87 ± 0.04	4.76 ± 0.07	NS
HB (g/L)	153.93 ± 1.93	152.39 ± 1.27	149.57 ± 2.35	NS
HCT (%)	43.82 ± 0.44	43.47 ± 0.28	42.99 ± 0.64	NS
After resting SPO <sub>2</sub> (%)	94.79 ± 1.43	94.91 ± 1.24	95.38 ± 1.41	NS
Exercising SPO <sub>2</sub> (%)	91.58 ± 2.14 <sup>a</sup>	91.79 ± 1.79 <sup>a</sup>	92.15 ± 1.75	NS
Resuming SPO <sub>2</sub> (%)	93.42 ± 1.01 <sup>a</sup>	93.51 ± 1.28 <sup>a</sup>	94.00 ± 1.43	NS
RBC (×1012 cell/L)	5.13 ± 0.06 <sup>b</sup>	4.97 ± 0.04 <sup>a</sup>	4.85 ± 0.08	0.026
HB (g/L)	159.79 ± 1.85 <sup>a</sup>	156.81 ± 1.38 <sup>a</sup>	153.86 ± 2.16	NS
HCT (%)	45.42 ± 0.46 <sup>a</sup>	44.61 ± 0.38 <sup>a</sup>	44.50 ± 0.57 <sup>a</sup>	NS

<sup>a</sup>Means  $p < 0.05$ <sup>b</sup>Means  $p \geq 0.05$ 

individual oxygen supply and their performance. Studies [11, 12] reported resting and exercising SPO<sub>2</sub> increased significantly after intermitted hypoxia training. Lvshaojun found that subjects' resting, exercising and resuming SPO<sub>2</sub> increased significantly after HiHiLo [13]. Niejing approved that HiHiLo was helpful for athlete improve their exercising and resuming SPO<sub>2</sub> in hypoxia condition [14]. Those showed that training combined with hypoxia exposure could increase individual hypoxia load, which made athlete adapt to hypoxia environment and improve their performance.

### 88.3.4 Association Between ACE Gene Polymorphism and the Effects of HiHiLo on SPO<sub>2</sub>

Study reported that there was significant difference about effects of hypoxia training between athletes [15]. Moreover, heredity paly an important role during the individuals adapt to hypoxia environment [16, 17]. Some gene polymorphisms could make clear these differences [18–20].

We found that subjects' exercising and resuming SPO<sub>2</sub> in hypoxia condition increased significantly after HiHiLo in II and ID groups, but no significant difference was found in DD genotype. This implied that ACE gene I/D polymorphism may be association with individual SPO<sub>2</sub> adjustability to HiHiLo. Those with II and ID genotypes may be more helpful individuals for maintenance SPO<sub>2</sub> during exercising in hypoxia environment and resuming SPO<sub>2</sub>. Woods found that individual SPO<sub>2</sub> change when athletes climbed rapidly mountain was association with ACE gene I/D polymorphism, association of I allele with the maintenance of SPO<sub>2</sub> at high altitude [4]. Bigham reported that individual resting and exercising SPO<sub>2</sub> was association close with ACE II genotype ( $P = 0.008$ ).

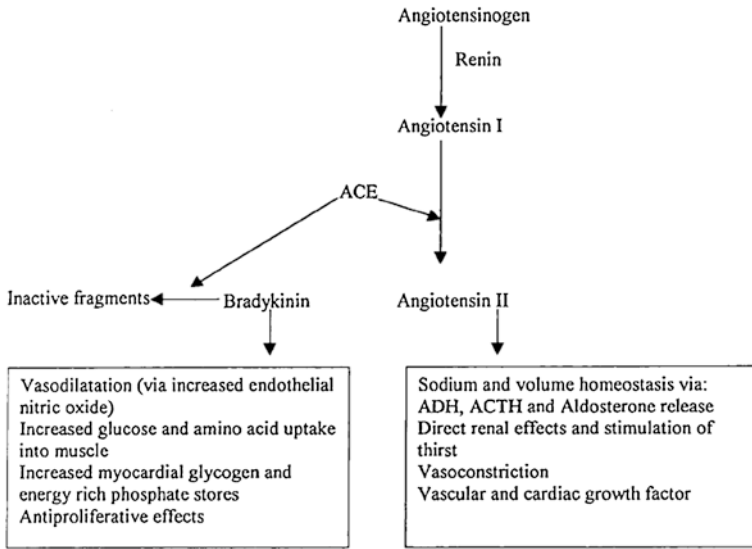


Fig. 88.1 Summary of the RAS. (Cited by Woods, 9)

Subjects' SPO<sub>2</sub> with II genotype were high by 2.3 % than other genotypes [5]. The mechanism of subjects with I allele maintenance SPO<sub>2</sub> during exercising in hypoxia environment and resuming SPO<sub>2</sub> was as follow. One, I allele was association close with less ACE activity blood serum and tissue [1], lower ACE activity could accelerated capillary hyperplasia and increased oxygen reserves (Fig. 88.1). Thus, less arterial oxygen has been absorbed when subject exercised at some a load leading to decreasing SPO<sub>2</sub> descend [21]. The other, subjects' RBC, CHB, HCT with II and ID genotypes had been improved significantly after HiHiLo, which was helpful for maintenance SPO<sub>2</sub> during exercising at some a load in hypoxia environment and resuming SPO<sub>2</sub>.

## 88.4 Conclusion

We found that HiHiLo lasting for 4 weeks could improve individuals adapt to hypoxia environment. Effects of HiHiLo on SPO<sub>2</sub> may be association with ACE gene I/D polymorphism. Subjects with II and ID genotypes may be helpful for maintenance SPO<sub>2</sub> during exercising at some a load in hypoxia environment and resuming SPO<sub>2</sub>.

**Acknowledgments** This research was partially supported by the National Science Council of the Republic of China under Grant Number NSC 30470834/C030314 and Department of Education Anhui province under Grant Number KJ2008B94ZC.

## References

1. Rigat B, Huberi C, Ighene GF A et al (1990) An insertion/deletion polymorphism in the angiotensin-1-converting enzyme levels. *J Clin Invest* 86:1343–1346
2. George G, Bing Y, Brett H et al (1998) Elite endurance athletes and ACE I allele the role of genes in athletic performance. *Hum Genet* 103:48–50
3. Qadar Pasha MA, Khan AP, Kumar R et al (2001) Angiotensin converting enzyme insertion allele in relation to high altitude adaptation. *Ann Hum Genet* 65:531–536
4. Woods DR, Pollard AJ, Collier DJ et al (2002) Insertion/Deletion polymorphism of the angiotensin i-converting enzyme gene and arterial oxygen saturation at high altitude. *Am J Respir Crit Care Med* 166:362–366
5. Bigham A, Kiyamu M, Leon-Vearde F et al (2008) Angiotensin-converting enzyme genotype and arterial oxygen saturation at high altitude in Peruvian Quechua. *High Alt Med Biol* vol 9:167–178
6. Xi Yi, Zhang Xiuli, Yang Hu et al (2006) The frequency distribution characteristics of the ACE Gene I/D polymorphism of northern han nationality youth. *J Tianjin Univ Sport* 21:205–208
7. Rigat B, Huberi C, Corvol P et al (1992) PCR detection of the insertion/deletion polymorphism of the human angiotensin converting enzyme gene. *Nucleic Acid Res* 20:1433–1436
8. Rice AJ, Scroop GC, Gore CJ (1999) Exercise—induced hypoxaemia in highly trained cyclists at 40 % peak oxygen uptake. *Eur J Appl Physiol Occup Physiol* 79:353–359
9. Pedersen PK, Mandoe H, Jensen K (1996) Reduced arterial O<sub>2</sub> saturation during supine exercise in highly trained cyclists. *Acta Physiol Scand* 158:325–331
10. Su Z, Wanmei X, Fang X (2004) Initial exploration into lower arterial oxygen in Hongkong athletes and improved method. The 7th sports science conference
11. Ricart A, Casas H, Casas M et al (2000) Acclimatization near home? Early respiratory changes after short-term intermittent exposure to simulated altitude. *Wilderness Environ Med* 11:84–88
12. Muza SR, Young AJ, Sawka MN et al (2004) Ventilation after supplemental oxygen administration at high altitude. *Wilderness Environ Med* 15:18–24
13. Lv S, Chen G, Zhuo Y et al (2010) Research on the effects of HiHiLo on body functions of elite wushu sanda athletes. *J Beijing Sport Univ* 33:56–59
14. Nie J, Hu Y, Yi L et al (2010) The correlation between the VEGFR2 Gene A+18487T polymorphism and changes of SpO<sub>2</sub> after HiHiLo. *J Beijing Sport Univ* 33:49–52
15. Chapman RF, Stray-Gundersen J, Levine BD (1998) Individual variation in response to altitude training. *J Appl Physiol* 85:1448–1456
16. Rajput C (2006) Endothelin-1 gene variants and levels associate with adaptation to hypobaric hypoxia in high-altitude natives. *Biochem Biophys Res Commun* 341:1218–1224
17. Ramirez G, Bittle PA, Rosen R et al (1997) High altitude living: genetic and environmental adaptation. *Aviat Space Environ Med* 70:73–81
18. Ahsan A, Norboo T, Baig MA et al (2005) Simultaneous selections of the wild-type genotypes of the G894T and 4B/4A polymorphisms of NOS3 associate with high-altitude adaptation. *Ann Hum Genet* 69:260–267
19. Jedlickova K, Stockton DW, Chen H et al (2003) Search for genetic determinants of individual variability of the erythropoietin response to high altitude. *Blood Cells Mol Dis* 31:175–182
20. Suzuki K, Kizaki T, Hitmi Y et al (2003) Genetic variation in hypoxia-inducible factor 1- $\alpha$  and its possible association with high altitude adaptation in Sherpas. *Med Hypotheses* 61(3):385–389
21. Woods DR, Montgomery HE (2001) Angiotensin-converting enzyme and genetics at high altitude. *High Alt Med Biol* 2:201–210

# Chapter 89

## Study on Biological Effect of Plasticizer

Yutao Gong, Minling Gao and Chunxiao Sun

**Abstract** In order to describe the influence of long-term and low dose exposure of plasticizer, the chronic toxicity of Dibutyl phthalate (DBP) to *Daphnia magna* was determined according to the residual concentration of DBP in the practical environment. The effect of DBP on survival, reproduction and growth was monitored. The parameters used to evaluate the environment effect on reproduction included the body length, moulting times, pregnancy times. The results showed that the low concentration of DBP had no significant ( $P < 0.05$ ) impact on the somatotype of *Daphnia magna*. While the concentration of DBP was in the range of 2–20  $\mu\text{g/L}$ , the ecdysis and pregnancy of the exposed organisms were promoted. And the stimulating effect was enhanced with increasing concentration of DBP.

**Keywords** Plasticizer • Dibutyl phthalate • *Daphnia magna*

### 89.1 Introduction

Di butyl phthalate (DBP) is one of the most popular phthalic acid esters (PAEs) and is used mainly as a solvent for dyes and a plasticizer for plastics [1, 2]. PAEs are often detected in water, atmosphere, soils and organism. In recent years [3, 4], DBP is widely present in the environment as a worldwide organic pollutant, especially in water environment [5, 6]. DBP is a persistent organic pollutant with low water solubility and a half-life of 22 years in aqueous solution [7, 8]. Therefore, the Environmental Protection Agency of United States, European Union, China and other international organizations have classified DBP as a priority environmental pollutant. Furthermore, DBP has significant impact on animals as one kind of endocrine disrupting chemicals.

---

Y. Gong (✉) · M. Gao · C. Sun  
School of Environmental and Chemical Engineering,  
Tianjin Polytechnic University, Tianjin, China  
e-mail: gongyutao123@126.com

M. Gao  
e-mail: tgao2009@126.com

C. Sun  
e-mail: sunchunxiao208@163.com

It could reduce the fecundity and made the reproductive organ teratogenesis [9, 10]. And it also has significant effect on the growing of plant. For example, it was reported that the synthesis of carotene during seeding growth was affected by DBP [11, 12]. Subsequently, the relative sensitivity of radish (*Raphanus sativus*) and cabbage (*Brassica oleracea*) exposed to DBP were also determined [13, 14].

Pollution situations of DBP in environment were investigated. The results showed that the concentration of DBP in the main water areas of China was about in the range of 1.9–218.8  $\mu\text{g/L}$  [15]. And Fromme et al. found that the highest concentration in environment was about 182  $\mu\text{g/L}$  [16]. In recent years, the reports on the environmental toxicity of DBP showed that EC50 of DBP to aquatic organism, including Algae, *Daphnia magna*, Salted shrimps, Fish et al., ranged from 1 to 10  $\text{mg/L}$  [17]. EC50 of DBP is obviously higher than the residual concentration in environment which can't well describe the environmental toxicity effect of DBP. Therefore, the studies on toxicity of aquatic organisms at long-term and low-dose exposure of DBP are needed.

In this study, in order to describe the environmental effect of long-term and low dose exposure to pollutants, the chronic toxicity of DBP on *Daphnia magna* was determined according to the residual concentration of DBP in the practical environment during 21 days. By studying the influence of DBP to *D. magna*, including the body length, moulting times, pregnancy times, the intrinsic rate of increase ( $r_m$ ), finite rate of increase ( $R_0$ ) and generation time ( $T$ ) of the population, the environmental effects of DBP on reproduction to *D. magna* could be better described. And, this study can provide the basis for the evaluation of environmental safety.

## 89.2 Materials and Methods

*D. Magna* was supplied by the Research Center of Environmental Science and Engineering of Nankai University, China. *D. magna* was continuously cultured more than three generations in laboratory according to Organization for Economic Co-operation and Development (OECD) 202 method. *Daphnia*'s were cultured and used experimentally in M4 media and maintained at  $22 \pm 2$  °C under a 16 h photoperiod with light intensity 1,100–2,500 lx. Cultured *Daphnids* were fed with *Scenedesmus obliquus* ( $3 \times 10^5$  cells  $\cdot \text{ml}^{-1}$ ) every day, which was pure culture. The sensitivity determination of the *Daphnids* accorded with ISO standard [18].

DBP (>99.5 % purity) used in experiments was purchased from the Tianjin Bodi Chemical Reagent Company (Tianjin, China). Acetone (analytically pure) used in experiments was purchased from the Tianjin Jinbei Chemical Reagent Company (Tianjin, China). Stock solutions of DBP were prepared by ultrasonic dispersion in Acetone, recommended co solvent by OECD. Prior to each experiment, the stock solutions were prepared fresh then diluted to the desired concentration in medium. The final Acetone concentration in the aquaria was 10  $\mu\text{L/L}$ .

The experiment was performed with semi-static system. Culture medium was renewed and offsprings were discarded every day. Based on the residual concentrations of DBP reported by Hermann et al. [16] and Chen et al. [15], four selected



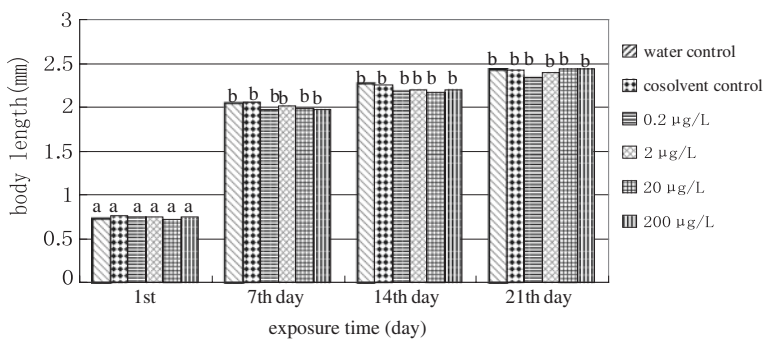
concentration groups (0.2, 2, 20, 200  $\mu\text{g/L}$ ) and two control groups (water control, co solvent control) were used in the experiment. Experimental design included 3 parallel groups to each of the concentration groups and every parallel group had 10 parallel vessels.

For the experiment, the neonates of *D. magna*, less than 24 h old, were used. One neonate was placed in an individual 50 ml container with 30 ml sample solution (M4 media). The experimental culture solutions were maintained at  $22 \pm 2^\circ\text{C}$  under a 16 h photoperiod with light intensity 1,100–2,500 lx. Experimental Daphnids were fed with *Scenedesmus obliquus* with the density of  $2.0 \times 10^5$ – $3.0 \times 10^5$  cells  $\cdot \text{ml}^{-1}$  every day. The experiment was continued for a period of 21 days and the culture medium was renewed per 24 h. Survival and growth was inspected and recorded everyday. And the body length of neonatal daphnia were inspected and recorded after 7, 14 and 21th day.

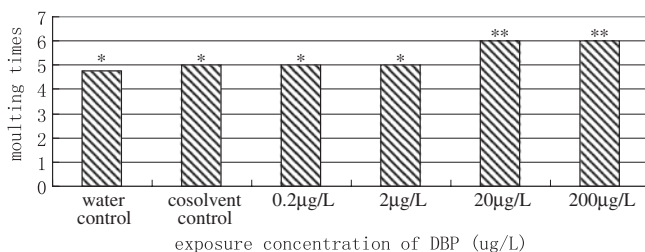
### 89.3 Results and Discussion

The body length from head capsule to caudal spine of the neonatal daphnia (1st, the 7, 14 and 21th day) were measured and recorded, respectively. And the body lengths of *D. magna* treated by the selected concentrations of DBP at different ages are shown in Fig. 89.1. The statistical results showed that the body length of every group has no significant difference ( $P > 0.05$ ). Therefore, there was no obvious effect on the growth of *D. magna* observed when the *D. magna* was exposed to the low dose of DBP during 21 days.

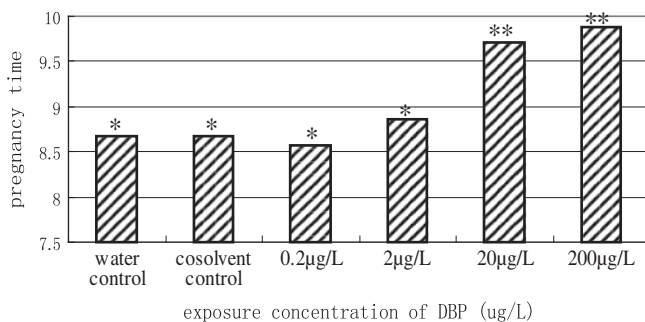
The moulting time of *D. magna* exposed to DBP is shown in Fig. 89.2. As can be seen in Fig. 89.2, the significance analysis demonstrated that the moulting times of control groups (water control, solvent control) and lower concentration groups (0.2, 2  $\mu\text{g/L}$ ) have no significant difference ( $P > 0.05$ ). Furthermore, there is also no significant difference ( $P > 0.05$ ) between 20 and 200  $\mu\text{g/L}$  treat group.



**Fig. 89.1** Body length of *D. magna* exposed to various concentrations of DBP histograms with different letters *a*, *b* differ significantly from one another



**Fig. 89.2** Moulting time of *D. magna* during 21 days. Histograms with \* differ significantly ( $P < 0.05$ ) from \*\*



**Fig. 89.3** Pregnancy time of *D. magna* during 21 days. Histograms with \* differ significantly ( $P < 0.05$ ) from \*\*

As the pollutant concentration increased, the moulting time was no significant change except for 20 and 200  $\mu\text{g/L}$  compared with blank treatment. Therefore, it is concluded that lower concentrations of DBP on *D. magna* had no significant role in the moulting time. After the exposure concentration of DBP reached 20  $\mu\text{g/L}$ , the moulting time was facilitated by DBP.

Base on the pregnancy time (Fig. 89.3), the effect on reproduction of *D. magna* exposed to DBP was evaluated. Similar to the result of moulting time, there were no significant difference ( $P > 0.05$ ) among control, 0.2 and 2  $\mu\text{g/L}$  treatments. 20 and 200  $\mu\text{g/L}$  treatment also had no significant difference ( $P > 0.05$ ). However, the pregnancy time was increased significantly ( $P < 0.05$ ) when the exposure concentration was ranged from 20 to 200  $\mu\text{g/L}$ . When the exposure concentration was less than or equal 2  $\mu\text{g/L}$ , the average of pregnancy time was five. On the contrary, the average of pregnancy time treated with 20 and 200  $\mu\text{g/L}$  is six. According to the data recorded, two-thirds of *D. magna* treated with 0.2 and 2  $\mu\text{g/L}$  group had five times pregnancy, whereas the remaining had six times. In addition, the pregnancy time of 20 and 200  $\mu\text{g/L}$  treatment reached six, even one-thirds of *D. magna* exposed to 200  $\mu\text{g/L}$  DBP reached seven times. Therefore, there was no significant ( $P > 0.05$ ) impact on the pregnancy of

*D. magna* exposed to the lower concentration of DBP. However, when the concentration was in the range of 20–200  $\mu\text{g/L}$ , the pregnancy of the selected organism was promoted.

The previous reports on the environmental toxicity of DBP indicated that the median effective concentration (EC50) of DBP to aquatic organism (Algae, *Daphnia magna*, Salted shrimps, Fish et al.) [17] Ranged from 1 to 10 mg/L. However, the highest concentration of DBP remained in the environment reported is 218.8  $\mu\text{g/L}$  [15, 16] far lower than the residual concentration. Accordingly, EC50 of DBP is not sufficient for describing the actual toxic effect of this organic pollutant to aquatic organisms. At this point, the studies on chronic toxicity of DBP to aquatic organisms much more meet the requirement to master the practically environmental effects.

In summary, the chronic toxicity of *D. magna* exposed to the residual concentrations of DBP reported was evaluated by determining the body length, moulting time, pregnancy time of *D. magna*. The results showed that survival and growth of *D. magna* are influenced because of the residue of DBP. This study provides the foundation on the environmental safety evaluation of environmental endocrine disruptors. Therefore, much more attentions should be paid on the environmental effects of DBP.

## References

1. Amir S, Hafidi M, Merlina G, Hamdi H, Jouraiphy A, Gharous ME, Revel JC (2005) Fate of phthalic acid esters during composting of both lagooning and activated sludges. *Process Biochem* 40:2183–2190
2. Gibson R, Wang MJ, Padgett E, Beck AJ (2005) Analysis of 4-nonylphenols phthalates and polychlorinated biphenyls in soils and biosolids. *Cousins Chemosphere* 61:1336–1344
3. Hutzinge O (1984) *The handbook of environmental chemistry*, vol 1. Springer, Berlin, pp 25–30
4. IPCS (1997) Environmental health criteria 189 di-n-butyl phthalate. *Health Organ Geneva* 1:225–231
5. Muszkat L, Bir L, Raucher D (1997) Identification of mixed o-phenyl alkyl phthalate esters in an agricultural land. *Bull Environ Contam Toxicol* 58:348–355
6. Rhind SM, Smith A, Kyle CE, Telfer G, Martin G, Duff E, Mayes RW (2002) Phthalate and alkylphenol concentrations in soil following applications of inorganic fertiliser or sewage sludge to pasture and potential rates of ingestion by grazing ruminants. *Environ Monit* 4:142–148
7. Teil MJ, Blanchard M, Chevreuil M (2006) Atmospheric fate of phthalate esters in an urban area (Paris-France). *Sic Total Environ* 354:212–223
8. Wolfe NL, Steen WC, Bums LA (1980) Phthalate ester hydrolysis: linear free energy relationships. *Cousins Chemosphere* 19:403–408
9. Lovekamp TN, Davis BJ (2001) Mono-(2-ethylhexyl) phthalate suppresses aromatase transcript levels and estradiol production in cultured rat granulosa cells. *Toxicol Appl Pharmacol* 172:217–224
10. Sung HH, Kao WY (2003) Effects and toxicity of phthalate esters to hemolytic of giant freshwater prawn. *Macro brachium Rosenberger* 64:25–37
11. Hemming IV, Ann-Marie H, Johan M (1981) Effects of di-n-butyl phthalate on the carotenoid synthesis in green plants. *Physiol Plant* 53:158–163

12. Herring R, Bering CL (1988) Effects of phthalate esters on plant seedlings and reversal by a soil microorganism. *Bull Environ Contain Toxicol* 40:626–632
13. Hardwick RC, Cole RA, Fyfield TP (1984) Injury to and death of cabbage (*brassica oleracea*) seedlings caused by vapours of di-butyl phthalate emitted from certain plastics. *Ann Appl Biol* 105:97–105
14. Hannay JW, Millar DJ (1986) Phytotoxicity of phthalate plasticisers. 1. Diagnosis and commercial implications. *Exp Bot* 37:883–897
15. Chen J, Qiu ZQ, Shu WQ, Cao J (2007) Pollution of PAEs in water and the biodegradations studies in china. *Zhuan Jia Lun Tan*, 19:212–214
16. Fromme H, Kuchler T, Otto T, Pilz K, Muller J, Wenzel A (2002) Occurrence of phthalates and bisphenol A and F in the environment. *Water Res* 36:1429–1438
17. William JA et al (1995) A summary of the acute toxicity of 14 phthalate esters to representative aquatic organisms. *Environ Toxicol Chem* 14:1569–1574
18. Zhou YX et al (1989) Test method for aquatic organisms. *Agric Press* 1:147–150

# Chapter 90

## Research on Human Hematopoietic Function by Medical Ray at Different Doses Management

Xiangke Cao, Qingzeng Qian, Fuhai Shen, Qian Wang  
and Junwang Tong

**Abstract** This research is based on medical ray at different doses management on human hematopoietic function influence. Observation group is 97 medical staff in one hospital at different areas of contact ray, who are divided into diagnostic radiology group, interventional radiology group, clinical nuclear medicine group and radiation therapy group. Control group is 32 medical staff in the hospital, who does not contact rays. Blood indexes of men in observation group except RBC are slightly smaller than women. Blood indexes in observation group are slightly smaller than control group. People in <10 group, 10-group, 20-group contact medical ray dose are significantly higher than control group. Blood indexes of people in <10 group, 10-group, 20-group except RBC are slightly smaller than control group. White cell injury is most obvious. Contact ray dose more injury. Contact ray injury longer.

**Keywords** Medical radiation • Dose equivalent • Hematopoietic function

### 90.1 Introduction

Radiation used in medical are called medical radiation. Along with Chinese medical science and technology innovation, medical radiation in China has become an important part of the field of medicine by the unceasing development of medical. Work load in exposure of medical staff is aggravating with each passing day [1]. Medical ray in the treatment of patients with various diseases

---

X. Cao (✉)

Central laboratory for college of Life Sciences, Hebei United University,  
Tang Shan 063000, China  
e-mail: caoxiangke2001@163.com

Q. Qian · F. Shen · Q. Wang · J. Tong

Central laboratory for college of public health, Hebei United University,  
Tang Shan 063000, China

brought us a variety of convenience, which endanger the patients and medical staff of the health of human body. Medical radiations source the gamma rays of certain energy by destroying the human tissue cause human body damage [2]. Human hematopoietic tissue of medical ray effect is one of the main target organs. Medical ray in different doses on human hematopoietic function will produce different influences [3]. In order to study the effect of medical ray at different doses on human hematopoietic function, we conducted this study for the government to formulate corresponding protection measures to provide effective basis.

### ***90.1.1 Respondents***

The observation group is 97 medical staff in one hospital at different areas of contact ray, who age 23–54. The mean age of the observation group is  $36.8 \pm 17.9$ . The control group is 32 medical staff in the hospital, who does not contact rays. The control group age 22–54. The mean age of the control group is  $37.1 \pm 16.7$ . Two groups of personnel age proportion have no significant difference ( $P > 0.05$ ), which can compared each other.

### ***90.1.2 The Survey on the Basic Situation***

With unified questionnaire, the main contents include: name, sex, age, job, accumulated radiation length of service and other basic information.

### ***90.1.3 Apparatus and Blood Index***

Radiation detection use TLD2000 personal dose monitoring meter. The result read by RGD-3 type thermo luminescence dosimetry data processing system. Blood routine examination use BC-2000 blood cell analyzer, including white blood cell (WBC), red blood cell (RBC), hemoglobin (HGB), platelet (PLT), the number of monocytes (MONO #), lymphocyte count (LYMPH #).

### ***90.1.4 Statistics Processing***

All data are used SPSS16.0 statistical analysis software for analysis. All measurement data use F test. When  $P < 0.05$ , there is a statistical significance.

## 90.2 Application

### 90.2.1 Gender Differences Between Various Haematological Comparison

Gender differences between various haematological comparison shows (Table 90.1): The blood indexes of men in observation group except RBC are slightly smaller than women, which have no significant difference. Compared with the control group, the blood indexes of all people in the observation group except RBC are significantly smaller than the control group. The difference is significant ( $P < 0.05$ ). There is a statistical significance.

### 90.2.2 Different Jobs Between the Blood Indexes

Different jobs between the blood indexes shows (Table 90.2): Diagnostic radiology group, clinical nuclear medicine group, interventional radiology and radiotherapy group exposure to medical radiation dose increased, while the medical staff of the hemogram index appears degressive trend. There are no significant differences between the comparison. Compared with the control group, the blood indexes of diagnostic radiology, clinical nuclear medicine group, interventional radiology and radiotherapy group except RBC are significantly smaller than the control group. The difference is significant ( $P < 0.05$ ). There is a statistical significance.

**Table 90.1** Gender differences between various haematological comparison

Sex	Number	Annual dose equivalent (mSv)	WBC ( $10^9/L$ )	RBC ( $10^{12}/L$ )
Control group	32	0.10 ± 0.03	7.81 ± 2.60	4.52 ± 1.97
Observation group, men	54	6.31 ± 3.14*	4.97 ± 3.49*	4.35 ± 2.01
Observation group, women	43	5.72 ± 2.73*	5.15 ± 2.93*	4.23 ± 1.87
F		20.048	10.407	0.574
P		0.000	0.001	0.632
Sex	HGB(g/L)	PLT( $10^9/L$ )	LYMPH # ( $10^9/L$ )	MONO # ( $10^9/L$ )
Control group	148.26 ± 29.13	267.91 ± 51.72	3.56 ± 0.93	0.61 ± 0.12
Observation group, men	133.48 ± 21.75*	216.64 ± 49.28*	2.84 ± 0.62*	0.54 ± 0.23*
Observation group, women	139.17 ± 18.67*	228.71 ± 48.18*	3.17 ± 0.86*	0.55 ± 0.16*
F	4.516	7.412	5.617	6.912
P	0.041	0.018	0.034	0.027

Compared with the control group \* ( $P < 0.005$ )

**Table 90.2** Different jobs between the blood indexes

Jobs	Number	Annual dose equivalent (mSv)	WBC ( $10^9/L$ )	RBC ( $10^{12}/L$ )
Control group	32	0.10 ± 0.03	7.81 ± 2.60	4.52 ± 1.97
Diagnostic radiology group	28	2.31 ± 0.62*	6.05 ± 1.07*	4.51 ± 0.92
Clinical nuclear medicine group	21	4.57 ± 1.58*	5.21 ± 0.93*	4.45 ± 1.03
Interventional radiology group	22	6.90 ± 1.44*	4.64 ± 1.12*	4.23 ± 0.87
Radiotherapy group	26	9.78 ± 3.26*	4.15 ± 0.83*	4.18 ± 0.69
F		34.151	21.263	0.891
P		0.000	0.000	0.352
Jobs	HGB(g/L)	PLT( $10^9/L$ )	LYMPH # ( $10^9/L$ )	MONO # ( $10^9/L$ )
Control group	148.26 ± 29.13	267.91 ± 51.72	3.56 ± 0.93	0.61 ± 0.12
Diagnostic radiology group	144.84 ± 17.56	243.89 ± 46.13*	3.25 ± 0.46*	0.58 ± 0.23
Clinical nuclear medicine group	137.40 ± 15.89*	227.64 ± 43.51*	2.86 ± 0.51*	0.47 ± 0.32*
Interventional radiology group	132.12 ± 20.75*	205.72 ± 40.54*	2.57 ± 0.52*	0.45 ± 0.26*
Radiotherapy group	129.67 ± 14.62*	175.81 ± 37.62*	1.80 ± 0.34*	0.33 ± 0.27*
F	8.198	14.827	8.563	9.351
P	0.009	0.000	0.007	0.001

Compared with the control group \* ( $P < 0.005$ )

### 90.2.3 Different Age Groups Between the Blood Indexes

Different age groups between the blood indexes shows (see Table 90.3): People contact medical ray dose in <10 age group, 10-age group and 20-age group are significantly higher than the control group. The medical staff of the hemogram index appears degressive trend. There are no significant differences between the comparison. Compared with the control group, People in <10 age group, 10-age group and 20-age group except RBC are significantly smaller than the control group. The difference is significant ( $P < 0.05$ ). There is a statistical significance.

## 90.3 Conclusion

In recent years at home and abroad for medical radiation injury on the human body has done a lot of research, but the occupation injury in China started late, especially long-term low-dose exposure to medical radiation caused by the human body injury mechanism is not enough [4]. This study aimed to contact Medical ray



**Table 90.3** Different age groups between the blood indexes

Length of service	Number	Annual dose equivalent (mSv)	WBC ( $10^9/L$ )	RBC ( $10^{12}/L$ )
Control group	32	0.10 ± 0.03	7.81 ± 2.60	4.52 ± 1.97
<10	22	5.93 ± 0.96*	6.19 ± 1.84*	4.43 ± 1.52
10–	41	6.14 ± 1.08*	5.42 ± 1.96*	4.34 ± 0.91
20–	34	5.05 ± 0.87*	4.89 ± 1.55*	4.27 ± 0.46
F		23.618	9.526	0.675
P		0.000	0.001	0.482

Length of service	HGB(g/L)	PLT( $10^9/L$ )	LYMPH # ( $10^9/L$ )	MONO # ( $10^9/L$ )
Control group	148.26 ± 29.13	267.91 ± 51.72	3.56 ± 0.93	0.61 ± 0.12
<10	141.63 ± 28.58	241.60 ± 43.82*	3.22 ± 1.46*	0.52 ± 0.26*
10–	138.79 ± 31.02*	216.96 ± 48.14*	3.15 ± 0.73*	0.47 ± 0.15*
20–	135.60 ± 27.54*	207.55 ± 42.78*	2.86 ± 0.65*	0.42 ± 0.17*
F	2.413	3.024	2.534	3.652
P	0.049	0.018	0.041	0.009

Compared with the control group \* ( $P < 0.005$ )

medical staff were ray dose detection and determination of blood results, Medical ray workers blood indexes were gender, age, job analysis, through comparative analysis, summarized Medical ray at different doses on human hematopoietic function influences, and to analyze its main hazard factors.

Medical ray workers in doses lower than the national standard of year 50 mSv cases [5], human body exposed to different doses of Medical ray, the blood results in the presence of varying degrees of differences in [6], where WBC is the most significant differences, followed by HGB, PLT, LYMPH and MONO # also has each different differences were statistically significant, while RBC had no significant difference.

Medical ray workers grouped according to sex between men and women, the observation group blood indexes were not significantly different, we believe that medical ray workers in the sex of the ionizing radiation dose without distinction. But compared with the control group showed significant difference, except RBC remaining blood index differences are remarkable, indicates that ionization radiation on human impact. Male dose was slightly higher than the female, except RBC remaining blood indicators are slightly lower than females, showed dose and blood index correlation exists, dose greater dose, effect on the human body damage more serious, leading to various haematological changes is more and more apparent.

Medical ray workers in different positions between the comparison, diagnostic radiology groups, clinical nuclear medicine group, interventional radiology and radiotherapy group exposure to medical radiation dose increased, while the medical staff of the hemogram index appears degressive trend, main reason is the exposure of different types, on the human body injury differentiated, diagnostic radiology and clinical nuclear medicine group of radioactive source is relatively

weak, low ray dose. And interventional radiology and radiotherapy group radiation source is relatively strong, high X-ray dose. The exposure time, diagnostic radiology and clinical nuclear medicine group contact time is short but high frequency, and interventional radiology and radiotherapy group longer contact time but lower frequency. The final performance for diagnostic radiology group exposure dose lowest, by Medical ray smaller effects, and therapeutic radiology group exposure dose maximum, by Medical ray effect.

Due to personal physical fitness have the difference, contact Medical ray type and dose are different, the blood indexes also exist certain errors, resulting in different age groups of medical staff of the hemogram index will be different. Along with the growth of the age, the body's resistance and resilience were reduced in different degree, by Medical ray irradiation, tissue cells produced some changes, but the young man back faster, in a relatively short period of time will be able to return to previous levels, older people or. Is mainly reflected in the <10 standing group, 10-age group and 20 to service group service group of medical staff in the blood has obvious decreasing trend.

With the wide application of Medical ray, human aging, in life we can be affected by various natural sources of radiation and artificial radiation source irradiation, the personal injury has many after all deep, remains to be further studied. The various hospital units should also take effective protective measures, minimize Medical ray to human body harm. To sum up, Medical ray at different doses on human hematopoietic function will produce different effects, white cells showed the most pronounced, different types produced radiation damage are also different, contact Medical ray dose in work injury more, contact Medical ray longer injury more.

## References

1. Wang Y, Liu L, Pazhanisamy SK et al (2010) Total body irradiation causes residual bone marrow injury by induction of persistent oxidative stress in murine hematopoietic stem cells. *Free Radical Biol Med* 48(2):348–356
2. Kobayashi I, Kuniyoshi S, Saito K et al (2008) Long-term hematopoietic reconstitution by transplantation of kidney hematopoietic stem cells in lethally irradiated clonal ginbuna crucian carp (*Carassius auratus langsdorfil*). *Dev Comp Immunol* 32(8):957–965
3. Hayashi N, Takahashi K, Abe Y et al (2009) Placental/umbilical cord blood-derived mesenchymal stem cell-like stromal cells support hematopoietic recovery of x-irradiated human CD34+ cells. *Life Sci* 84(17–18):598–605
4. He Y, Kong T, Dong W (2009) Scorpion venom polypeptide accelerate irradiated hematopoietic cells proliferation. *Pathophysiol* 16(4):253–258
5. Singh VK, Singh PK, Wise SY et al (2011) Mobilized progenitor cells as a bridging therapy for radiation casualties: a brief review of tocopherol succinate based approaches. *Int Immunopharmacol* 11(7):842–847
6. Lin CC, Pumsanguan W, Koo MMO et al (2007) Radiation protective effect of cordyceps sinensis in blood cells. *Tzu Chi Med J* 19(4):226–232

# Chapter 91

## High-Performance Liquid Chromatographic Method for the Determination of Bisphenol A, Nonylphenol and Octylphenol in Sewage

Qingzeng Qian, Xiangke Cao, Qian Wang, Yanhua Cao,  
Suying Rong and Sujing Yu

**Abstract** This research is based on high performance liquid chromatographic method for the determination of bisphenol A, nonylphenol and octylphenol in sewage. Sewage samples use dispersive liquid-liquid extraction-pre column derivatization-High performance liquid chromatography method for the determination. Dichloromethane is extracting agent. Acetonitrile and water (V:V = 90:10) are mobile phase. Bisphenol A, nonylphenol and octylphenol detect by Inertsil ODS-P column (5  $\mu\text{m}$ , 250  $\times$  4.6 mm) after the separation of fluorescence. Fluorescence excitation wavelength is 227 nm. The emission wavelength is 313 nm. Sample complete in 6 min within the peak. Linear range is  $0.1^{-10}$  mg/L. In 0.1, 0.5 and 1 mg/L three concentrations of added level of sewage recovery of samples are respectively 94.7–106.8 %. The method is simple, rapid and economic actual samples. It can be used for sewage.

**Keywords** High performance liquid chromatography • Sewage • Bisphenol A • Nonyl phenol • Octyl phenol

---

Q. Qian (✉) · Q. Wang · Y. Cao  
Central Laboratory for College of Public Health, Hebei United University,  
Tangshan 063000, China  
e-mail: qianqingzeng@yahoo.cn

X. Cao  
Central Laboratory for College of Life Sciences, Hebei United University,  
Tangshan, China

S. Rong  
College of Tangshan Vocational and Technical, Tangshan, China

S. Yu  
The Fourth Hospital of Tangshan City, Tangshan, China

## 91.1 Introduction

Nonylphenol (NP), octylphenol (OP) and bisphenol A (BPA) belong to the environmental endocrine disruptors (EES). NP and OP are in the environment of alkyl phenol polyoxyethylene ether degradation products. BPA is the production of polycarbonate and epoxy resins [1, 2]. As a result of alkyl phenol polyoxyethylene ether, polycarbonate and epoxy resins are widely used. The nonylphenol, octylphenol and bisphenol A exists widely in various environments [3, 4]. Studies show that NP and BPA can induce male vitellogenin generation. OP major cause of reduced fertility in males. The estrogenic activity of NP is more than 40 times. BPA estrogenic activity has been widely demonstrated [5]. In order to better assess the material impact on the ecological environment, a rapid, accurate, sensitive and efficient analysis method is particularly important. At present, nonylphenol, octylphenol and bisphenol A analysis method with gas chromatography—mass spectrometry, liquid chromatography mass spectrometry, capillary electrophoresis, micellar electrokinetic chromatography and high performance liquid chromatography [6]. Involving samples are biological, food, water, toys. GC-MS and HPLC-MS method because of its high sensitivity analysis of estrogen of commonly used methods, requirement on instruments high and failed to popularity, HPLC is commonly used for the analysis of EES method, used for environmental water analysis, this study uses dispersive liquid–liquid extraction–high performance liquid chromatography technology and analysis of sewage in BPA, nonyl phenol and Octyl phenol.

## 91.2 Application

### 91.2.1 Apparatus and Reagents

The Agilent 1,200 high performance liquid chromatograph, equipped with four yuan of pump, the autosampler, on-line degasser, fluorescence detector (American Agilent company), Inertsil ODS-P column (5  $\mu\text{m}$ , 250  $\times$  4.6 mm) (Dima Technology), (KQ-500VDB) frequency NC Ultrasonic Cleaner (Kunshan City ultrasonic instrument limited company), Pune—echo 2002-U type ultrapure water system (Chongqing City Eco Pu laboratory), Jin Yue DK-8D type constant temperature water bath pot (medical instrument factory in Jintan city). BPA, 4-nonylphenol and 4-Octylphenol were Sigma reagent. Chromatographic purity methanol purchased from the United States of America Fisher company. Dichloromethane purchased from Beijing Jinhui chemical company limited. Acetonitrile purchased from the Shanghai trial of a chemical reagent limited company. Standard stock solution (20 g/ml): measure the BPA, NP and OP 1 mg, methanol capacity to 50 ml Brown volumetric flask, ultrasonic mixing, 4  $^{\circ}\text{C}$  and dark storage.

### ***91.2.2 Sample Processing***

Extraction methods use dispersive liquid-liquid extraction. Extraction solvent selection is dichloromethane. The specific steps are as follows: the sewage sample 0.45  $\mu\text{m}$  membrane, while using the 6 mol/L hydrochloric acid to adjust the pH to 2–3. 1 L/2 L quantity of liquid is poured into the funnel, then we join 30 mL dichloromethane. We use the table to shake and set aside for 20 min so that the liquid two-phase stratified. With 120 mL rotary retort and taking the lower methylene chloride liquid, then respectively by 30 and 20 mL according to the steps of dichloromethane extraction for two times, will extract collected from the same rotating distillation bottle, and then by a rotary evaporator concentrate to 0.5 mL, using a constant flow of nitrogen blowing. Add 50  $\mu\text{L}$  1.92  $\mu\text{g/L}$  BPA-d16 (internal standard), methanol capacity to 1 mL, mixing, with sample collection vial, 4 °C save preparation.

### ***91.2.3 Chromatographic Conditions***

Chromatographic column: Inertsil ODS-P column (5  $\mu\text{m}$ , 250  $\times$  4.6 mm) (Dima Technology); mobile phase: acetonitrile and water (V:V = 90:10); flow rate of 1.0 ml/min; column temperature of 35 °C; the excitation wavelength ( $\lambda_{\text{ex}}$ ) = 227 nm, emission wavelength ( $\lambda_{\text{em}}$ ) = 313 nm; inlet sample volume 10  $\mu\text{L}$ .

## **91.3 Results and Discussion**

### ***91.3.1 Sample Extraction Condition Optimization***

High performance liquid chromatography with mobile phase of methanol, acetonitrile, multiple use of water. Among the many mobile phase, acetonitrile eluting capacity best, so selection of acetonitrile and water as the study of the extraction agent. Through the selection of several mobile phase proportion, acetonitrile and water (V:V = 50:50, 70:30, 80:20, 90:10, 100:0) as mobile phase, comparative analysis of various proportioning conditions peak and sensitivity, final selection of acetonitrile and water (V:V = 90:10). As a result of BPA, NP and OP have a certain polarity, in the process of testing, the sensitivity is also different.

### ***91.3.2 The Selection of Chromatographic Conditions***

#### **91.3.2.1 Selection of Chromatography Column**

Examines the  $\text{C}_{18}$  column and Inertsil ODS-P column on BPA, NP and OP separation effect. General  $\text{C}_{18}$  column, will be a very good BPA and other two kinds of compounds, but can not be completely separated NP and OP, Inertsil ODS-P

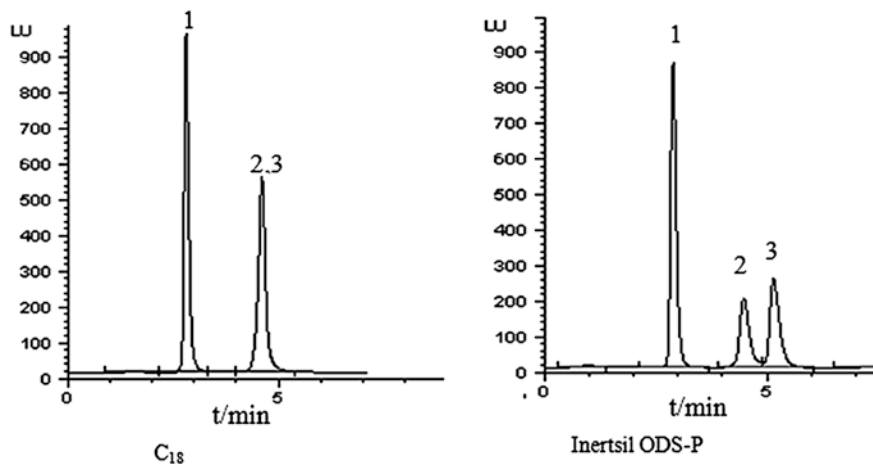


Fig. 91.1 Chromatograms of a mixture of BPA, NP and OP were separated by C<sub>18</sub> columns and inertsil ODS-P columns, 1 bisphenol A, 2 nonylphenol, 3 octylphenol

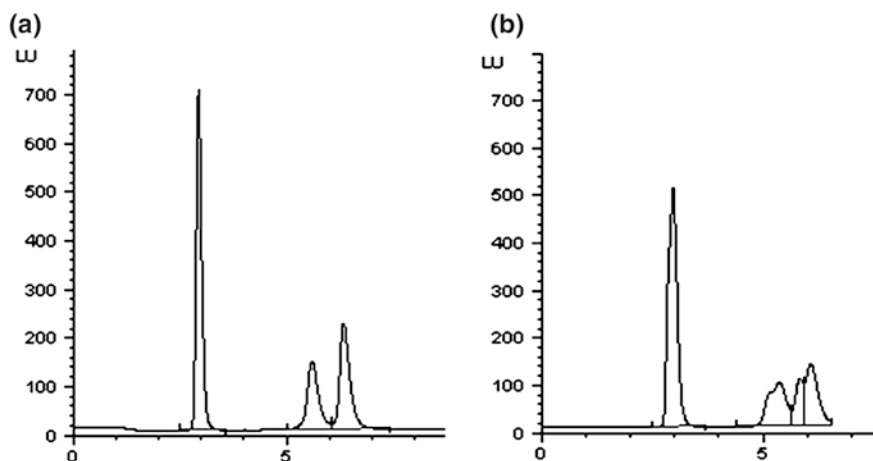


Fig. 91.2 Chromatograms of a mixture of BPA, NP and OP were separated by acetonitrile and **a** acetonitrile and water (V:V = 90:10); **b** methanol and water (V:V = 90:10)

using multidetector C<sub>18</sub> bonded phase, with a specific selectivity, especially on the structure similar to that of the material or isomers were separated well. The results show that, using the Inertsil ODS-P column, acetonitrile and water as mobile phase, to obtain the most ideal separation result (Fig. 91.1).

### 91.3.2.2 The Selection of Mobile Phase

Study of methanol—water, acetonitrile water two flow relative to the target compounds separation effect, the results showed that methanol, acetonitrile eluting

ability strong, have better separation ability, and the baseline is more stable, the experiment of acetonitrile and water as mobile phase, when acetonitrile percentage is 90 %, three kinds of target compounds can the very good separation, and can in a short period of time to complete the analysis (Fig. 91.2).

### 91.3.2.3 The Temperature of the Column Selection

Compares the column temperature for 25–40 °C. BPA, NP and OP on the separation effect, the results show that, when the column temperature is 35 °C, the target compounds separation degree and the sensitivity of the most ideal.

## 91.3.3 Method of Evaluation

### 91.3.3.1 The Linear Ranges and Detection Limit

The prepared standard stock solution dispensed into a series of different concentrations of mixed liquid in sample, the optimization of chromatographic conditions were determined, the components of the peak area and the concentration showed a good linear relationship, linear range in 0.1–10 mg/L, the correlation coefficients are larger than 0.993. Method of retention time, linear equations, correlation coefficients (Table 91.1), the signal to noise ratio (S/N) = 3 the detection limit, (S/N) = 10 for the lower limit of quantification.

### 91.3.3.2 Method Precision and Accuracy

On low (0.1 mg/L), (0.5 mg/L) and high (1 mg/L) of three different concentration of standard solution in the same days of continuous determination of 6, 3 target compounds in calculation of peak area within day precision: were continuously measured for 6 days, calculation of 3 target compounds of the peak area of day to day precision (Table 91.2).

**Table 91.1** Retention time, linear equation, correlation coefficients and limit of detection for BPA, NP and OP

Chemical	Retention time (min)	Linear equation	Correlation coefficients (r)	Limit of detection (mg/L)
BPA	2.89	$y = 313.36x - 10.78$	0.9963	0.82
NP	4.47	$y = 143.44x - 7.975$	0.9926	8.01
OP	5.36	$y = 164.5x - 6.415$	0.9972	6.35

**Table 91.2** Precision tests (n = 6)

Concentration of standard solution ( $\mu\text{g/ml}$ )	Chemical	Intra-day RSD (%)	Inter-day RSD (%)
0.1	BPA	1.42	3.41
	NP	8.26	11.1
	OP	5.87	6.68
0.5	BPA	0.98	2.42
	NP	2.07	4.76
	OP	0.92	1.95
1.0	BPA	0.73	1.64
	NP	1.35	4.10
	OP	0.74	2.16

**Table 91.3** The contents of BPA, NP and OP in sludge and soil samples

Chemical	Water content range (mg/L)	Water average content (mg/L)
BPA	0–0.82	0.69
NP	0–8.01	7.48
OP	0–6.35	5.73

Take Table 91.3 sewage samples as the blank sample, respectively, determination of its background value. Another equally sewage samples 12 copies each, divided into 3 groups, each group of 4 copies, respectively adding low of 3 concentrations of mixed standard solution, according to this method were determined, calculation of recovery rate. Sewage recovery of samples in 94.7–106.8 %.

### 91.3.4 Method and its Application

The application of the method for the determination of the sewage collected from sewage irrigation area of 5 samples, according to the 2.2 samples (Table 91.3).

## References

1. Xiao J, Shao B, Wu XY et al (2011) A study on bisphenol A, nonylphenol, and octylphenol in human urine amples detected by SPE-UPLC-MS. *Biomed Environ Sci* 24(1):40–46
2. Cooper JE, Kendig EL, Belcher SM (2011) Assessment of bisphenol A released from reusable plastic, aluminium and stainless steel water bottles. *Chemosphere* 85(6):943–947
3. Yiantzi E, Psillakis E, Tyrovolas K et al (2010) Vortex-assisted liquid-liquid microextraction of octylphenol, nonylphenol and bisphenol A. *Talanta* 80(5):2057–2062
4. Langdon KA, Warne MSJ, Smernik RJ et al (2011) Degradation of 4-nonylphenol, 4-t-octylphenol, bisphenol A and triclosan following biosolids addition to soil under laboratory conditions. *Chemosphere* 84(11):1556–1562



5. Zhou Q, Gao Y, Xie G (2011) Determination of bisphenol A, 4-n-nonylphenol, and 4-tert-octylphenol by temperature-controlled ionic liquid dispersive liquid-phase microextraction combined with high performance liquid chromatography-fluorescence detector. *Talanta* 85(3):1598–1602
6. Ferrer E, Santoni E, Vittori S et al (2011) Simultaneous determination of bisphenol A, octylphenol, and nonylphenol by pressurized liquid extraction and liquid chromatography tandem mass spectrometry in powdered milk and infant formulas. *Food Chem* 126(1):360–367

## Chapter 92

# Joint Torque Calculation Model Based on the Relationship Between Individual Muscle Force and Surface Electromyography

Jianfeng Wu, Haiying Li, Bing Xu and Xiaojian Liu

**Abstract** The joint torque calculation model based on the relationship between individual muscle force and surface electromyography (EMG) was described. Joint torque is one of the most important motion information of human people, and it has been widely used in the biomechanics, ergonomics, production design and other related fields. Firstly, the architecture of this joint torque calculation method based on individual muscle force was established based on muscle physiological model and musculoskeletal geometry model. Secondly, using the “force–length” and the “force–velocity” relationships of the individual muscle, the muscle force could be dynamic predicted according to the muscle active level that was expressed by the surface EMG signals in this method. Thirdly, the total torque produced by all muscles of the joint can be expressed as the sum of individual muscles’ contributions. At last, the experimental results confirmed the effectiveness of this calculation method.

**Keywords** Joint torque • Individual muscle force • Surface EMG • Physiological model • Musculoskeletal geometry model

---

J. Wu (✉) · B. Xu · X. Liu  
Institute of Industrial Design, Zhejiang University of Technology, Hangzhou 310023, China  
e-mail: jianfw@126.com

B. Xu  
e-mail: xubing@zjut.edu.cn

X. Liu  
e-mail: crazylxj@126.com

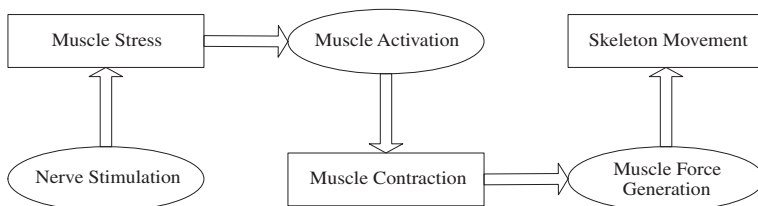
H. Li  
Wenzhou Institute of Industry and Science Research, Wenzhou 325028, China  
e-mail: wzlhy69@126.com

## 92.1 Introduction

The powerful motion system of human beings composed with bones, joints, muscles and nerves helps people to complete lots of complex tasks. The skeleton muscles can generate active forces for the static and dynamic motor functions when acting upon the bone and joint system [1], so its biomechanical properties reflects the inherent characteristics of human motions. But limited by existing technology, it is difficult to obtain the human limb's muscle forces and joint torques effectively and precisely in real-time at present. There are two basic methods to calculate the muscle force and joint torques since Hill established the muscle contraction theory in 1938, such as the inverse kinematics algorithm (IK) [2, 3] and “bio-signals” method [4, 5].

IK algorithm is usually to estimate the external loads of skeleton muscles, and the muscle force must be solved through some optimization methods which established by artificial assumptions [6]. The electromyography (EMG) is the biological electrical changes as the central nervous system controlling the muscles, and it reflects the muscle's electrical activity. A muscle initiates the mechanical force production under the electrophysiological activation, and this process includes two major problems indicated by Fig. 92.1 [7].

The first problem is the neuromuscular activation, and the “composition elements” within a muscle receive the nerve stimulation in this progress; the second is the muscle contraction, in this progress the muscle starts to contract and the muscle force generates. So, the muscle activity can be observed as the nerve stimulations (the electromyography). Particularly, the surface EMG has advantages of available non-invasive measurement, it has become an important research issues. There are two kinds of ways to estimate the muscle force and joint torque using EMG: the first is based on statistical theory. Its main idea is to establish a non-linear relationship between muscle strength and EMG using polynomial functions or artificial neural network algorithms. The second method is based on the physiological characteristics of the individual stimulated muscle. According the “force-length” and “force-velocity” relationships of the muscle, the muscle force can be calculate through a prior anatomy-based muscle model while the muscle active level is taken as one parameter. The relations between the EMG activity and isokinetic elbow joint torque were determined by Luh using an artificial neural network model [8]. Dariani designed an artificial neural network to model force-velocity relation



**Fig. 92.1** The process of a muscle initiates the force under the electrophysiological activation [7]

in skeletal muscle isotonic contraction [9]. Manal determined the relationship between muscle activity levels and EMG signals [10, 11], and Lloyd estimated the knee joint torque in walking, climbing and running behaviors using EMG and the improved lower limb muscle model [12]. Erdemir established muscle forces and joint torques during movement using the same method. This kind of method is chosen in this study because that it can provide dynamic analysis of individual muscle.

### 92.2 Model Architecture

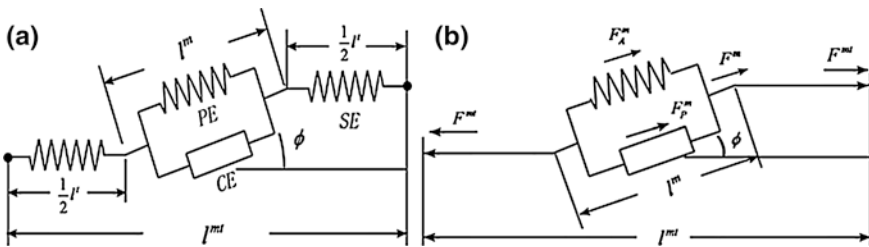
Based on Hill three elements model of muscle physiology and the muscles and skeletons geometric model, this module's function is to build a Torque-EMG model between the surface EMG signals and the relative muscles' force.

#### 92.2.1 Simplified Muscle Physiological Model Based on Hill Three Elements Model

The muscle physiological model based on the structural characteristics of muscle physiology is used to explain the muscle contraction response. Generally, the Hill model consists the Hill model is made of three elements as shown in Fig. 92.2: a contractile element (CE) generates the active muscle force,  $F_A^m$ , a parallel elastic element (PE) producing the passive force,  $F_P^m$ , and the series elastic element (SE) that does not produce any force [7]. And in this figure,  $F^{mt}$  means the muscle force,  $l^{mt}$  means the entire length of the muscle,  $l^t$  means the length of the tendon,  $l^m$  means the fiber length, and  $\phi$  is the pennation angle.

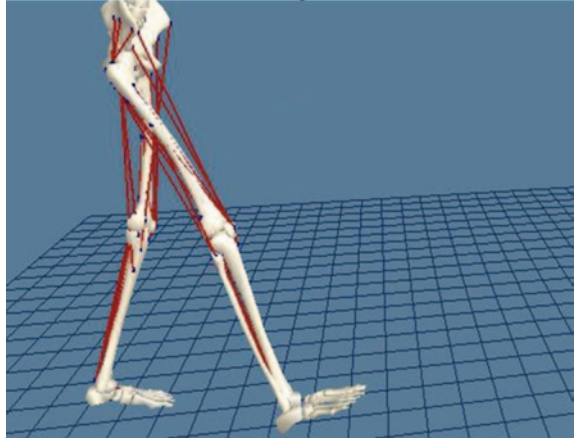
#### 92.2.2 Musculoskeletal Geometry Model Based on Anatomy

The musculoskeletal geometry model is the basis to calculate muscle force and joint torque. To express the relative positions of skeletons and muscles accurately,



**Fig. 92.2** The simplified muscle physiological model based on Hill three-element model **a** Hill model **b** The simplified Hill muscle model

**Fig. 92.3** The human lower extremity musculoskeletal geometry model



this study established the human lower extremity musculoskeletal geometry model using ZJU-ERGOMAN [13] (shown in Fig. 92.3).

### 92.2.3 Muscle Force Calculation Model Based on Surface EMG

As the skeleton muscle's contraction activities are stimulated and controlled by the never signals, the muscle activations can be described by EMG values. This paper adopts the exponential-type function according to Potvin [14]:

$$a(u) = \frac{e^{AuR^{-1}} - 1}{e^A - 1} \quad (92.1)$$

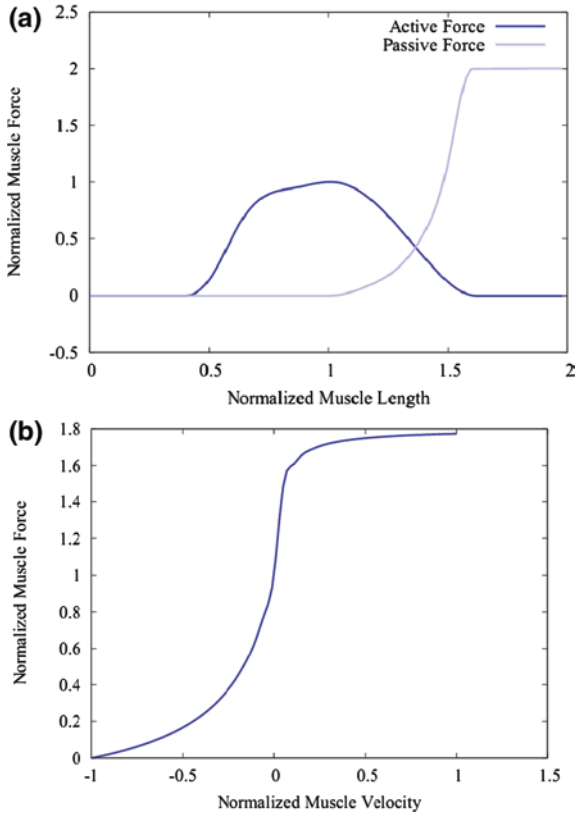
where  $a(u)$  is the muscle activation function,  $u$  is the amplitude value of muscle surface EMG signal,  $R$  is the estimated value of the maximum EMG, and  $A$  is the non-linear curve factor range from  $-5$  to  $0$ .

Based on the simplified Hill muscle model shown as Fig. 92.2b, the series elastic element (SE) of the skeleton muscle does not produce any force. So, when the muscle is stretched, the muscle force,  $F^{mt} = F_A^m + F_P^m = f_A(\tilde{l}^m) \cdot f_v(\tilde{v}^m) \cdot F_o^m \cdot a(u) + f_P(\tilde{l}^m) F_o^m$ , can be described as following based on the “force–muscle length curve” (Fig. 92.4a) and the “force–muscle velocity curve” (Fig. 92.4b) [15]:

$$F^{mt} = F_A^m + F_P^m = f_A(\tilde{l}^m) \cdot f_v(\tilde{v}^m) \cdot F_o^m \cdot a(u) + f_P(\tilde{l}^m) F_o^m \quad (92.2)$$

Where  $f_A(\tilde{l}^m)$  is the active force–length function and  $f_P(\tilde{l}^m)$  is passive force–length function which describe the ability of the muscle to produce force at a certain muscle fiber length,  $f_v(\tilde{v}^m)$  is the active force–velocity function which describes the ability of the muscle to produce force at a certain muscle

**Fig. 92.4** The force–length curve and the force–velocity curve [15, 16], **a** force–muscle length curve; **b** force–muscle velocity curve



fiber contract velocity,  $F_o^m$  is the maximum isometric force,  $\tilde{l}^m$  is the normalized muscle fiber length. Since some parameters can be taken from literature [16], the subject-dependent parameters of this model are  $F_o^m$  and  $a(u)$  for every muscle which should be obtained through the calibration.

### 92.2.4 Joint Torque Calculation Based on Muscle Force

The joint torque can be expressed as the product between the force and the moment arm shown as Eq. 92.3. So, the total torque produced by all muscles of the joint can be expressed as the sum of individual muscles’ contributions:

$$T_i = r_i F_i^{mt} \tag{92.3}$$

$$T(t) = \sum_{i=1}^N F_i^{mt}(t) \cdot r_i(t) \tag{92.4}$$

where  $N$  is the number of all muscles of the joint,  $r_i$  is the approximated moment arm of the  $i$ th muscle,  $F_i^{mt}$  is the force of the  $i$ th muscle, and  $t$  is a sampling point.

### 92.3 Experiment

The sagittal knee joint torque is selected as the sample in this study. Three participants were ordered to complete five standing tasks. And using the motion capture system, the surface EMG acquisition system and the plantar pressure distribution measurement system, all the related data were collected. In this study, the Rectus Femoris (RF), the Vastus Medialis (VF), the Vastus Lateralis (VL), the Biceps Femoris (BF) and the Semitendinosus (SE) were chosen based on the literature [17] as shown in Fig. 92.5.

The real joint torque cannot be obtained directly, so one set of data selected randomly was used to estimate the knee joint torque with IK algorithm. The results were used to calibrate those parameters in the torque calculation model. In fact, those parameters solving is attributed to optimization problem, and the sum squared error function is selected as the optimization objective function in this study. Then the other data were used to calculate the knee joint torques while standing up. Otherwise, the surface EMG electrode could not measure all relevant muscles about the knee joint, and only five muscles could be measure. Thus, to reduce the systematic errors, the formula calculating joint torque was modified as following:

$$T_{knee-measured}(t) = \sum_{i=1}^5 w_i F_i^{mt}(t) \cdot r_i(t) \quad (92.5)$$

where  $w_i$  is the correction parameter of joint torque of an individual muscle. To verify the model accuracy, the root mean square errors (RMSE) and the average

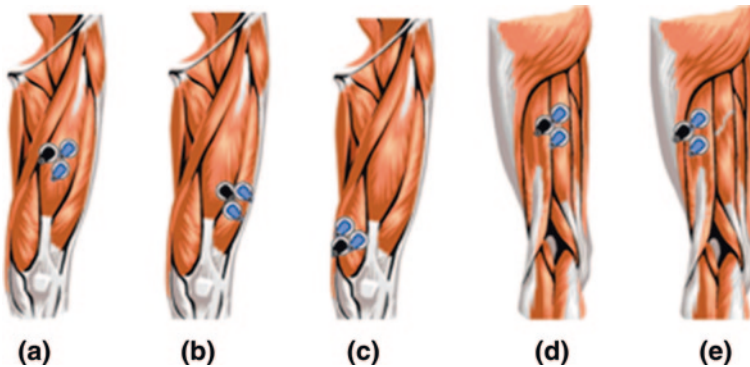


Fig. 92.5 The selection muscles and the electrode placements. a RF b VL c VM d SE e BF

**Table 92.1** The compared results of all subjects

Number of subject	RMSE (Nm/kg m)	MAXE (Nm/kg m)
1	0.029	0.052
2	0.027	0.030
3	0.033	0.042

maximum errors (MAXE) between the values based on IK and values estimated by the model of all the three subjects were shown in Table 92.1. The results of these experiments confirmed the effectiveness of the joint torque calculation model.

## 92.4 Conclusions

In this paper, a joint torque calculation model based on muscle force–surface EMG relationship is represented. And the stand-up experiments were taken as examples to test the effectiveness of this algorithm. The research results not only contribute to biomechanical analysis, but also have a wide range of application prospects such as disability rehabilitation, humanoid robot controlling, sports biomechanics, human computer interaction technology and other related theoretical research fields.

**Acknowledgments** This work was financially supported by the Science and Technology Project of Zhejiang Province (Grant No. 2011C11052) and Wenzhou Science Research Project (No. 20100139).

## References

1. Disselhorst-Klug C, Schmitz-Rode T, Rau C (2009) Surface electromyography and muscle force: limits in sEMG–force relationship and new approaches for applications. *Clin Biomech* 24:225–235
2. Forner-Cordero A, Koopman HJFM, van der Helm FCT (2006) Inverse dynamics calculations during gait with restricted ground reaction force information from pressure insoles. *Gait Posture* 23:189–199
3. Blajer W, Dziewiecki K, Mazur Z (2007) Multibody modeling of human body for the inverse dynamics analysis of sagittal plane movements. *Multibody Syst Dyn* 18:217–232
4. Bogey RA, Perry J, Gitter AJ (2005) An EMG-to-force processing approach for determining ankle muscle forces during normal human gait. *IEEE Trans Neural Syst Rehabil Eng* 13:302–310
5. Wu JF, Sun SQ, Xu M, Shi YW (2008) A muscle force prediction model for ergonomics simulation. *China Mech Eng* 19:571–574
6. Wu JF, Li HY, He XD, Yang NT, Shi FQ (2010) Muscle force and joint torque prediction model for intelligent human-assisted product design. *Adv Mater Res* 102–104:165–169



7. Zajac FE (1989) Muscle and tendon: properties, models, scaling, and application to biomechanics and motor control. *Crit Rev Biomed Eng* 17:359–411
8. Luh JJ, Chang GC, Cheng CK, Lai JS, Kuo TS (1999) Isokinetic elbow joint torques estimation from surface EMG and joint kinematic data: using an artificial neural network model. *J Electromyogr Kinesiol* 9:173–183
9. Dariani S, Keshavarz M, Parviz M, Raoufy MR, Gharibzadeh S (2007) Modeling force–velocity relation in skeletal muscle isotonic contraction using an artificial neural network. *BioSyst* 90:529–534
10. Manal K, Buchanan TS (2003) A one-parameter neural activation to muscle activation model: estimating isometric joint moments from electromyograms. *J Biomech* 36:1197–1202
11. Manal K, Gonzalez RV, Lloyd DG, Buchanan TS (2002) A real-time EMG-driven virtual arm. *Comput Biol Med* 32:25–36
12. Lloyd DG, Besier TF (2003) An EMG-driven musculoskeletal model to estimate muscle forces and knee joint moments in vivo. *J Biomech* 36:765–776
13. Xu M (2006) A biomechanical virtual human model for ergonomics simulation and analysis. *Zhejiang Univ* 22(4):467–473
14. Potvin JR, Norman RW, McGill SM (1996) Mechanically corrected EMG for the continuous estimation of erector spinae muscle loading during repetitive lifting. *Eur J Appl Physiol* 74:119–132
15. Delp SL, Loan JP, Hoy MG, Zajac FE, Topp EL, Rosen JM (1990) An interactive graphics-based model of the lower extremity to study orthopaedic surgical procedures. *IEEE Trans Biomed Eng* 37:757–767
16. Fleischer C (2007) Controlling exoskeletons with EMG signals and a biomechanical body model. Technical University of Berlin, De
17. Fleischer C, Hommel G (2007) Calibration of an EMG-based body model with six muscles to control a leg exoskeleton. *Proc IEEE Int Conf Robot Autom* 32:2514–2519

# Chapter 93

## Prognosis of Hyperuricemia in Patients with Acute Cerebral Infarction

Yanbo Peng, Xin Xiong, Yu Su, Zhuo Wang, Jingyue Wang, Xiaojing Zhao and Dali Wang

**Abstract** *Background* The prognostic significance of uric acid (UA) levels in acute ischemic stroke is unclear, so the objective of this study was to investigate the relationship between the uric acid and the outcome in patients with acute ischemic stroke. *Methods* Consecutive patients (n = 2,128) presenting with acute ischemic stroke ( $\leq 72$  h) were included in the study. We determined the association of uric acid level with at discharge (alive at discharge, good outcome; dead or living in care, poor outcome). Demographics, history of past illness, and laboratory markers, were analyzed in both outcome groups with the use of multivariate logistic regression. *Results* We measured serum urate in 2,128 patients. Elevated urate level predicted a lower chance of good outcome at discharge (odds ratio, 1.25 per additional 0.1 mmol/L; 95 % confidence interval [CI], 1.66–3.05) independently of other prognostic factors. Higher urate levels have a greater effect on outcome in the presence of hypertriglyceridemia (additional relative hazard, 2.57 per additional 0.1 mmol/L; 95 % CI, 1.88–6.77). *Conclusions* Hyperuricemia is independently associated with an increased risk of outcome in acute ischemic stroke.

**Keywords** Cerebral Infarction • Hyperuricemia • Prognosis

---

Y. Peng · X. Xiong · Z. Wang · J. Wang · X. Zhao · D. Wang (✉)  
Department of Neurology, Affiliated Hospital of Hebei United University, Tangshan, China  
e-mail: wangdali0823@163.com

Y. Peng  
Department of Epidemiology, School of Radiation Medicine and Public Health, Medical College of Soochow University, Suzhou, China

Y. Su  
Human resources department, Hebei United University, Tangshan, China

J. Wang  
International education center, Hebei United University, Tangshan, China

## 93.1 Introduction

There is a well-recognized epidemiological link between elevated serum uric acid and increased cerebrovascular risk. Several large studies have identified the value of hyperuricemia in independently predicting the risk of cerebrovascular disease it is a matter of controversy whether serum uric acid is an independent predictor of mortality patients with cerebrovascular disease or whether it represents an indirect marker of adverse outcome by reflecting the association between uric acid and other established cerebrovascular risk factors [1].

In the present study we examined the association of hyperuricemia with the clinical outcome and the fatality rate of patients with acute ischemic stroke.

## 93.2 Methods

From 1998 to 2010, 2,128 patients with acute ischemic stroke were admitted to the Affiliated Hospital of Hebei United University within 72 h from the onset of symptoms. All patients within the definition of cerebral infarction, which was defined on the Fourth China Conference on cerebrovascular disease in 1995, and experiencing a neurological event Brain imaging (either CT or MRI) was performed routinely within 72 h of admission. Data were collected with regards to patient demography, medical history, and risk factors for stroke or vascular.

Indexes of stroke outcome used the Modified Rankin Scale (MRS). Outcome was categorized as alive at discharge, alive in care, or dead at discharge after the index stroke. A good outcome after the index stroke was defined as alive at discharge and bad outcome as alive in care or dead at discharge. Serum uric acid was measured as part of a fasting biochemical profile taken on the morning after admission. The subjects were classified into two categories, according to the definition of hyperuricemia: hyperuricemia ( $\geq 420$  mmol/L) and non hyperuricemia ( $< 420$  mmol/L) groups. The above information was then recorded prospectively into a computerized database. Serum urate was measured with standard analytical methods in the hospital biochemistry department.

The results are expressed as percentages for categorical variables and as mean  $\pm$  standard deviation for continuous variables. The Chi square was used to compare respective categorical and continuous variables between groups. Using multiple logistic regressions we assessed the effect of hyperuricemia on acute cerebral infarction outcome after controlling for clinical variables that differed significantly between groups in the univariate analysis or that are already established as predictors of stroke. All statistical analyses were performed with the SPSS11.5 software.

### 93.3 Results

In total, 2,128 patients with a diagnosis of acute stroke were studied, 1,273 (59.8 %) men and 855 (40.2 %) women, with a median age of 64 years (IQR, 40–95 years), were included in the present study. Table 93.1 lists the demographics, the cerebral infarction risk factors of the study population. On univariate analysis, hyperuricemia was associated with the cerebral infarction risk factors: older, sex, hypertension, diabetes, coronary artery disease, prior stroke, smoking and alcohol intake. The hypertension and gender were most associated with hyperuricemia, which were present in 70.4 and 65.9 %, respectively, of the patients.

Table 93.2 lists the laboratory findings at admission. Patients with hyperuricemia group had significantly higher glucose, urea, creatinine and triglycerides at admission compared with patients with non hyperuricemia group ( $P < 0.05$ , respectively); patients with hyperuricemia group had significantly lower high-density lipoprotein-cholesterol at admission compared with patients with non hyperuricemia group ( $P < 0.05$ ).

A good outcome at discharge (MRS  $< 3$ ) was scored in 1,897 patients, and adverse outcome (MRS  $\geq 3$ ) was scored in 231 patients. Table 93.3 lists the outcomes of the study population. Overall adverse outcome during hospitalization was 10.9 %; case adverse outcome for hyperuricemia group was 18.8 % and for non hyperuricemia group, 8.1 % ( $P < 0.001$ ).

We used multiple logistic regression analysis to confirm the independent relationship between hyperuricemia on admission and adverse outcome at hospital discharge. As shown in Table 93.4, in addition to the hyperuricemia, other variables independently associated with clinical outcome include age, sex, alcohol intake, triglycerides. Moreover, the effect of hyperuricemia on the adverse outcome was greater when hypertriglyceridemia was present (a further hazard ratio of 2.57 per additional 0.1 mmol/L when hypertriglyceridemia present; 95 % CI, 1.88 to 6.77;  $P < 0.001$ ).

**Table 93.1** Demographics, cerebral infarction risk factors of the study population

Variable	Hyperuricemia group (n = 537)	Non hyperuricemia group (n = 1591)	P
Age, ( $\bar{x} \pm s$ )	64.26 $\pm$ 11.89	63.59 $\pm$ 11.12	0.239
Man, n (%)	354 (65.9)	919 (57.8)	0.001
Hypertension, n (%)	378 (70.4)	811 (51.0)	<0.001
Diabetes, n (%)	127 (23.6)	290 (18.2)	0.006
Coronary artery disease, n (%)	98 (18.2)	96 (6.0)	<0.001
Prior stroke, n(%)	151 (28.1)	320 (20.1)	0.000
Current smoking, n (%)	139 (25.9)	346 (21.7)	0.048
Alcohol intake, n (%)	98 (18.2)	225 (14.1)	0.022

**Table 93.2** Laboratory findings at admission

Variable	Hyperuricemia group (n = 537)	Non Hyperuricemia group (n = 1591)	P
Glucose, mmol/L	6.59 ± 2.97	6.18 ± 2.32	0.002
Urea, umol/L	7.36 ± 4.79	5.43 ± 2.07	<0.001
Creatinine, umol/L	107.30 ± 57.87	71.98 ± 21.80	<0.001
CHOL, mmol/L	5.21 ± 1.18	5.14 ± 1.12	0.238
TG, mmol/L	2.06 ± 1.38	1.70 ± 1.29	<0.001
HDL-C,(mmol/L)	1.16 ± 0.34	1.23 ± 0.34	<0.001
LDL-C,(mmol/L)	3.27 ± 1.06	3.24 ± 0.93	0.616

\* *CHOL* Cholesterol, *TG* Triglycerides, *HDL-C* high-density lipoprotein-cholesterol, *LDL-C* low-density lipoprotein-cholesterol

**Table 93.3** Outcomes of the study population

Uric acid	Adverse outcome	Good outcome	Rate (%)
Hyperuricemia group	102	440	18.8
Non hyperuricemia group	129	1,457	8.1
Total	231	1,897	10.9
$\chi^2$	47.664		
p	<0.001		

**Table 93.4** Multiple analysis of adverse outcome at hospital discharge

Variable	Odds ratio	95 % CI	P
Uric acid	2.25	1.66–3.05	<0.001
Sex	1.81	1.30–2.53	0.001
Age	1.03	1.02–1.05	<0.001
Alcohol intake	2.38	1.45–3.92	0.001
Hypertriglyceridemia	1.69	1.22–2.34	0.002
Uric acid and hypertriglyceridemia	3.57	1.88–6.77	<0.001

## 93.4 Discussion

Several studies have found serum uric acid levels to be an independent predictor of poor outcome in stroke patients. In a large prospective study, serum levels of urate measured within the first 24 h after stroke onset in 2,498 patients were found to be directly and independently associated with poor outcome [2].

In this study, serum urate measured within the first 24 h after hospital admission for acute cerebral infarction is an independent maker of poor outcome. Hyperuricemia independently predict a bad outcome as defined by death or survival in care (indicating a poorer functional outcome) at discharge. This relationship holds true even after correction for the presence of established cerebrovascular risk factors such as hypertension, diabetes, coronary heart disease and hyperlipidemia.

Although in this study hyperuricemia was found to be a predictor of acute cerebral infarction or excess mortality in patients with hypertriglyceridemia, no study

has previously shown that hyperuricemia independently predicts poor outcome in acute cerebral infarction patients regardless of hyperlipidemia. Several studies, however, have shown a relationship between serum urate and hypertension [3], and serum urate and coronary heart disease [4] in certain populations. A cohort study of Type 2 diabetes patients with acute stroke has found a relationship between increased serum urate concentration and poor outcome [5].

Apart from the interactions between uric acid and other risk factors, there are several plausible mechanisms whereby uric acid may directly affect atherogenesis or the clinical course of cerebrovascular disease. Increased uric acid levels promote oxygenation of low-density lipoprotein cholesterol and facilitate lipid peroxidation [6]. In addition, increased uric acid levels are associated with increased production of oxygen free radicals [7]. Uric acid impairs nitric acid production; which activates the renin-angiotensin system [8] and induces endothelial dysfunction and smooth muscle cell proliferation [9]. Furthermore, uric acid has been found in rats to stimulate the synthesis of monocyte chemo attractant protein-1 by vascular smooth muscle cells [10], which is known to have a key role in stimulating macrophage infiltration in atherosclerotic vessels [11]. Finally, hyperuricemia impairs platelet adhesiveness and aggregation and disturbs hemorheology [12].

In conclusion, this study demonstrated that hyperuricemia is an independent maker of poor outcome after acute cerebral infarction [13]. Although traditional risk factors such as hypertension, diabetes mellitus and hyperlipidaemia are nowadays treated aggressively after stroke, there is a need to identify additional treatable risk factors that are easily measured and highly prevalent in the general population. Hyperuricemia is one such potential risk factor, but asymptomatic hyperuricemia alone has been considered benign and is not an indication for treatment. Large interventional trials are required to provide definitive conclusions.

## References

1. Lehto S, Niskanen L, Ronnema T et al (1998) Serum uric acid is a strong predictor of stroke in patients with noninsulin dependent diabetes mellitus. *Stroke* 29(3):635–639
2. Weir CJ, Muir SW, Walters MR, Lees KR (2003) Serum urate as an independent predictor poor outcome and future vascular events after acute stroke 34(8):1951–1956
3. Jossa F, Farinro E, Panico S, Krogh V, Celentano E, Galasso R, Mancini M, (1994) Trevisan M. Serum uric acid and hypertension: the Olivetti Heart Study's Hum Hyper tens 8:677–681
4. San Diego R, Pan D, Morisky D, Enonmoh A, Fong R, Ward H (1999) Elevated serum uric acid levels are associated with increased hypertension morbidity in the minority population 90(3):50–54
5. Wannamethee SG, Shaper AG, Whincup PH (1997) Serum urate and the risk of major coronary heart disease events. *Heart* 78:147–153
6. Newman EJ, Rahman FS, Lees KR, Weir CJ, Walters (2006) MR. Elevated serum urate concentration independently predicts poor outcome following stroke in patients with diabetes 22(1):79–82
7. DeScheeder IK, van de Kraay AM, Lamers JM, Koster JF, deJon JW, Serruys PW (1991) Myocardial malondialdehyde and uric acid release after short-lasting coronary occlusions during angioplasty: potential mechanisms for free radical generation. *Am J Cardio* 68:392–395

8. Johnson RJ, Kang DH, Feig D, et al (2003) Is there a pathogenetic role for uric acid in hypertension and cardiovascular and renal disease? *41*:1183–1190
9. Eslami P, Corry DB, Nyby MD et al (2004) Inhibition of oxidative stress and improvement of nitric oxide production by ACE inhibitors and AT1 receptor blockers in uric acid stimulated vascular smooth muscle cells. *Am J Hypertens* *17*(1):154–155
10. Rao GN, Corson MA, Berk BC (1991) Uric acid stimulates vascular smooth muscle cells proliferation by increasing platelet-derived growth factor A-chain expression. *J Biol Chem* *266*:8604–8608
11. Khosla UM, Zharikov S, Finch JL et al (2005) Hyperuricemia induces endothelial dysfunction. *Kidney Int* *67*:1739–1742
12. Kannelis J, Watanabe S, Li JH et al (2003) Uric acid stimulates monocyte chemo attractant protein-1 production in vascular smooth muscle cells via mitogen-activated protein kinase and cyclooxygenase-2. *Hypertension* *41*:1287–1293
13. Gu L, Okada Y, Clinton SK et al (1998) Absence of monocyte chemo attractant protein-1 reduces atherosclerosis in low density lipoprotein receptor deficient mice. *Mol Cell* *2*:275–281

# Chapter 94

## Adults Prevalence of Metabolic Syndrome in China's Tangshan

Lixiang Zhang, Bo Hu and Xiaoyu Liu

**Abstract** *Objective* to compare the prevalence of the metabolic syndrome and its main components in the population of Tangshan city at the age of 35–70 years. *Methods* the 3,562 households of population from Tangshan were chosen by cluster sampling during 2005–2006. The physical examinations and Laboratory tests were performed. Metabolic syndrome was defined according to the International Diabetes Federation consensus worldwide definition in 2005. *Results* 4,761 subjects participated in the study. The age-standardized prevalence of the MS was 18.7 % in male and 31.8 % in female ( $P < 0.05$ ). The residents in urban (27.4 %) had a higher prevalence of MS than in rural (23.1 %) ( $P < 0.05$ ). In female, the prevalence of MS was increased together with age increased either in urban or rural ( $P < 0.05$ ). *Conclusion* there is a big difference in the prevalence rate of metabolic syndrome between rural and urban. The prevention and control the metabolic syndrome is urgently in China.

**Keywords** Metabolic syndrome • Prevalence • Epidemiology • Cluster sampling • Community

### 94.1 Introduction

The metabolic syndrome (MS) patients are at increased risk for developing diabetes mellitus (DM) [1] and cardiovascular disease (CVD) [2] as well as increased mortality from cardiovascular disease and all causes [3]. The MS is becoming

---

L. Zhang (✉)

National Mine Medical Rescue Training Base of Hebei United University, Tangshan, Hebei, China

e-mail: lxy\_hb007@126.com

B. Hu

Hebei United University, Institute of Public Health Tangshan, Hebei, China

X. Liu

Kai Luan hospital, Department of Respiratory, Tangshan, Hebei, China



increasingly common in developed countries, as shown by emerging prevalence data [4, 5]. The MS has been associated with an increased risk of DM and CVD morbidity and mortality, resulting in an enormous economic burden to society [2, 6–8]. However, few data exist on the MS in economically developing countries. Hence the purpose of this study is to describe the demographic characteristics and the prevalence of MS in a Chinese population of Tangshan.

## **94.2 Study Design**

### ***94.2.1 Study Population***

Adults of Han people were recruited for the study through community hospitals conducted during 2008–2009 in Tangshan by cluster sampling. At last, six communities and fourteen villages were selected. Each individual of every household was surveyed in the selected communities. The inclusion criteria were: Han people; age between 35 and 70 years; reside permanently in the selected communities for at least 2 year. Exclusion criteria were: not meeting one or more of the inclusion criteria. Participation was entirely voluntary, and informed consents were obtained from all subjects. There are 5,639 individuals agreed to take part in the study and 4,761 individuals completed the survey and physical examination.

### ***94.2.2 Data Collection***

The questionnaire includes two parts: information on demographic characteristics (date of birth, sex, education, occupation, contact information, medical history); clinical examination (height, weight, waist circumference, hip circumference, blood pressure).

During the clinical examination, blood pressure and anthropometric measurements were obtained by trained and certified observers by using of standard protocols and techniques [9]. 10 cc overnight fasting blood specimens were obtained for measurement of total cholesterol (TC), HDL cholesterol (HDL-C), triglyceride (TG) and fasting plasma glucose (FPG). The metabolic syndrome was defined according to International Diabetes Federation criteria in 2005. Abdominal obesity means waist circumference greater than 90 cm in men or greater than 80 cm in women.

This study was designed to provide precise estimates of the prevalence of the individual components of the metabolic syndrome and the prevalence of the metabolic syndrome by sex, and area of residence (rural and urban). Prevalence estimates were calculated for the overall population. Additionally, age-standardized prevalence estimates were calculated, men and women, and urban and rural areas, after age standardization to the overall year 2000 population distribution for China.

### 94.3 Results

4,761 subjects participated in the study. The age of the subjects ranged from 35 to 70, with a mean age of 50.8 (SD = 10.41). Characteristics of the study participants are shown in Table 94.1. Age, BMI, systolic blood pressure, diastolic blood pressure and TG were significantly higher in male than in female ( $P < 0.05$  for all comparisons). In male, Population in urban has higher BMI, FPG, TG than in population in rural ( $P < 0.05$  for all comparisons). In female, BMI and HDL-C were higher in urban than in rural, but systolic blood pressure, diastolic blood pressure and FPG were lower in urban than in rural (Table 94.1).

Table 94.2 showed the age-standardized prevalence of metabolic syndrome defined on criteria of International Diabetes Federation and its components. The age-standardized prevalence of the MS was 18.7 % in male and 31.8 % in female ( $P < 0.05$ ). The residents in urban (27.4 %) had a higher prevalence of MS than in rural (23.1 %) ( $P < 0.05$ ). The residents of urban had higher prevalence of all components except low HDL cholesterol (35.6 % vs. 34.2 %) ( $P < 0.05$  for all comparisons). Women had a higher prevalence of abdominal obesity and low HDL cholesterol than did men; whereas men had a higher prevalence of high blood pressure or take antihypertensive agents and FPG increased or take hypoglycemic agents than did women ( $P < 0.05$  for all comparisons).

Figure 94.1 showed that was the number of MS in different definitions. The numbers of MS were highest by IDF criteria either in male or in female.

Figure 94.2 was the number of MS in different gender and different age group. In female, the prevalence of MS was increased together with age increased either in urban or rural. The trend test is statistical significance ( $P < 0.05$  for all). But the trend was not found in male.

**Table 94.1** The compare of people's character in the different gender or section ( $\bar{X} \pm SD$ )

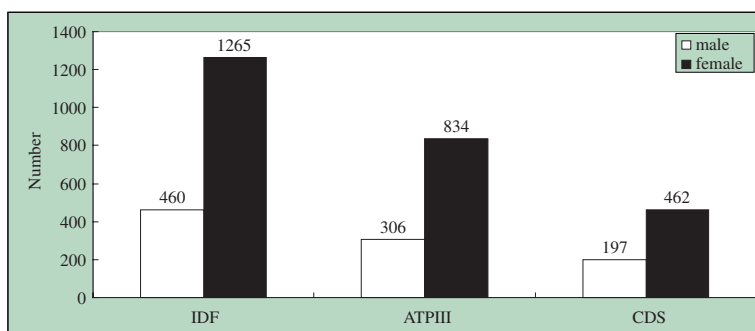
	n	Age (year)	BMI (kg/m <sup>2</sup> )	SBP (mmHg)	
Male	1,963	51.8 ± 9.6*	24.6 ± 4.5*	135.7 ± 20.6*	
Urban	461	53.4 ± 9.1Δ	25.9 ± 4.1Δ	134.3 ± 19.6	
Rural	1,502	50.1 ± 9.7	23.6 ± 4.7	136.4 ± 21.0	
Female	2,798	49.5 ± 10.1	23.5 ± 4.2	133.1 ± 22.6	
Urban	829	51.6 ± 8.3Δ	25.7 ± 4.4Δ	129.8 ± 22.4Δ	
Rural	1,969	48.2 ± 10.2	22.2 ± 4.0	134.0 ± 22.6	
		DBP (mmHg)	FPG (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)
Male		85.1 ± 12.0*	5.9 ± 1.6	1.49 (0.97,2.35)*	1.3 ± 0.3
Urban		85.7 ± 12.1	6.1 ± 1.9Δ	1.67 (1.08,2.51)Δ	1.3 ± 0.3
Rural		84.6 ± 12.0	5.6 ± 1.7	1.14 (0.82,1.67)	1.3 ± 0.3
Female		84.3 ± 12.5	5.8 ± 1.5	1.24 (0.89,1.86)	1.4 ± 0.3
Urban		82.7 ± 11.8Δ	5.7 ± 1.6Δ	1.34 (0.99,1.97)	1.4 ± 0.3Δ
Rural		85.0 ± 12.2	5.9 ± 1.5	1.10 (0.86,1.73)	1.3 ± 0.3

\*Compare with female  $P < 0.05$ , Δ compare with rural  $P < 0.05$ . FPG fasting plasma glucose, BMI body mass index

**Table 94.2** Age-standardized prevalence of MS (%)

	Total				Male		Female	
	Male	Female	Urban	Rural	Urban	Rural	Urban	Rural
MS	18.7*	31.8	27.4 $\Delta$	23.1	19.5 $\Delta$	14.2	27.3 $\Delta$	35.2
Abdominal Obesity	24.3*	43.2	39.8 $\Delta$	34.3	30.0 $\Delta$	21.6	41.2 $\Delta$	47.2
High TG	31.8	29.9	38.5 $\Delta$	29.6	45.8 $\Delta$	27.3	36.4	26.7
Low HDL-C	22.1*	47.6	35.6	34.2	19.6	24.1	42.3 $\Delta$	50.6
High blood pressure or take antihypertensive agents	55.4*	47.2	48.7 $\Delta$	56.0	59.7 $\Delta$	52.4	43.4 $\Delta$	51.0
FPG increased or take hypoglycaemic agents	46.2*	40.3	42.7 $\Delta$	38.4	50.7 $\Delta$	39.5	37.8 $\Delta$	41.9

\*Compare with female  $P < 0.05$ ,  $\Delta$  compare with rural  $P < 0.05$



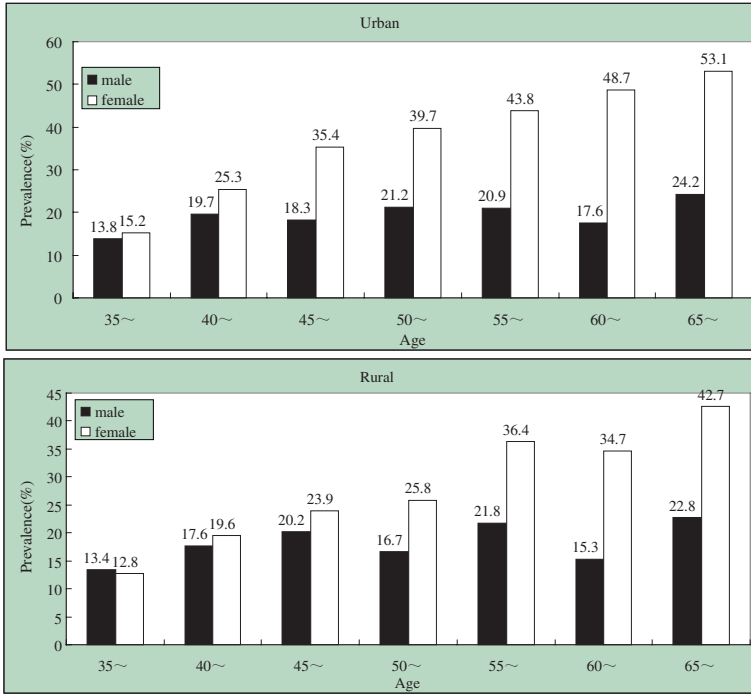
**Fig. 94.1** Distribution of MS in different criterion of diagnosis. *IDF* International Diabetes Federation criteria; *ATP III* National Cholesterol Education Program Adult Treatment Panel criteria; *CDE* Chinese Association of Diabetes criteria

## 94.4 Discussions

The prevalence of the MS reported in our study was higher in female than male, and higher in urban than rural.

The prevalence of MS estimated in the present study was higher than that in the USA [10] and in other countries [7, 11]. Findings from NHANES III in the USA showed an age-adjusted prevalence of the MS of 23.8 % as defined by ATP III criteria [10]. Similar results to those of the current studies have been reported in China. The prevalence of the metabolic syndrome in a cohort study of 27,739 men and women aged 35–64 from 11 provinces in China was 13.3 % (12.7 % in men and 14.2 % in women) [12].

Gu D and colleagues identified the age-standardized prevalence of metabolic syndrome was 10.0 % in men and 23.3 % in women, the age-standardized prevalence of metabolic syndrome was 23.5 % in urban and 14.7 % in rural area (according to IDF 2005 criteria) [13]. The reason that the results of the present study were higher



**Fig. 94.2** The prevalence of MS in different age and gender

than others studies [12–14] in China could be explained from four aspects as follow. First, the data of the present study were collected from 2008 to 2009, and the data of other studies were collected before 2002. The prevalence of MS would step up with economic growth. Second, the age of subjects in the present study (35–70 years) was higher than that in other study. The prevalence of MS was higher in old people than in young people. Third, using different definition of the MS can get different results.

The metabolic syndrome was defined according to International Diabetes Federation criteria in 2005. The condition of judgment is abdominal obesity combine two or more of four other risk factors. Abdominal obesity means waist circumference greater than 90 cm in men or greater than 80 cm in women. Other risk factors mean respectively: serum TG concentration of 1.7 mmol/L or greater; HDL cholesterol concentration of less than 1.04 mmol/L in men or less than 1.3 mmol/L in women; BP 130/85 mmHg or greater; or FPG concentration of 5.6 mmol/L or greater. Individuals who were using antihypertensive or antidiabetic medications met the criteria for high blood pressure or high fasting glucose. The IDF definition is the fourth modified clinical criteria for the metabolic syndrome. These are designed for global application in clinical practice and represent modifications of the WHO and ATP III definitions, because the ATP III criteria and the WHO criteria for HDL cholesterol and waist circumference might not be appropriate for Asian populations. The IDF definition has a greater emphasis on abdominal

(visceral) obesity as the core feature of the syndrome, making it an essential requirement for diagnosis. The other variables employed by ATP III are not modified. The IDF criteria took an important step forward by defining abdominal obesity for different ethnic populations defined by waist circumference measurements based on epidemiologic data from various ethnic populations. This extension adds universality and worldwide applicability to the concept of the metabolic syndrome. Our study used IDF2005 criteria. The prevalence of MS must be higher than other study necessarily. So it is not suitable to compare directly between our findings with corresponding data from other surveys. This could be parts of causes which made the higher prevalence of MS in the study.

The difference in prevalence of MS in genders is not coincidence in world. In the USA, the prevalence of the metabolic syndrome was similar among men and women [10]. But in the present study, women had a much higher prevalence of the metabolic syndrome than did men. This difference might be due to a higher prevalence of low HDL cholesterol in women compared with men. As same as the results of other studies in China, the prevalence of MS would increase to follow age increasing in either male or female. But the kind of increasing of male was not as obviously as that of female. The difference between male and female were concordant with other studies in China [14]. We need results of further study to discuss the problem.

## 94.5 Conclusions

First, there is a higher increasing speed in prevalence of the metabolic syndrome in China. Third, developing comprehensive national strategies should think about the change of prevalence of MS in different regions and areas of residence to reduce the increased societal burden of cardiovascular disease in China.

## References

1. Haffner SM, Valdez RA, Hazuda HP (1992) Prospective analysis of the insulin resistance syndrome. (*syndromeX*) 41:715–722
2. Isomaa B, Almgren P, Tuomi T (2001) Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care* 24:683–689
3. Trevisan M, Liu J, Bahsas FB, Menotti A (1998) Syndrome X and mortality: a population-based study. *Am Epidemiol* 148:958–966
4. Flegal KM, Carroll MD, Kuczmarski RJ (1998) Overweight and obesity in the United States: prevalence and trends, 1960–1994. *Int J Obes Relat* 22:39–47
5. Ford ES, Giles WH, Dietz WH (2002) Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. *JAMA* 287:356–359
6. Krauss RM, Winston M, Fletcher BJ (1998) Obesity: impact on cardiovascular disease. *Circulation* 98:1472–1476

7. Lakka HM, Laaksonen DE, Lakka TA (2002) The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. *JAMA* 288:2709–2716
8. Meigs JB (2002) Epidemiology of the metabolic syndrome. *Am. J. Manag. Care* 8:283–292
9. Perloff D, Grim C, Flack J (1993) Human blood pressure determination by sphygmomanometry. *Circulation* 88:2460–2470
10. Ford ES, Giles WH, Dietz WH (2002) Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. *JAMA* 288:356–359
11. Chuang S, Chen C, Tsai S (2002) Clinical identification of the metabolic syndrome in Kinmen. *Acta Cardiol Sin* 18:16–23
12. Zhong H, Yu F, Yi X, Za Z (2002) Further study of risk factors for stroke and coronary heart disease cooperation group. *Chengdu Inst Phys Edu*, (11) 36:298–300
13. Yao CH, Hu YS, Zhai FY (2007) Adult's prevalence of metabolic syndrome in China in 2002. *Chin J Diabetes* 15:332–335
14. Gu D, Reynolds K, Wu X (2005) Prevalence of the metabolic syndrome and overweight among adults in China. *Lancet* 365:1398–1405

# Chapter 95

## Prevalence and Risk Factors of Metabolic Syndrome

Xiaoyu Liu, Yunqiu Liu and Xuan Lan

**Abstract** *Objective* to compare the prevalence and risk factors of metabolic syndrome (MS) in the population between 35–70s of Beijing and Nanjing in China. *Methods* 10,276 households from Beijing and Nanjing were chosen by cluster sampling during 2007–2008, IDF (2005) was used as the diagnostic criteria of MS. Multivariate logistic regression was used to identify associated risk factors. *Results* The age-standardized prevalence of MS was 32.6 versus 21.9 % in Beijing and Nanjing. The prevalence was higher in women than men, and higher in rural than urban. Multivariate logistic regression showed that female, age, longer sitting time, family history of diabetes and hypertension, the interaction of age and gender, living in Urban could significantly increase the risk of MS. *Conclusions* There was a huge difference in the prevalence rate of MS between subjects in Beijing and Nanjing. Female, family history and physical activities were important risk factors of MS.

**Keywords** Metabolic syndrome • Epidemiology • Cluster sampling • Community • Multivariate analysis

### 95.1 Introduction

Cardiovascular disease is the leading cause of mortality worldwide [1]. China and other developing countries have experienced a cardiovascular disease epidemic in recent decades, while mortality from cardiovascular disease has fallen in developed countries [1, 2]. Obesity, hypertension, and diabetes are becoming major public health challenges in a large portion of Chinese population, although the prevalence of such conditions remains lower than that in developed countries [3–6]. A cluster of metabolic risk factors, a technical term as the ‘Metabolic Syndrome’ (MS), collectively increase the risk of developing both diabetes and CVD two- to three-folds [7]. MS patients are at increased risk for developing diabetes mellitus (DM) [8] and cardiovascular disease (CVD) [9].

---

X. Liu (✉) · Y. Liu · X. Lan  
Department of Respiratory, Kai Luan Hospital, Tangshan, Hebei, China  
e-mail: lxy\_hb007@126.com

However, there are almost no systematic studies on how lifestyle factors and risk factors of demography characteristics influence the development of MS in Chinese population. Hence the purpose of this study is to describe the prevalence of MS in a Chinese population of Beijing and Nanjing, and examine the relationships among risk factors and MS in this population.

## **95.2 Materials and Methods**

### ***95.2.1 Study Population***

Han people whose age older than 35 were recruited for the study during 2007–2008 in Beijing and Nanjing by cluster sampling. At last, seven communities and nine villages were selected in Beijing, and eight communities and seven villages were selected in Nanjing. The community hospitals were widely advertised through the print and broadcast media, and all participants were required to pre-register and come to the fair in the fasted state. The inclusion criteria were: Han people; age between 35 and 70 years; reside permanently in the selected communities for at least 4 year. Informed consents were obtained from all subjects.

### ***95.2.2 Data Collection***

Data were collected in examination centers at local health stations or community clinics in the participants' residential area. The questionnaire include: information on demographic characteristics (date of birth, sex, education, occupation, household income, contact information, medical history, current medications, family history, smoking history, drinking history, physical activity, dietary information); clinical examination (height, weight, waist circumference, hip circumference, blood pressure, heart Rate, pulmonary function test, electrocardiogram). Blood pressure were obtained by trained and certified observers by using of standard protocols and techniques [10] and using an electronic sphygmomanometer after 5 min rest in the sitting position. 10 cc fasting blood specimens were obtained for lipid's measurement.

Criteria of MS from International Diabetes Federation in 2005 were selected. Abdominal obesity means waist circumference greater than 90 cm in men or greater than 80 cm in women.

#### **95.2.2.1 Statistical Analysis**

Sample sizes were estimated to meet generally recommended requirements for precision in a complex survey [11]. All calculations were weighted to represent the total Chinese adult population aged 35–70. Age-standardized prevalence estimates



were calculated for Beijing and Nanjing, men and women, and urban and rural areas, after age standardization to the overall year 2000 population distribution for China. The categorical and continuous variables were compared between gender, area of residence and region using the  $\chi^2$  test and t-tests, respectively; Mann-Whitney U-test was used for comparison of the variables that had a non-normal distribution. A logistic regression model was employed to evaluate the associations of MS with possible associated factors. All data analyses were done with Statistical Analysis System software (Version 9.13), the significance level was set at  $P < 0.05$  (2 side).

### 95.3 Results

10,276 subjects participated in the study. The gender distribution was 59.28 % male, 40.72 % female. The age of the subjects ranged from 35 to 70, with a mean age of 51.5 (SD = 9.45). Characteristics of the study participants are shown in Table 95.1.

Table 95.2 showed the age-standardized prevalence of metabolic syndrome and its components. The age-standardized prevalence of the MS was 37.77 % in Beijing and 28.11 % in Nanjing. The residents in rural had a higher prevalence of MS than in urban, and women had a higher prevalence of MS than men both in Beijing and Nanjing.

Figures 95.1 and 95.2 was the age-specific prevalence of MS in different gender. Women had higher prevalence than men after age 40 years either in Beijing or in Nanjing. The trend test is statistical significance ( $P < 0.05$  for two comparisons).

In multiple regression analysis (Fig. 95.3), after controlling all variables in the model, region, living in urban or rural areas, age, gender, interaction between age and gender, with family history of diabetes, with family history of hypertension and sitting time were significant predictors in the regression model. In other words, respondents who were older, were female, had family history of diabetes, had family history of hypertension, living in urban, living in Beijing, reported longer sitting time were more likely to have MS.

### 95.4 Discussions

In this study, we sought to compare the prevalence of MS in 35–70 adults between Beijing and Nanjing regions, at the same time, to identify the possible risk factors of MS. The prevalence of the MS reported in our study was higher in Beijing than Nanjing, higher in rural than urban and higher in female than male. On the other hand, Age, Gender, BP, FPG, living in Beijing and living in rural are the independent risk factors of MS. These findings showed that the metabolic syndrome had become serious public health challenges in China.

**Table 95.1** Characteristics of participants by sex and region [mean (SD)]

	Beijing		Nanjing	
	Urban	Rural	Male	Female
<b>Total</b>				
Number (%)	2822 (52.18 %)	2586 (47.82 %)	2029(37.52 %)	3379 (62.48 %)
Age (years)	52.38 ± 9.06	50.37 ± 8.99¶	52.79 ± 9.15	52.12 ± 9.00#
SBP (mmHg)	136.69 ± 22.59	138.90 ± 22.30¶	138.16 ± 21.19	135.81 ± 23.35#
DBP (mmHg)	84.11 ± 11.73	85.31 ± 12.00¶	85.58 ± 12.08	83.22 ± 11.43#
Weight (Kg)	66.30 ± 11.91	64.88 ± 11.83¶	71.66 ± 11.80	63.08 ± 10.77#
Height (cm)	160.56 ± 8.28	159.36 ± 8.21¶	167.95 ± 6.27	156.12 ± 5.79#
TG (mmol/L)	1.64 ± 1.29	1.55 ± 1.23¶	1.64 ± 0.48	1.67 ± 0.47#
HDL-C (mmol/L)	1.38 ± 0.31	1.37 ± 0.31¶	1.33 ± 0.31	1.41 ± 0.31#
FFPG (mmol/L)	5.99 ± 1.79	5.76 ± 1.65¶	6.01 ± 1.74	5.79 ± 1.82
<b>Nanjing</b>				
Number (%)	1120 (23.01 %)	3748 (76.99 %)	2155 (44.27 %)	2713 (55.73 %)
Age (years)	50.66 ± 9.41*	50.39 ± 9.27¶	51.21 ± 9.43§	50.22 ± 9.37  #
SBP (mmHg)	131.09 ± 20.68*	132.22 ± 20.54‡¶	132.04 ± 19.69§	130.34 ± 21.41  #
DBP (mmHg)	82.03 ± 11.71*	83.39 ± 11.53‡¶	82.87 ± 11.73§	81.36 ± 11.66  #
Weight (Kg)	61.78 ± 11.57*	61.08 ± 10.94‡¶	65.46 ± 11.74§	58.85 ± 10.57  #
Height (cm)	160.26 ± 7.88	160.05 ± 7.74‡¶	166.20 ± 6.20§	155.55 ± 5.55  #
TG (mmol/L)	1.55 ± 1.27*	1.58 ± 1.20¶	1.70 ± 0.45§	1.72 ± 0.45
HDL-C (mmol/L)	1.30 ± 0.31*	1.27 ± 0.32‡¶	1.27 ± 0.31§	1.31 ± 0.31  #
FFPG (mmol/L)	5.54 ± 1.32*	5.52 ± 1.23‡	5.52 ± 1.19§	5.55 ± 1.41

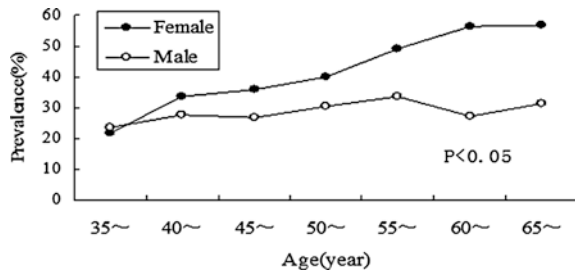
\*, †, ‡, §, || P < 0.05 for Beijing vs. Nanjing; ¶ P < 0.05 for Urban vs. Rural in the same cities; # P < 0.05 for Male vs. Female in the same cities. SBP systolic blood pressure; DBP diastolic blood pressure; TG triglyceride; HDL-C high density lipoprotein cholesterol; FPG fasting plasma glucose

**Table 95.2** Age-standardized prevalence of MS and its components (%)

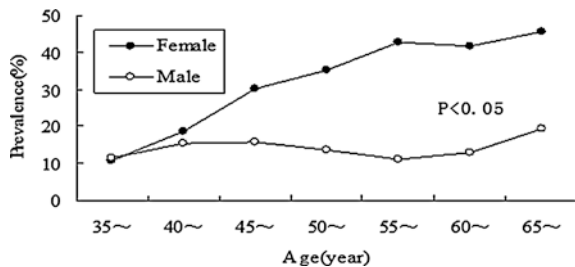
	Beijing				
	Total	Urban	Rural	Male	Female
MS	37.77	37.10	37.35¶	27.94	37.73#
Abdominal obesity	55.02	48.94	54.64¶	39.53	54.98#
High TG	29.05	37.24	30.24¶	36.86	29.00
Low HDL-C	44.18	28.60	31.44¶	15.20	44.24#
High BP or take antihypertensive agents	56.15	62.93	67.94¶	65.36	56.08#
FPG increased or take hypolycemic agents	42.85	58.61	41.61¶	50.32	42.63#
	Nanjing				
MS	28.11*	20.36†	24.04‡¶	13.93§	28.05  #
Abdominal obesity	41.69*	37.05†	32.52‡¶	19.97§	41.62  #
High TG	26.61*	21.34	31.22‡¶	31.22§	26.57
Low HDL-C	50.46*	21.43†	42.56‡¶	24.57§	50.49  #
High BP or take antihypertensive agents	47.91*	46.70†	56.00‡¶	53.93§	47.84  #
FPG increased or take hypolycemic agents	34.63*	38.93†	36.66‡	37.37§	34.60

\*, †, ‡, §, || P < 0.05 for Beijing vs. Nanjing; ¶ P < 0.05 for Urban vs. Rural in the same cities; # P < 0.05 for Male vs. Female in the same cities. *SBP* systolic blood pressure; *DBP* diastolic blood pressure; *TG* triglyceride; *HDL-C* high density lipoprotein cholesterol; *FPG* fasting plasma glucose

**Fig. 95.1** Prevalence of MS in different age and gender (Beijing)



**Fig. 95.2** Prevalence of MS in different age and gender in Nanjing



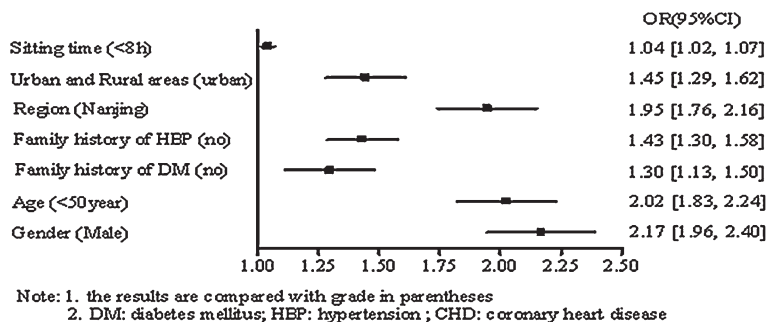


Fig. 95.3 Results of multivariate logistic regression

The prevalence of the metabolic syndrome in Beijing and Nanjing estimated in the present study was higher than others studies [12–14] in China. Gu D and colleagues identified the age-standardized prevalence of metabolic syndrome was 10.0 % in men and 23.3 % in women, the age-standardized prevalence of metabolic syndrome was 23.3 % in northern and 11.5 % in southern China, the age-standardized prevalence of metabolic syndrome was 23.5 % in urban and 14.7 % in rural area (according to IDF 2005 criteria) [14]. In the nutrition and health survey in 2002, the prevalence rate of the MS among adults over 18 years old was 6.6 % according to the criteria of Chinese Association of Diabetes [13]. The reason is that different definitions of the MS used in different studies. In IDF 2005, abdominal obesity was judged by waist ( $\geq 90$  cm for male,  $\geq 80$  cm for female). The definition is lower than other definition obviously. The prevalence of MS must be higher than other study necessarily. So it is not suitable to compare directly between our findings with corresponding data from other surveys.

The difference in prevalence of MS in genders is not coincidence in world. In the USA, the prevalence of the metabolic syndrome was similar among men and women [15]. But in the present study, women had a much higher prevalence of the metabolic syndrome than did men. This difference might be due to a higher prevalence of low HDL cholesterol in women compared with men. The cutoffs of low HDL cholesterol might not be appropriate in Chinese in some reports [16, 17]. Mean HDL cholesterol concentrations have been reported to differ only slightly between men and women in China. The results of our study showed a higher prevalence of MS in Beijing than Nanjing. Differences in diet and physical activity between northern and southern China might contribute to the regional differences [18, 19].

Age is one of risk factors of MS. Older people often have a clustering of central obesity, insulin resistance, dyslipidemia, and hypertension, which increase the risk of cardiovascular disease and type 2 diabetes [20]. Family history was an independent risk factor of MS in the present study. Many studies also got the same conclusion. Hunt and Heiss reported that the family history of diabetes or high blood pressure significantly affects the development of metabolic syndrome. Many studies

had confirmed that exercise can widely accommodate the function of human body and reduce the risk factors of MS. Exercise training improves body composition, often independent of weight loss], and may preferentially reduce abdominal visceral fat. The Joint National Committee (JNC) for Detection, Evaluation, and Treatment of High Blood Pressure guidelines recommended exercise for reducing mild hypertension before initiating drug therapy for most individuals.

## 95.5 Conclusions

According to the results of our study, we can draw some possible conclusions. At first, the prevalence of the metabolic syndrome in China is rapidly increasing. Second, Economic development and consequential changes in lifestyle are the possible main causes of this high and increasing prevalence.

## References

1. Lopez AD (1993) Assessing the burden of mortality from cardiovascular diseases. *World Health* 46:91–96
2. Murray CJ, Lopez AD (1997) Mortality by cause for eight regions of the world: global burden of disease study. *Lancet* 349:1269–1276
3. Gu D, Reynolds K, Wu X (2002) Prevalence, awareness, treatment, and control of hypertension in china. *Hypertension* 40:920–927
4. Popkin BM, Doak CM (1998) The obesity epidemic is a worldwide phenomenon. *Nutr Rev* 56:106–114
5. King H, Aybert RE, Herman WH (1998) Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. *Diabetes Care* 21:1414–1431
6. Gu D, Reynolds K, Duan X (2003) Prevalence of diabetes and impaired fasting glucose in the Chinese adult population: international collaborative study of cardiovascular disease in Asia (InterASIA). *Diabetologia* 46:1190–1198
7. Reaven GM (2003) The insulin resistance syndrome. *Curr Atheroscler* 5:364–371
8. Haffner SM, Valdez RA, Hazuda HP (1992) Prospective analysis of the insulin resistance syndrome (syndrome X). *Diabetes* 41:715–722
9. Isomaa B, Almgren P, Tuomi T (2001) Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care* 24:683–689
10. Perloff D, Grim C, Flack J (1993) Human blood pressure determination by sphygmomanometry. *Circulation* 88:2460–2470
11. Plan and operation of the Third National Health and Nutrition Examination Survey, 1988–1994 (1994) Series 1: programs and collection procedures. *Vital Health* 32:1–407
12. Yu ZY, Yi F, Zhi XZ (2002) Further study of risk factors for stroke and coronary heart disease cooperation group. The prevalence of metabolic syndrome in an 11 provinces cohort in China 36:298–300
13. Yao CH, Hu YS, Zhai FY (2007) Adult's prevalence of metabolic syndrome in China in 2002. *Chin J Diabetes* 15:332–335
14. Gu D, Reynolds K, Wu X (2005) Prevalence of the metabolic syndrome and overweight among adults in China. *Lancet* 365:1398–1405

15. Ford ES, Giles WH, Dietz WH (2002) Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. *JAMA* 287:356–359
16. The World Health Organization Western Pacific Region, the International Association for the Study of Obesity, and the International Obesity Task Force (2000) *The Asia-Pacific perspective: redefining obesity and its treatment*. Melbourne: Health Communications Australia
17. He J, Gu D, Reynolds K (2004) Serum total and lipoprotein cholesterol levels and awareness, treatment, and control of hypercholesterolemia in China. *Circulation* 110:405–411
18. Zhou B, Rao X, Dennis BH (1995) The relationship between dietary factors and serum lipids in Chinese urban and rural populations of Beijing and Guangzhou. *Chongqing Norm Univ* 8(3):528–534
19. He J, Klag MJ, Wu Z (1995) Stroke in the People's Republic of China. I. Geographic variations in incidence and risk factors. *Stroke* 26:2222–2227
20. Wu X, Huang Z, Stamler J (1996) Changes in average blood pressure and incidence of high blood pressure 1983–1984 to 1987–1988 in four population cohorts in the People's Republic of China. The PRC-USA Cardiovascular and Cardiopulmonary Epidemiology Research Group. *J Hypertens* 14:1267–1274

# Chapter 96

## Combined Toxic Effects of DBP and DEHP on Sperm in Male Mice

Yulan Hao, Guoying Zheng, Qingzhao Li, Houjun Xu, Yanshu Zhang and Licheng Yan

**Abstract** *Objective* to study the combined toxic effects of di-2-ethylhexyl phthalate (DEHP) and di-n-butyl phthalate (DBP) on spermatogenesis of male mice. *Methods* Forty Kunming male mice were randomly divided into 4 groups (10 mice in each group): DEHP + DBP (1.6 g/kg DEHP + 0.9 g/kg DBP), DEHP (1/20 LD<sub>50</sub> 1.6 g/kg), DBP (1/20 LD<sub>50</sub>, 0.9 g/kg) and a control group which was given corn oil. The experiment was conducted through gavage every other day for 35 days. The mice were sacrificed after treatment and the testis and the epididymis were collected for experiment. The number of sperm, the survival rate of sperm and the sperm malformation rate were detected by histologic examination. *Results* the sperm count and sperm survival rate in DBP&DEHP group were significantly lower, while the sperm malformation rate in DBP&DEHP group was higher than that of the other groups. Compared with DBP group, the sperm counts and sperm survival rate of DEHP group decreased, but there was no significant difference in sperm malformation rate. No significant difference between DBP and control group was detected. *Conclusion* DEHP and DBP mixture can induce strong hazardous effect on male reproductive ability.

**Keywords** DBP • DEHP • Sperm survival rate • Sperm malformation rate

### 96.1 Introduction

Phthalate esters (PAEs) are common used man-made chemicals. They were used as a plasticizer to enhance the flexibility of plastic. PAEs are found in a wide range of products such as building materials, paints, children's toys, water, sludge and air [1]. Because phthalate esters are not chemically bound in polymers, slow emission from the products to air or other media usually occurs. At the same time, it has

---

Y. Hao (✉) · G. Zheng · Q. Li · H. Xu · Y. Zhang · L. Yan  
Division of Sanitary Toxicology and Sanitary Chemistry, The College of Public Health,  
Hebei United University, Tangshan 063000, China  
e-mail: haoyulan2011@163.com

a high lipid-water partition coefficient and is difficult to be degraded. Therefore, PAEs have been recognized as major pollutants to the environment [1, 2].

There are about 14 kinds of PAEs in the industrial production. Six of them are counted as environmental priority pollutants by U.S. Environmental Protection Agency (EPA). Four of them are counted as environmental priority pollutants in China. Di-2-ethylhexyl phthalate (DEHP) is the most widely used PAE and accounts for more than 50 % of total phthalate production. Plasticizers di (n-butyl) phthalate (DBP) is the next most widely used PAE. Some studies have investigated that the DEHP exposure level of human is 2–5 times higher than that of DBP [3]. Toxicological studies have shown that some PAEs can cause reproductive and genetic damages. In addition, DEHP or DBP was found that it could induce lipid per oxidation on rats [4]. Most of the toxicological studies focused on toxicity of single PAE, However, humans can be exposed to two or more PAEs because there are more than two kinds of PAEs are commonly used in the manufactures.

In this report, we determined sperm parameters (sperm counts, the spermatozoon survival rate and the rate of the sperm deformation) and counted the organ coefficients of the testis. The combined effects of di-2-ethylhexyl phthalate (DEHP) and di-n-butyl phthalate (DBP) on reproductive system of male mice were studied, which might provide more scientific evidence for long term effect of PAEs and provide safety guidance for PAEs using.

## 96.2 Materials and Method

### 96.2.1 Chemicals and Instrument Materials

Di-2-ethylhexyl phthalate (DEHP) and di-n-butyl phthalate (DBP) were purchased from Sino harm Chemical Reagent Company (degree of purity  $\geq 99.0\%$ ). DBP and DEHP were dissolved in corn oil and adjusted to the indicated concentration before experiment.

### 96.2.2 Grouping of Animals and Obesity Model

Forty healthy Kunming male mice were supplied by the Beijing Experimental Animal Center. Animal batch number was SCXK (JING) 2009–0004. The body weight of the mice was 18–25 g. The animals were housed in SPF grade animal laboratory of barrier environment of Hebei United University for a week.

The forty mice were randomly divided into 4 groups, 10 mice in each group. There were three experimental groups: DEHP + DBP (1.6 g/kg DEHP + 0.9 g/kg DBP), DEHP (1/20 LD<sub>50</sub> 1.6 g/kg), DBP (1/20 LD<sub>50</sub>, 0.9 g/kg) and a control group which was given corn oil. The mice were kept in plastic cages in the laboratory which was maintained at a temperature of  $22 \pm 2\text{ }^{\circ}\text{C}$ , with a relative humidity



of  $50 \pm 10\%$ . All animals were allowed free access to rodent chow and tap water. According to the grouping, the animal were gavaged for 0.1 ml/(10 g·d) every other day for 35 days. The entire animal were weighed every four days, and at the same time observed changes of the daily behaviors, mind about the mice.

### ***96.2.3 Sperm Quality Analysis***

The testis was shredded in 2 ml saline. The masses were combed with pipette for 30 times, bigger masses were filtered with 100 wells. Total sperm number was counted with blood counting chamber after filtered liquid was diluted to an appropriate concentration. In order to count sperm survival rate (%), 200 sperms were observed in every mouse. The filtered liquid was smeared, dried, fixed with methyl hydrate, dyed with hematoxylin-eosin and observed under optical microscope. Sperm malformation rate (%) was counted by observing 1,000 no overlap sperms.

### ***96.2.4 Statistical Analysis***

All results were expressed as mean  $\pm$  SE. The data were analyzed by using one-way analysis of variance (ANOVA) followed by Dunnett-test using SPSS version 13.0. Level of significance was fixed at 0.05.

## **96.3 Results**

### ***96.3.1 Effect on Testis Quality and Quantity***

The quantity and survival rate of the sperm of the DBP&DEHP group sharply declined compared with that of the other groups, and the sperm malformation rate obviously increased. The quantity and survival rate of sperm in DEHP group was significantly lower than that of DBP group, but there was no significance difference in sperm malformation rate between DEHP and DBP group. The quantity and survival rate of sperm in control group was higher than that of DBP group in quantity and survival rat, while the sperm malformation rate of control group was slightly lower than DBP group without statistical significance (Table 96.1).

### ***96.3.2 Testis Histological Examination***

Histological analysis demonstrated that testis somniferous tubule of the control mice arranged regularly, and this structure consists of multilevel spermatogenic

**Table 96.1** The changes of testis quality and quantity ( $n = 10, \bar{x} \pm s$ )

Groups	Sperm quantity ( $\times 10^6$ )	Sperm survival rate (%)	Sperm malformation rate (%)
Control	32.3 $\pm$ 12.5	82.58 $\pm$ 17.67	0.40 $\pm$ 0.22
DBP	34.7 $\pm$ 11.1	79.00 $\pm$ 7.29	1.11 $\pm$ 0.38
DEHP	13.7 $\pm$ 4.88 <sup>a</sup>	48.06 $\pm$ 11.29 <sup>b, c</sup>	2.38 $\pm$ 0.93
DBP&DEHP	12.2 $\pm$ 12.8 <sup>a, c</sup>	25.73 $\pm$ 18.18 <sup>b, c</sup>	10.63 $\pm$ 3.20 <sup>b, c, d</sup>

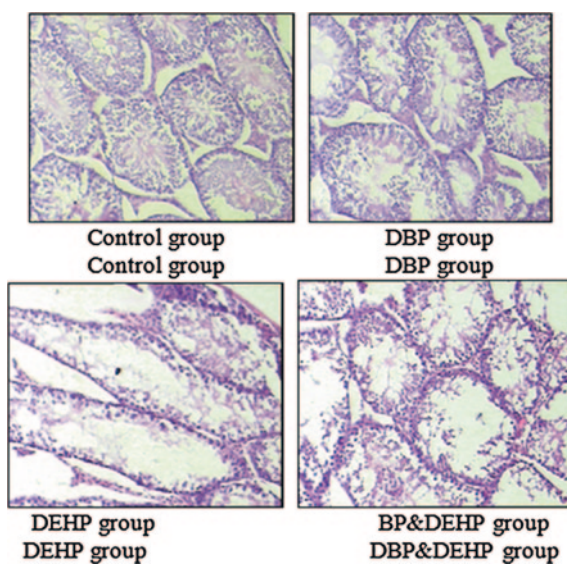
<sup>a</sup> $p < 0.05$ , when compared with control group

<sup>b</sup> $p < 0.01$ , when compared with control mice

<sup>c</sup> $p < 0.05$ , when compared with DBP group

<sup>d</sup> $p < 0.01$ , when compared with DEHP group

**Fig. 96.1** Photomicrograph of male mice testis administered with DEHP + DBPHE 100 $\times$



cells and sertoli cells which lie between spermatocytes and spermatids, all the cell arranged tightly and normally. The histomorphological examine of the testicular tissues of DBP group showed no obvious changes under this dose. The shape of testis somniferous tubule in DEHP group appeared essentially normal, but the connections between spermatogenic cells and sertoli cells reduced significantly, the number of sertoli cells decreased and somniferous epithelium become thinner. at the same time, cells arranged loosely and disorderly, cells falling off could be observed. Testis somniferous tubule in DEHP + DBP group was atrophied and degenerated. Spermatogenetic cells were exhausted. There were only a small amount of sertoli cells at the base of somniferous epithelium, although base-ment membranes of the cells were basic integrity. Some of them became swelling, degenerated, even appeared vacuole like changes (Fig. 96.1).

## 96.4 Discussion

PAEs are environmental endocrine disrupters, which are widely distributed in the living environment and becoming a public hazard that seriously threaten the health of human beings in the world. As well-known, Phthalate esters are mainly used as plasticizer, more and more plastic goods are made and abuse used. As a result, plastic wastes produces “white pollution”. Phthalate esters can easily release from plastic and gain entry through many ways. Studies have shown that the content of DEHP and DBP can reach 4.76–23.99 mg/L and 0.08–0.98 mg/L in human serum and semen [5]. So it’s important to assess potential threat about the exposure of DBP and DEHP.

Previous research has established that Phthalate esters interference could affect internal secretion and male system [6]. Zhang Jing reported that DEHP& DBP had potential genetic toxicity to *Drosophila melanogaster* [7]. National Toxicology Program (NTP) also suggested DBP and DEHP had reproductive toxicity. Besides that, it could cause hepatomegaly [8].

The sperm quantity and quality are important parameters for the reproductive capacity of male, and it concerns pregnancy and embryo quality directly. Study has shown sperm quantity of adult rat decreased significantly, meanwhile, sperm death rate and sperm malformation rose obviously after administration of 5 g/(kg·d) DEHP. In this study, sperm death rate and sperm malformation increase significantly in DEHP&DBP group. So DEHP and DBP may have an effect on mutation and gene expression.

Somniferous epithelium in testis consists of multilevel spermatogenic cells and sertoli cells, and the latter connects with germ cells. Sertoli cell provides structural support and nutrient for germ cells. The degeneration and necrosis of sertoli cells can affect spermatogenesis and maturation. Histopathology of this study showed that testis somniferous tubule of DEHP&DBP group had irregular shapes and it was atrophied and degenerated. Somniferous epithelium degenerated or even disappeared. sertoli cell cells became degeneration, swelling and atrophy.

With the development of industry, the detected content of DEHP and DBP become much higher. Its damage can be amplified through bio-enrichment. Therefore these issues should lead to the concerned branch takes seriously.

## References

1. Deng C, Chen DY, Luo DG (2011) The research on the transportation simulation of Di-(2-ethylhexyl) Phthalate (DEHP) in vadose zone. *Bioinf Biomed Eng*, 5th International Conference on 33(7):1–4
2. Xu Y, Park J, Kofoed Sorensen V, Clausen P (2008) Characterizing emissions of phthalate plasticizer from vinyl flooring in a specially-designed chamber. *Epidemiology* 19(6):294–295
3. Sha Y, Xia X, Yang Z (2007) Distribution of PAEs in the middle and lower reaches of the Yellow River China. *Eviron Monit Assess* 124(1–3):277–287

4. Wang YB, Song L, Zhu ZP (2004) Effect of Dibutyl Phthalate of the biochemical enzymes and lipid per oxidation in rat testes. *Natl J Androlog* 10(10):729–733
5. Zhang YH, Cheng BH, Zheng LX (2003) Study on the level of phthalates in human biological samples. *Chin J Prey Med* 37(6):429–434
6. Fisher JS (2004) Environmental anti-androgens and male reproductive health: focus on phthalates and testicular dysgenesis syndrome. *Reproduction* 127(23):305–315
7. Zhang J, Li SG, Zhang XW (2009) The genotoxic effect of DBP and DEHP on the drosophila melanogaster. *J Toxicol* 23(6):119–446
8. Hauser R (2006) The environment and male fertility: recent research on emerging chemicals and semen quality. *Semin Reprod Med* 24(6):156–167

# Chapter 97

## Effect of Soyasaponin on Pulmonary Tissue Apoptosis of Silicotic Fibrosis Rats

Houjun Xu, Yu Su, Qingzhao Li, Jianhui Wu, Yulan Hao, Hongmin Fan, Manman Wang, Nan Liu and Guoying Zheng

**Abstract** *Objectives* To discuss effect of SS on pulmonary tissue apoptosis of Silicotic Fibrosis Rats. *Methods* It was observed concluding nitrous oxide (NO) and reactive oxygen species (ROS) in serum and changes of that after SS intervened. Analysis of apoptosis of pulmonary tissue cells: Apoptosis was detected by TdT-mediated dUTP nick end labeling (TUNEL) to determine the changes of morphology and apoptotic index. *Results* After SS intervened, the level of ROS, NO were all decreased significantly ( $P < 0.05$ ). TUNEL showed that apoptotic index descended remarkably. But we could also observe the appearance of apoptosis in alveolar epithelial cells and pulmonary vascular endothelial cells. *Conclusion* A certain dose of SS might relieve the progress of silicotic pulmonary fibrosis through reducing excessive apoptosis of pulmonary tissue.

**Keywords** Silicosis • Pulmonary fibrosis • Soyasaponin • Apoptosis

### 97.1 Introduction

Silicosis is due to long-term inhalation of a large amount of free  $\text{SiO}_2$ , causing pulmonary progressive fibrosis diseases. At early stage pathological changes of silicosis is characterized by alveolar injury and inflammation while later stage by fibrosis formation. In this process, alveolar macrophages (AM), alveolar epithelial cells (AEC) and bronchial epithelial cells tend to have a large number of losses [1]. Vivo studies in rats also showed that alveolar epithelial cell apoptosis is one of the main causes of silicotic fibrosis [2]. Research shows that: the silica induction of the AM apoptosis is mediated by ROS and Caspase, activated AM and AEC cells can express the FasL to realize its apoptosis [3]. Soybean saponin

---

H. Xu (✉) · Y. Su · Q. Li · J. Wu · Y. Hao · H. Fan · M. Wang · N. Liu · G. Zheng  
Hebei United Univeristy, Tangshan 063000, Hebei Province, China  
e-mail: houjunxu@126.com

(Soyasaponin, SS), one of the active ingredient, extracted from soybean has the function of antioxidant [4], tumor suppression, immunoregulation and other beneficial physiological functions. Therefore, we choose SS as an intervention; hope to reduce the lung tissue cell apoptosis, trying to provide some basic data for silicosis prevention and pathogenesis studies.

## 97.2 Materials and Methods

Experimental animals and establishment of animal model: 40 SD rats of clean level, body weight  $200 \pm 30$  g, male, provided by Beijing dimension Lihua experimental animal company. SD rats were randomly divided into control group (group NS), silica dust group (group SiO<sub>2</sub>), the intervention group 1 (SS 10 mg/kg) and intervention group 2 (SS 15 mg/kg), 10 rats in each group. All rats in each group after ether anesthesia, the opening devices were put into mouths of all the rats of each group, 1 ml of different experimental liquids directly injected to the groups accordingly, 0.5 ml for left lung and 0.5 ml for right. Injection liquid for control group is sterile physiological saline, and for model group and intervention group the injection liquid was SiO<sub>2</sub> dust suspension (50 mg/ml). After Molding, the two intervention groups were given 10 and 15 mg/kg respectively for SS gavages, 4 times a week; meanwhile, the control group and the model group were given equal volume of physiological saline for lavage. The animals of each group would be killed by half 40 and 80 days after the Molding. Using saline, SS solution were made to the concentration of 4 mg/ml and the solution was stored at the temperature of 4 °C after microporous membrane filtering and degerming.

Animal treatment and specimen collection: Rat intraperitoneal injection of 0.3 % mass fraction of sodium pentobarbital anesthesia, cardiac blood, 2,000 r/min centrifugal 15 min, serum stored under -70 °C for later use. Aseptic operation applied for taking out of the lungs, the left lung was treated with the volume fraction of 10 % neutral buffered formaldehyde, paraffin-embedded, TUNEL staining.

Serum nitric oxide (NO), reactive oxygen species (ROS). Using Nanjing Building Research Institute of biological engineering kit, operated according to the manual.

Detection of the apoptosis of lung tissue cells: Using TUNEL (TdT-mediated dUTP nick end labeling) technology for the detection of apoptotic cells. In situ cell detection kit was the product of the German company Roche. 5 slices were chosen randomly from each experimental group, 5 representative HPF ( $\times 400$ ) were selected in each slice, counting the amount of TUNEL staining positive cells in 500 cells, apoptosis index were applied, which equals to the number of apoptotic cells divided by cell number and finally in percentage format.

Statistical processing: All the results were expressed by mean  $\pm$  SD ( $x \pm s$ ), using SAS6.12 software for One-factor analysis of variance, SNKq test statistical processing, when P was less than 0.05, it would indicate the difference has statistics significance.

## 97.3 Results

### 97.3.1 Change of Serum Index of Rats

The variation of NO conten in serum of animals in different groups at different time is shown in Table 97.1 40 days after the rats contact with the silica dust, serum NO concentration increased significantly, compared with the control group, the difference was significant ( $P < 0.05$ ). In SiO<sub>2</sub> group after contact with dust, NO content in that of 40d was significantly higher than 80d, the difference was statistically meaningful ( $P < 0.05$ ). The content of serum NO in SS intervention group decreased by 28.9, 41 and 38.5, 45.3 % respectively in comparison to SiO<sub>2</sub> group, and obviously the difference was significant ( $F = 32.63$ ,  $P < 0.05$ ) (Table 97.2).

The variation of ROS content in serum in groups of animals at different time.

Serum reactive oxygen content increased significantly after silica dust went into rats, serum ROS content increased by 80.4 and 63.9 % in comparison to the NS group 40 and 80 days after the dust contact, furthermore, and it maintained at a comparatively higher level for a long time. Even though the serum ROS content started to decline after 80 days the trend was not strong and the difference was not statistically significant ( $P < 0.05$ ). The serum ROS content decreased gradually after the SS intervention, the 80D group was most obvious, the difference was statistically significant ( $F = 44.86$ ,  $P < 0.05$ ) compared with the SiO<sub>2</sub> group.

**Table 97.1** The comparison of serum NO in different groups ( $\mu$  mol/L)

Groups	40d ( $x \pm s$ , $n = 5$ )	80d ( $x \pm s$ , $n = 5$ )
NS	37.49 $\pm$ 8.97	36.32 $\pm$ 7.65
SiO <sub>2</sub>	130.91 $\pm$ 12.40 <sup>a</sup>	77.06 $\pm$ 15.60 <sup>ac</sup>
SiO <sub>2</sub> + SS(10 mg/kg)	93.08 $\pm$ 11.07 <sup>ab</sup>	47.37 $\pm$ 8.79 <sup>bc</sup>
SiO <sub>2</sub> + SS(15 mg/kg)	77.15 $\pm$ 11.65 <sup>ab</sup>	42.13 $\pm$ 7.97 <sup>bc</sup>

*Note*

<sup>a</sup> $P < 0.05$  verses NS group

<sup>b</sup> $P < 0.05$  verses SiO<sub>2</sub> group

<sup>c</sup> $P < 0.05$  verses 40d group

**Table 97.2** The comparison of serum ROS in different groups (U/ml)

Groups	40d ( $x \pm s$ , $n = 5$ )	80d ( $x \pm s$ , $n = 5$ )
NS	390.27 $\pm$ 37.38	421.69 $\pm$ 71.67
SiO <sub>2</sub>	704.16 $\pm$ 80.49 <sup>a</sup>	690.95 $\pm$ 72.53 <sup>a</sup>
SiO <sub>2</sub> + SS(10 mg/kg)	577.30 $\pm$ 46.20 <sup>ab</sup>	563.09 $\pm$ 51.86 <sup>ab</sup>
SiO <sub>2</sub> + SS(15 mg/kg)	551.72 $\pm$ 50.01 <sup>ab</sup>	531.50 $\pm$ 73.65 <sup>ab</sup>

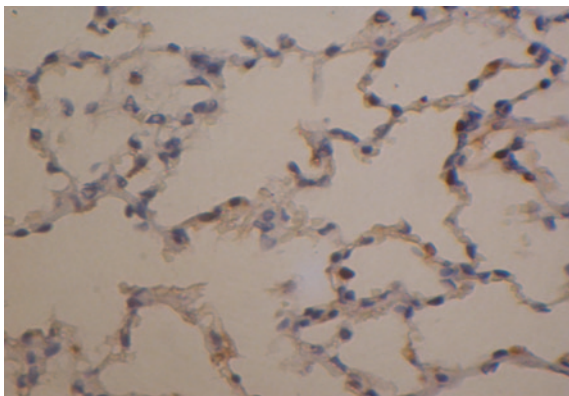
*Note*

<sup>a</sup> $P < 0.05$  verses NS group

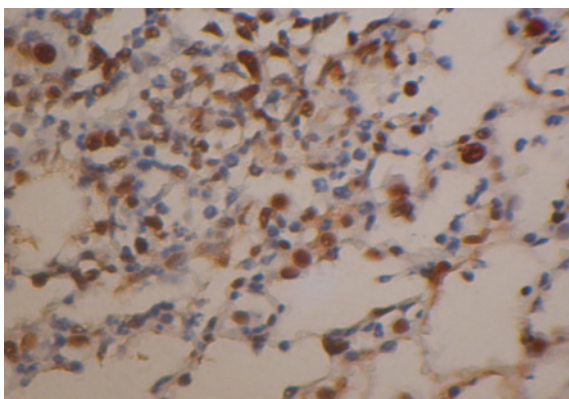
<sup>b</sup> $P < 0.05$  verses SiO<sub>2</sub> group



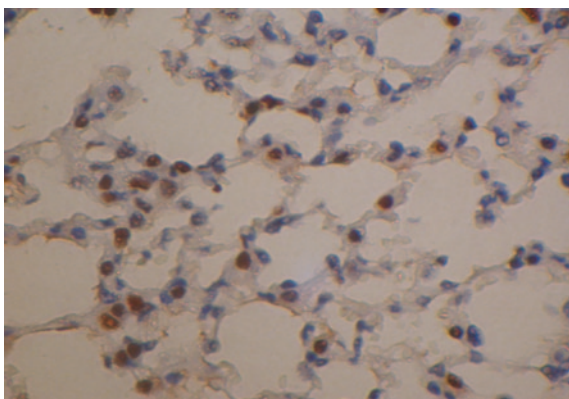
**Fig. 97.1** The apoptosis picture of lung tissue of rats in NS group (TENUL, DAB developer,  $\times 400$ )



**Fig. 97.2** The apoptosis picture of lung tissue of rats in SiO<sub>2</sub> group (TENUL, DAB developer,  $\times 400$ )



**Fig. 97.3** The apoptosis picture of lung tissue of rats intervention group 10 mg/kg, 40d (TENUL, DAB developer,  $\times 400$ )





**Table 97.3** The comparison of apoptotic index in pulmonary tissue after SiO<sub>2</sub> instilled among different groups (%)

Groups	40d (x ± s. n = 5)	80d (x ± s. n = 5)
NS	8.75 ± 3.63	6.68 ± 3.46
SiO <sub>2</sub>	37.28 ± 4.84 <sup>a</sup>	39.80 ± 5.00 <sup>a</sup>
SiO <sub>2</sub> + SS(10 mg/kg)	22.25 ± 4.44 <sup>ab</sup>	20.28 ± 6.04 <sup>ab</sup>
SiO <sub>2</sub> + SS(15 mg/kg)	17.76 ± 4.48 <sup>abc</sup>	17.38 ± 5.27 <sup>abc</sup>

*Note*<sup>a</sup>P < 0.05 verses NS group<sup>b</sup>P < 0.05 verses SiO<sub>2</sub> group<sup>c</sup>P < 0.05 verses SiO<sub>2</sub> + SS (10 mg/kg)

The detection results of apoptosis of lung tissue cells in situ:

TUNEL method was shown to be the most sensitive method for the quantitative detection of apoptosis at present [5], the positive sign was that the stained nuclei were brown just as in Figs. 97.1, 97.2, 97.3. The stained positive cells of the lung tissue in this study were mainly bronchial epithelial cells, alveolar epithelial cells and some inflammatory cells, tissue sections showed nuclear pyknosis, in a round or polygonal shape, and the gathering into a mass distribution of the chromatin at the edge of the cell nucleus, which were consistent with the morphological changes of apoptotic cells, apoptotic body could be seen in individual cells [6]. At different times the apoptotic index changes of the cells in lung tissue of different groups of animals were shown in Table 97.3.

### 97.3.2 Change of Histomorphology of Rats

## 97.4 Conclusions

As an active constituent extracted from soybean, SS has many beneficial physiological activity. SS is related to the occurrence of reducing the apoptosis of lung tissue cells. The mechanism of the function of SS in inhibiting the apoptosis of lung tissue cells in the process of the silicosis fibrosis may be that through inhibiting the activity of ROS SS can reduce the activation of the death receptor. Whether by decreasing the expression of the FasL in lung tissue cells to achieve this purpose remains unknown, specific mechanisms need to be further discussed.

**Acknowledgments** Hebei United Univeristy, Tangshan Hebei Province, China, 063000. Science and technology research and development program of Tangshan City (Grant No.10150204A-36).

## References

1. Kuwano K, Hagimoto N, Tanaka T et al (2000) Expression of apoptosis regulatory genes in epithelial cells in pulmonary fibrosis in mice. *Pathol* 190(2):221–229
2. Fine A, Jansser-Heininger Y, Soultanakis RP et al (2000) Apoptosis in lung pathophysiology. *Am J Physiol Lung Cell Mol Physiol* 279(3):423–427
3. Borges VM, Lopes MF, Falcao H et al (2002) Apoptosis underlies immunopathogenic mechanisms in acute silicosis. *Am J Physiol Lung Cell Mol Physiol* 27:78–84
4. Yinping W, Jiayang W, Fenglan Z et al (1993) The influence to SOD and LPO of diabetic rat caused by soyasaponin and ginsenosides from stems to leaves saponins. *Norman Bethune Univ Med Sci* 19(2):122–123
5. Gavrieli Y, Sherman Y, Ben-Sasson SA (1992) Identification of programmed cell death in situ via specific labeling of nuclear DNA fragmentation. *J Cell Biol* 119:493–497
6. Kitagawa I et al (1983) Saponins from soybean. *Kagaku to Seibutsu* 21:224–228

# Chapter 98

## Surface Reconstruction of Bilateral Skull Defect Prosthesis Based on Radial Basis Function

Lei Zhou, Yang Song, Jianhui Wu, Huilan Li, Guobin Zhang and Chunling Sun

**Abstract** The paper proposed an approach to surface reconstruction of bilateral skull defect prosthesis based on radial basis function. First, patient' CT image data were processed for three-dimensional surface model of his skull. Second, K dimension tree was utilized to determine the information about boundary points of the defect area. Finally, interpolation surface expressed by radial basis function was availed to fill the area of defect, thus getting the mathematical model of the defect area. The results showed that this approach could improve the accuracy of prosthesis and supply a new preparation method for clinical application.

**Keywords** Skull • Skull prosthesis • Radial basis functions • Surface reconstruction

### 98.1 Introduction

At present, many patients suffered from skull defects due to various causes, such as congenital skull defect, brain trauma, brain tumor resection and so on. These patients need surgical repair of skull defects. Titanium has become an ideal material for cranioplasty [1–3] because of its good biocompatibility, light weight, high strength. However, nowadays the preparation of titanium skull restoration is accomplished by doctors' hand during surgery according to the defect size and shape of patient's skull. During the process of surgery, doctors must compare titanium stencil with edge of skull defect repeatedly until the shape is similar to that of patient's skull defect area, and then the shaped titanium network plate was screwed on the defect area. During the repairing process, due to different skull shape, different size of the skull defect area, deformation ability of the titanium

---

L. Zhou (✉) · Y. Song · J. Wu · H. Li · G. Zhang · C. Sun  
Hebei United Univeristy, Tangshan 063000, Hebei Province, China  
e-mail: heuzhoulei@163.com

network plate, hand-shaped prosthesis couldn't match with the edge of defect area accurately, leading to the decline of repairing effects. In addition, when the defect area is large or the structure of defect area is complex, it is very difficult for doctors to shape the prosthesis by hand.

Nowadays, preoperative shaping method has been used to overcome these shortcomings and its key is to how to rebuild the mathematical model of the skull defect area of patients. Currently, preoperative shaping method mainly adopts free-surface design method. When the defect area is close to the area of frontotemporal and periorbital, the curvature of the surface changes greatly. So it is difficult to make a model matching with patients' head type by constructing a curve, and surface design. The traditional method to solve skull defect repair relies on UG, CAD systems such as Solid work, using human-computer interaction to rebuild the hole parts. But these tools lack domain-specific operation methods, and the interactive steps are complex, and professionals are needed to be involved in the process, and the production cycle is long, all of which seriously affect the clinical success rate. In Mimics [4] systems and literatures [5], he proposed mirroring repair method to one side skull defect, using the geometric mirroring to rebuild models to defect area. But for patients with bilateral skull defects, this method could not meet the asymmetrical skull defect repair requirements such as trauma and bilateral parietal skull defects.

Owing to its accuracy and stability of multi-dimensional interpolation, RBF (Radial Basis Function, RBF) makes the discrete points surface fitting based on RBF widely concerned. In this paper, the algorithm to hole repair based on RBF was adopted to make surface reconstruction of skull defect area, making the titanium skull prosthesis fitting the skull defect area, thus reaching the requirements of surgical repair.

## 98.2 RBF-Based Implicit Surface Equation

As an explicit function in indicating surface has some limitations, implicit equation can be adopted to indicate surface in the algebraic approach. In a given  $R^3$  space, a series of scattered points and their corresponding constraint function value and the value of each point can be defined as an implicit surface. RBF-based implicit surface equation is:

$$f(r) = p(r) + \sum_{i=1}^N \lambda_j \phi(|r - c_j|) \quad (98.1)$$

$r$  refers to any data point on the generated surface;  $c_j$  refers to scattered points defining the equation;  $c_j \in R^3 (j = 1, 2, \dots, n)$ ,  $\lambda_j$  refers to RBF coefficient,  $p(r)$  refers to load function, usually one first-order polynomial;  $\phi$  refers to RBF, and its form is

$$\phi(r) = |r|^3 \quad (98.2)$$

In defining  $h_i$  as the distance value from  $c_i$  to the surface, two types of samples existed: interpolation  $h_i = 0$  and additional constraint points  $h_i \neq 0$ . Orthogonal conditions to meet the energy minimum by the two types of samples are:

$$\sum_{i=1}^n \lambda_i = \sum_{i=1}^n \lambda_i c_i^x = \sum_{i=1}^n \lambda_i c_i^y = \sum_{i=1}^n \lambda_i c_i^z = 0 \tag{98.3}$$

Corresponding equation  $AX = B$  is a symmetric positive semi-definite linear equation, and there exists one unique solution.

To solve the weights and polynomial coefficients, the interpolation constraint conditions must be met:

$$f(c_i) = \sum_{j=1}^n \lambda_j \varphi(c_i - c_j) + P(c_i) = h_i \quad (j = 1, 2, \dots, n) \tag{98.4}$$

### 98.3 Data Acquisition

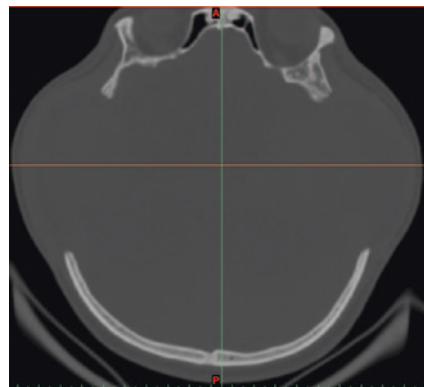
In this paper, a patient’s head was scanned by 64 slice spiral CT to obtain CT image of patient’s skull. Appropriate space tomography [6] should be selected because the layer distance of CT scanning had great impact on the accuracy of data. In this paper, CT scanning fault spacing was set to 1 mm, 171 layers. Figure 98.1 was a skull image of CT scanning fault.

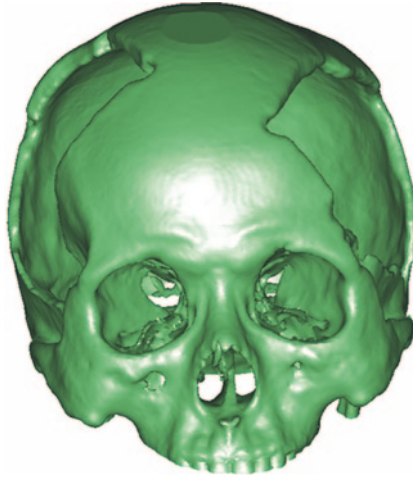
Seen from Fig. 98.1, the patient had a larger defect area in bilateral skulls. The mirroring method proposed by literature [4, 5] couldn’t provide the three-dimensional data to the defect area repair.

At present, much medical CT imaging software had the ability of image processing and three-dimensional reconstruction. In this paper, Mimics software was adopted to preprocess the skull CT image of the patient. Then the collected CT image was treated with thresholding, region growing and three-dimensional reconstruction to obtain the three-dimensional model of the skull. As is shown in Fig. 98.2.

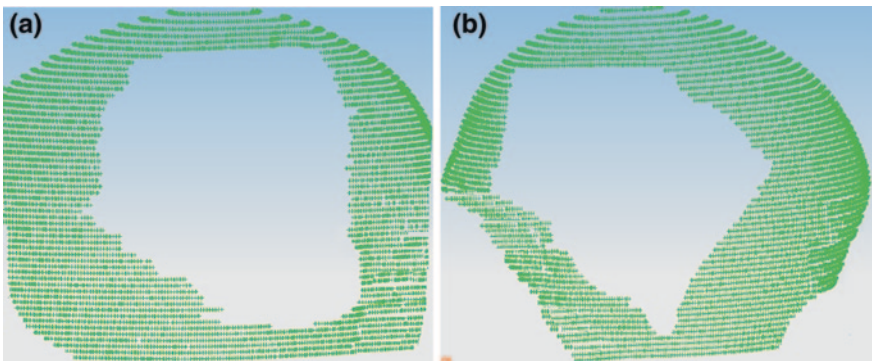
Figure 98.2 showed that there were two large defect areas in left and right side of the patient’s skull. Three-dimensional model was output to obtain the surface

**Fig. 98.1** A skull image of CT scanning fault





**Fig. 98.2** Three-dimensional skull model of the patient



**Fig. 98.3** The point cloud surface model of the defect area. **a** the *left* side of the defect area, **b** the *right* side of the defect area

model. Extracting data in skull defect area, expressing to the defect area, removing the outreach area of the defect as a target area for processing could lead to the formation of the point cloud model of the defect area. As is shown in Fig. 98.3.

## 98.4 Mathematical Model Reconstruction for the Defect Area

### 98.4.1 *Determining the Defect Area Boundary*

In this paper,  $k$  dimension tree was adopted to extract boundary. The basic algorithm was based on certain criteria for selecting a coordinate axis as the split direction, dividing the data set into two sub data sets, and then splitting them recursively, and ultimately leading to the formation of search tree.

Let  $p(x_p, y_p, z_p)$  to be a point of the point cloud, Let  $q_i, (i = 1, 2, \dots, m)$  be the retrieved neighboring points with  $m$  number to  $p$ . Let  $\Omega$  be the least-squares plane by  $q_i$  fitting.  $p'$  and  $q_i'$  were the projection points of  $p$  and  $q_i$  on  $\Omega$  respectively,  $C$  was the unit circle with  $p'$  as its center on the plane  $\Omega$ ,  $q_i''$  was the projection point of  $q_i'$  on  $C$ .

Boundary determination algorithm is: constructing least-squares plane  $\Omega$  by  $q_i (i = 1, 2, \dots, m)$ , calculating the projection point  $p', q_i'$  and the vector  $vec_i$ ,

$$vec_i = q_i' - p' (i = 1, 2, \dots, m) \tag{98.5}$$

By calculating the directed angle from  $vec_1$  to  $vec_i$ , ranking the angle values from small to large, angle values  $\theta_i$  with  $m$  number was got. If there was  $k$ , the following must be met:

$$\Delta\theta = \theta_{k+1} - \theta_k \geq \vartheta \tag{98.6}$$

or

$$\Delta\theta = 2\pi - \theta_m \geq \vartheta \tag{98.7}$$

$\vartheta$  refers to threshold.  $p(x_p, y_p, z_p)$  was the border point. Otherwise, it was not.

### 98.4.2 Filling the Defect Area

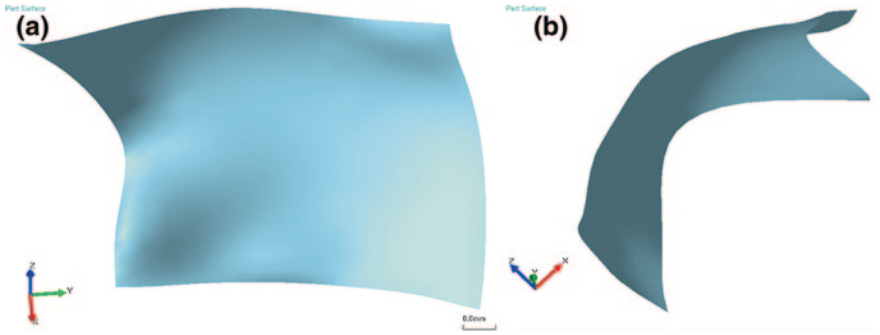
In this paper, thin plate spline function was used to interpolation fill in the point cloud data. Thin plate spline function was used to bivariate radial basis function with two-dimensional space. In theory, thin plate spline function has been proved to be the most smooth interpolation function of space and has got a wide range of applications in practice.

Combined with reconstructed mathematical model of skull prosthesis, the paper adopted the thin plate spline function as followed:

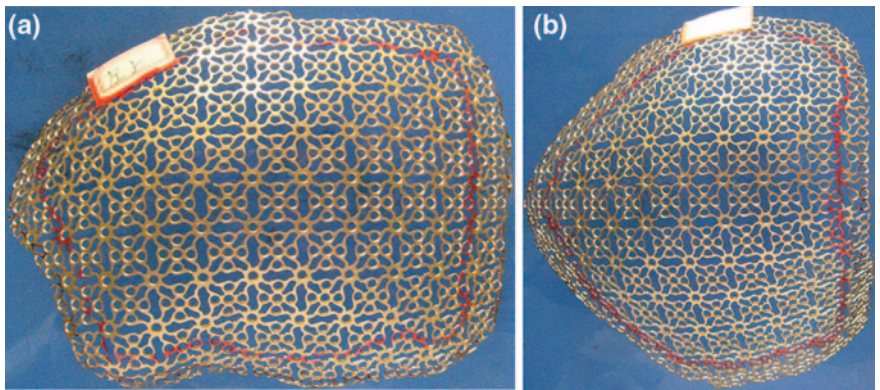
$$f(x) = p(x) + \sum_{i=1}^N \lambda_i \varphi(|x - x_i|) \tag{98.8}$$

$x \in R^2; x_i \in R^2 (i = 1, 2, \dots, N)$ ,  $x_i$  refers to the point of the point cloud with  $n$  number,  $p(x)$  refers to the load function,  $\lambda_i$  refers to RBF coefficient,  $\varphi$  refers to basis function.

Basic function  $\varphi$  is a real valued function, and also a radial symmetric function with  $x_i$  as its center, among which  $x_i$  is the center of the radial basis function. Using the symbol of  $r = |x - x_i|$ , the basis function can be written as  $\varphi(r)$ . Obviously, as to the interpolation, after setting  $p(x)$  and  $\varphi(r)$ , a linear equation can be solved to get a coefficient to determine the thin plate spline function. In this paper, taking  $\varphi(r) = r^2 \lg r$ , the most smooth interpolation surface can be ensured to get. At the same time, considering the shape of human skull similar to that of



**Fig. 98.4** The mathematical model of skull prosthesis. **a** the mathematical model of prosthesis of the *left* side, **b** the mathematical model of prosthesis of the *right* side



**Fig. 98.5** The shaped titanium skull prosthesis. **a** the shaped prosthesis of the *left* side, **b** the shaped prosthesis of the *right* side

the ellipsoid, the load function  $p(x)$  was taken as the quadratic. This paper took the load function as followed:

$$p(x, y) = ax^2 + by^2 + c \tag{98.9}$$

$a, b, c$  refer to unknown coefficients. The values of  $a, b, c$  can be got by least-squares fitting and the load function can be determined. For the solution of thin plate spline function, we used Diagonal Pivoting Method provided by LAPACK package to solve the linear equations. The solution algorithm was completed by giving the initial value iteration. Figure 98.4 was the mathematical model of skull prosthesis using thin plate spline interpolation according to the healthy side of the skull surface.



## 98.5 Conclusions and Examples

The model of patient's skull defect area can be processed mechanically to obtain personalized patient's own prosthesis. As was shown in Fig. 98.5.

As to bilateral skull defect surface, the healthy side of the skull cannot be used to the mirroring reconstruction. This paper proposed the algorithm of surface reconstruction of bilateral skull defect prosthesis based on radial basis function and solved the bilateral cranial prosthesis modeling problems. The algorithm has good stability, satisfactory results to actual defect surface reconstruction, and good integration between the generated data and the original data. Thus, it could meet the requirements of cranioplasty and improve production efficiency.

At present, the approach has been used clinically and has completed 8 cases with bilateral skull defect repair with good results.

## References

1. Zheng YF, Zhao LC (2004) Biomedical Nation. Science Press, Beijing 6(3):5–6
2. Marbacher S, Andres RH, Fathi AR et al (2008) Primary reconstruction of open depressed skull fractures with titanium mesh. *J Craniofac Surg* 19(2):490–495
3. Scholza A, Wehmollerb M, Lehmbrock J et al (2007) Reconstruction of temporal contour for traumatic tissue loss using CAD/CAM-prefabricated titanium implant-case report. *J Cranio Maxillofac Surg* 35(8):388–392
4. Aterialise. Mimics Software <http://www.materialise.com>
5. Liu HQ, Hu QG, Li LM et al (2006) A study of the method of reconstructing the bionic scaffold for repairing defective bone based on tissue engineering. IFIP TC5 international conference, PROLAMAT. Springer, Boston 6(1):650–657
6. Zhang CC, Su JC, Yu BQ et al (2004) Numerical model simulation study of human bones. Second Military Medical University Press, Shanghai 22(5):4–7

# Chapter 99

## Research of New Method of Developing Blood Fingerprints with RDZ

**Xiaomei Zhang**

**Abstract** Based on the components and characteristics of blood, using the principle of protein staining, through scanning different colorants and some ordinary reagents and experimenting and studying the thickness determination, the cleaning reagent and cleaning procedure and simultaneously experimenting and testing sensitivity of this reagent and analyses the results of left blood fingerprints in different period of time, this thesis determines the best new formula as 0.5 % RDZ methanol solution. The new prescription adapts to not only these usual nonporous surfaces such as tiles, glasses, aluminium alloys, PVC, and plastic, but also these semi-porous surfaces such as copy chapters and leather, artificial leathers and rubbers. Drop this new reagent on the surfaces to develop blood fingerprints. It is an easy and quick method. The developed fingerprints ridges are clear, fluent and steady, and can be kept for a long time. Furthermore, it is not harmful to human beings. The reagent can be saved for a long time and used repeatedly.

**Keywords** Blood fingerprint • RDZ • Nonporous surface

### 99.1 Introduction

Now we mostly use TMB and Amino black 10B to develop blood fingerprints, each method has its own limit. Aiming to enrich the developing methods and improve appearance rate, the author used a new kind of developing reagent to develop blood fingerprints on ordinary nonporous, semiporous and porous surfaces, then analyzed. Finally, the author found the new RDZ reagent is an easy, wild used and good effect method.

---

X. Zhang (✉)

Department of Forensic Science and Technology, China Criminal Police University,  
110035 Shenyang, Liaoning, China  
e-mail: zhangxiaomei568@yahoo.com.cn

### ***99.1.1 The Components and Characteristics of the Blood***

The blood is composed of blood cells, over 80 % water, proteins, amino acid (nitrogenous organism or nonnitrogenous organisms) and minerals. The proteins in blood include plasma protein (globulin, albumin, fibrin and salts) and hemoglobin. Hemoglobin a polymer by bead proteins and hemachromes takes great part in the blood. The bead protein is a kind of multi-molecule protein. Hundreds of amino acids connect with peptide linkage and make a peptide chain, and the chains circumvolve in the space with a certain way. Hemachromes show the blood's color, whose molecular weight is 64, with porphyrin ring and contain chelate Fe atom. Conjugate linkages absorb visible lights and make the hemachromes red. Fe atom, ferrous ion, is in the center of four pyrrole ring and connects four nitrogen atoms with coordination bonds.

### ***99.1.2 The Qualities of RDZ***

RDZ is a kind of red powder and can dissolve in methanol, ethanol and water. It mainly used to dye Terylene, blending fabric, cellulose acetate and acrylic. It has strong and quick dyeing power to the protein in blood [1].

### ***99.1.3 The Principle of Developing Fingerprints with RDZ***

With RDZ to develop blood fingerprints on the smooth nonporous, half porous and porous surfaces bases on the principle of the protein dying [2].

In the wet condition, the protein is colloid and shows absorption ability and absorbs RDZ selectively. The color groups in the dye connect the amides, carboxyl groups in the amino acid at the tail peptide chain in the protein through intermolecular forces, hydrogen bonds and electrovalent bonds. The dye molecules sink on the surface of the fingerprints and the lines show the dye color. It is the protein dying procedure.

## **99.2 Materials and Methods**

### ***99.2.1 Equipments and Chemicals***

Chemical scales, spoons, beakers, measuring cylinder, glass sticks, pliers, absorbent cotton, dripping flasks, rubber gloves, respirators and digital cameras.

RDZ, Mordant Black, Weak Acid Brilliant Blue, Acid red, Disperse Blue B, Methanol, absolute grain Alcohol, distilled Water and Peroxide.

### ***99.2.2 Sample Making***

The main experimental samples are nonporous samples: tiles, glasses, aluminum alloys, PVC, plastic and semi-porous samples: leather, artificial leathers, rubbers and porous samples: copy papers and so on.

Making fresh blood fingerprints samples: Cover your finger uniformly with blood and press on the samples with equality force and avoiding rolling and gliding. Keep the samples for several days, we get the aged samples.

### ***99.2.3 Development Operations***

Operation: incline the samples and drop the disperse scarlet on the samples equally with a straw, then dry the samples with hot air and volatilize the solvent. After drying, rinse away the extra development reagent and the dyestuff on the samples' background and lines with water quickly, blow again and take pictures. In the operation, cover the whole fingerprint with development reagent in one time to avoid unevenly dyeing. After dripping, incline the samples and avoid the development reagent flowing back and affect the result. The experiment should be made in ventilated place.

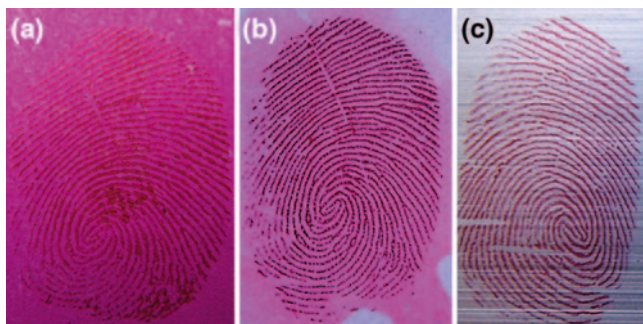
## **99.3 Results and Discussion**

After a series of dyestuff and solvent experiments, we determine the RDZ methanol solution is the best solution to develop blood fingerprints. To find its best concentration and its applicability to blood fingerprints, we made the experiments about determine the best concentration of RDZ methanol solution, the determination of lotion and rinsing procedure, Sensitivity test of RDZ solution for the different concentration blood fingerprints, different aged blood fingerprints developed by disperse scarlet methanol and the validity of the solution.

### ***99.3.1 Determine the Best Concentration of RDZ Methanol Solution***

After the early experiments we find when the concentration of the RDZ solution between 0.6 % and saturated, the visualization are same. We need to determine the lowest efficiency concentration of the solution and the range is from 0.1 to 0.6 %.

Use the above method to confect 40 ml 0.1, 0.2, 0.3, 0.4, 0.5 and 0.6 % disperse scarlet methanol solutions. Depend on the basic operation to develop fresh blood



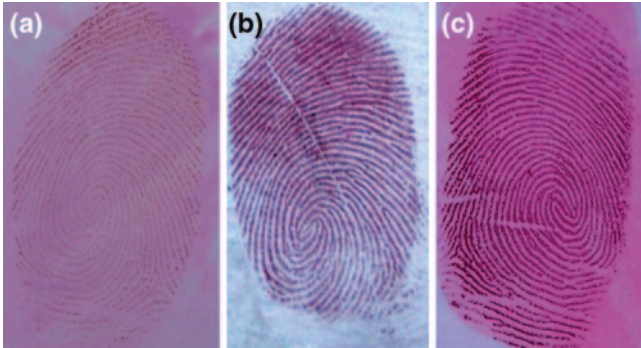
**Fig. 99.1** a The blood fingerprint on the paper developed by 0.5 % RDZ methanol solution. b The blood fingerprint on the leather developed by 0.5 % RDZ methanol solution. c The blood fingerprint on the aluminum alloy developed by 0.5 % RDZ methanol solution

fingerprints on different surfaces, The results show that when the concentration is below 0.5 %, the higher the concentration is, the better the visualization is. The lines are clear, the contrast is big and the visualization is good. There will be no obvious different when we add more disperse scarlet in it. Comparatively, this kind of solution can give very good visualizations for developing blood fingerprints on nonporous smooth surfaces such as tile, glass, aluminum alloy, PVC, green plastic, transparence plastic and semiporous smooth surface such as leather. The visualization of copy paper is worse than the above ones. And the visualizations of the dark semiporous artificial leather and rubber are not very good with little contrast. Figure 99.1 show the results.

### 99.3.2 *The Determination of Lotion and Rinsing Procedure*

Since we need to enhance the contrast of the fingerprint and background, we choose proper lotion and rinsing procedure to rinse the fingerprints. In the experiment, we choose the lotion from the common and harmless liquid such as methanol, ethanol, water and the mix of methanol and ethanol; and the rinsing procedure from a and b. rinsing procedure: procedure a, after dropping the developing solution, rinse the fingerprint then blow it to dry. Procedure b, after dropping the developing solution, Blow it to dry, then rinse it and blow to dry again.

First, develop fingerprints on tile with 0.5 % RDZ methanol solution, and rinse them with methanol, pure ethanol, water and the mix of methanol and ethanol, then dry them with blower and fixed in picture; use the same method, after developing dry them with blower, then rinse them with methanol, pure ethanol, water and the mix of methanol and ethanol, at last dry them with blower and fixed in picture. The operation is the same. From the result, we find if we use water as lotion and after developing deal it with procedure b: blow-rinse-blow, the visualizations of the blood fingerprints on tile, glass, aluminum alloy, PVC, transparence and leather are the best with good dyeing, no pervasion, clear lines, and



**Fig. 99.2** a Rinse with water, procedure b, blood fingerprint on leather. b Rinse with water, procedure b, blood fingerprint on transparency. c Rinse with methanol, procedure b, blood fingerprint

strong contrast, as well the blood fingerprint on the porous surface, copy paper. Figure 99.2 shows the results.

After a series of experiments, 0.5 % RDZ methanol solution is chosen as the best prescription, water is the best lotion and blowing-rinsing-blowing is the best rinsing procedure. But for the further determination of the practicability of the solution, we make the sensitivity test of the best prescription for the different concentration blood fingerprints; validity test of different aged blood fingerprints and period of validity test of different aged solutions to the blood fingerprints.

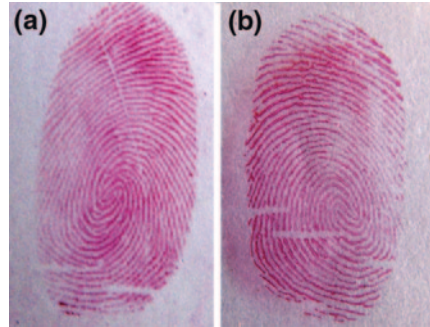
### ***99.3.3 Sensitivity Test of the RDZ Solution for the Different Concentration Blood Fingerprints***

Press down original, 50, 20, 10, 5 and 1 % blood fingerprints on the tile, glass, aluminium alloy, PVC, thick plastic, transparency plastic, leather, artificial leather, rubber and copy paper then develop them with 0.5 % RDZ methanol solution under the basic operation. The results show that the visualizations of the 5 % blood fingerprints on the smooth nonporous surfaces such as the tile, glass, aluminium alloy, PVC, thick plastic, transparency plastic and leather developed by 0.5 % RDZ methanol solution are very good, with high sensitivity, good dyeing, clear lines and strong contrast. Figure 99.3 shows the result.

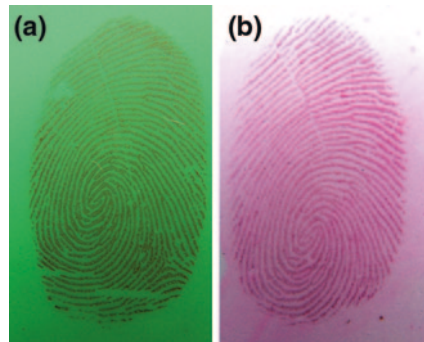
### ***99.3.4 Different Aged Blood Fingerprints Developed by RDZ Methanol***

Develop fresh, 1 day aged, 2 day aged, 5 day aged, 10 day aged, 20 day aged and 30 day aged blood fingerprints on different surface with 0.5 % RDZ methanol.

**Fig. 99.3** **a** 20 % blood fingerprint on tile developed by 0.5 % RDZ methanol. **b** 10 % blood fingerprint on tile developed by 0.5 % RDZ methanol



**Fig. 99.4** **a** 10 days aged blood fingerprint on green plastic RDZ methanol developed by 0.5 %. **b** 10 days aged blood fingerprint on leather developed by 0.5 % RDZ methanol



The results show that the time has little effect on the visualizations of the blood fingerprint developed by 0.5 % RDZ methanol. Because of the stability of the protein, the solution can develop 30 day aged fingerprint. Without decay, if we prolong the developing procedure, soak the blood deeply, we can develop aged fingerprints. Figure 99.4 shows the results.

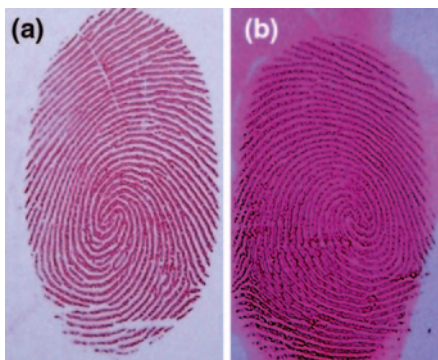
### **99.3.5 The Validity of the Solution**

Develop blood fingerprints on different surfaces with fresh, 1 day aged, 5 day aged, 10 day aged, 20 day aged and 30 day aged 0.5 % RDZ methanol solution. Figure 99.5 shows the results.

The results show that 0.5 % RDZ methanol solution can keep well for a long time in airtight condition without decay and can't affect the developed visualization.



**Fig. 99.5** **a** Blood fingerprint on tile, developed by 10 days aged 0.5 % RDZ methanol. **b** Blood fingerprint on leather, developed by 20 days aged 0.5 % RDZ methanol



## 99.4 Conclusion

The best prescription to develop blood fingerprint is 0.5 % RDZ methanol.

After the development, the best rinsing procedure is blowing-rinsing-blowing.

The visualization of the fresh and aged blood fingerprints on the smooth nonporous surfaces such as tile, glass, aluminum alloy, PVC and plastic are very good; the contrasts of the visualizations on copy paper and semiporous surface such as artificial leather and rubber are weak.

The visualizations developed by this solution of the blood fingerprint which concentration is over 5 % are very good with clear and fluent lines and strong contrast. It can develop aged fingerprints and can be kept for a long time in airtight condition.

## References

1. Yang X, Luo Y, Li J, He Y (2000) Dyestuff and organic paint, Chemical Industry Press, pp 498–499
2. Liu S, Geng Q (1994) Fingerprint, Police Officer Education Press, p 237



# Chapter 100

## Study of Fuzzy Analytic Hierarchy Process in Clinical Nursing

Mei Sun, Siyuan Tang, Yujia Ren, Fen Jiang and Binbin Ji

**Abstract** Clinical departments are critical functional components of hospitals. Their nursing quality is closely concerned with hospitals' public image. Moreover, good nursing quality is effective in helping patients to recuperate their health within shorter period. As for this, nursing quality is being attached with more and more importance by patients and hospital administration bureaus. In this chapter, analytic hierarchy process and fuzzy mathematics combined ideology in Operations Research is employed to comprehensively and particularly discuss how to evaluate clinical nursing quality with fuzzy analytic hierarchy process. On this basis, we are to analyze the obtained result, to propose particularly suggestions, and to make nursing for clinical treatment more effective.

**Keywords** Fuzzy analytic hierarchy process • Evaluation index system • Clinical nursing

### 100.1 Introduction

With the fast development of the society and the constant innovation of scientific technology, people are putting forward increasingly high expectations on hospitals' treatment and service quality. Nursing quality is an important constituent part of medical service quality provided by hospitals for patients. For this reason, to improve nursing quality has become a focal point for hospitals of difference levels [1]. Among all nursing jobs, clinical nursing is to serve patients with high liquidity, in which, a wide range of departments are involved. Therefore, it is considered to be a window for hospitals to face the public. In order to further improve nursing quality and to explore new nursing modes for clinical

---

M. Sun (✉) · S. Tang · F. Jiang · B. Ji  
Nursing College of Central South University, Changsha 410083, China  
e-mail: guoquan2011@126.com

Y. Ren · F. Jiang · B. Ji  
Xiangtan Vocational Technical College, Xiangtan 411007, China

treatment, evaluation on clinical nursing is a necessity. This will be more helpful in improving clinical nursing engagers' overall quality, so as to provide patients with better nursing service. By drawing support from statistical methods, modern computer technology and fuzzy analytic hierarchy process, the chapter is designed to offer scientific and effective basis for hospitals to objectively evaluate their nursing quality.

## 100.2 Clinical Nursing Quality Evaluation System

### 100.2.1 Clinical Work and Clinical Nursing

Clinical medicine is a branch of science to give treatment to patients on the basis of preclinical medicine. Here, patients' problems include physical, mental issues, etc.

Clinical work has the following two features [2]: Firstly, patients are high in mobility and large in number. As it covers the area from clinical diagnostics to clinical therapeutics, both the mobility and the quantity are quite considerable. Secondly, plenty of departments are involved. According to concrete treatment objective or organ system, it is comprised by many clinical subjects: internal medicine, surgical department, gynecology and obstetrics, pediatrics department, neurology department etc. [4] (Fig. 100.1).

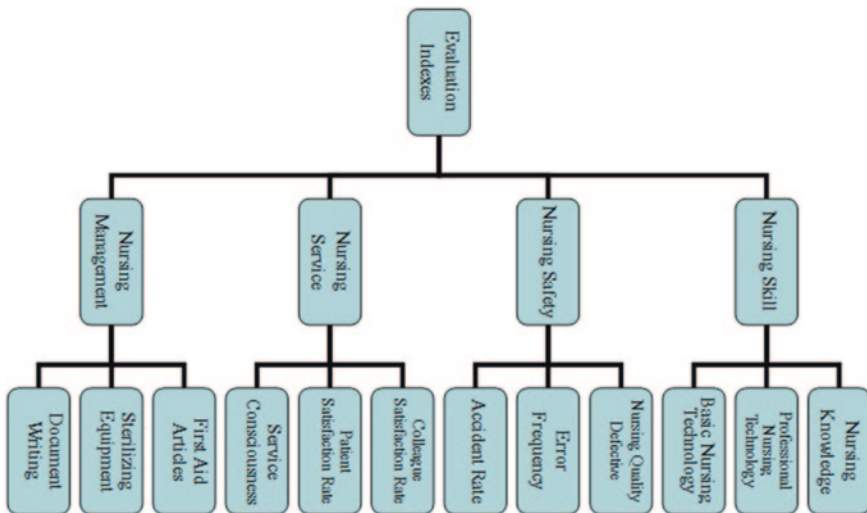


Fig. 100.1 Clinical nursing quality evaluation system

### ***100.2.2 Construction of Clinical Nursing Quality Evaluation System***

Wang Jianrong and other researchers once had constructed a nursing process quality evaluation system [3], which was comprised by four first-level indexes (i.e. nursing management, nursing service, nursing safety and nursing skill), thirteen second-level indexes and five third-level indexes. Based on this evaluation system and by integrating the features of clinical work, we recomposed this system into Clinical Nursing Quality Evaluation System, as is shown in the following diagram:

## **100.3 Fuzzy Analytic Hierarchy Process**

### ***100.3.1 Basic Theory***

Analytic hierarchy process was first put forward in the early 20th century, by the US Operations Researcher, Professor of University of Pittsburgh—Saaty. It was a hierarchy weighting analysis method, with the major ideology to divide elements related with decision-making into objective, rule, plan and other multiple hierarchies, so as to develop into multiple hierarchies with multiple indexes (rules or conditions). On this basis, hierarchies' single order and overall order can be figured out according to quantitative indexes, to be used as the basis of decision optimization [4]. Its essence is to provide complicated decision-making problems with simplified solutions, by introducing mathematical methods into quantitative-information-related thinking process. Fuzzy mathematics was first presented by the US Computer and Control Theory Expert L. A. Zadeh in 1965, which was a sort of mathematical theory and method for studying and processing fuzzy problems. Fuzzy mathematical methods include fuzzy clustering analysis, fuzzy pattern recognition, fuzzy synthetic evaluation, fuzzy planning and optimization, etc. Fuzzy mathematical methods have achieved significant positive results and economic benefits in many fields [5].

Fuzzy analytic hierarchy process refers to the analytic hierarchy process, which introduces fuzzy mathematical ideology into decision-making science, so as to construct the comprehensive evaluation model. To a large extent, this method has overcome some defects of traditional analytic hierarchy process, which positively expands its applicable range [6].

### ***100.3.2 Procedures of Fuzzy Analytic Hierarchy Process***

1. Establishment of Index System. Index weight is normally calculated via expert questionnaire, with some references as the supplement. On this basis, the index system can be established.

2. Calculation of Index Weight. The so-called index weight is to be figured out according to indexes' significance degree, on the premise that, different indexes have different influence on the overall evaluation. Traditionally, the most frequently applied expert grading method is easily affected by subjectivity. In this chapter, weight will be determined by analytic hierarchy process in Science of Design Making. As for this, experts' view and analyzers' objective judgment will be directly and effectively combined together, turning weights from qualitative variables into quantitative variables, and making the result more objective.
3. Establishment of Single Index Fuzzy Vector. Here, we unified evaluation on indexes to be satisfaction degree, i.e. making use of descriptions like Very Satisfied, Satisfied, Medium, Dissatisfied, and Very Dissatisfied to indicate all indexes. Based on experts' opinion and by drawing support from fuzzy processing method, we may figure out the fuzzy satisfaction rate.

Assuming that the evaluation set for a certain index is  $V = \{V_1, V_2 \dots V_n\}$ , in which,  $V_j$  ( $J = 1, 2 \dots n$ ) represents grades from higher to lower, described as "Very Satisfied, Satisfied, Medium, Dissatisfied, and Very Dissatisfied".

Set  $n$  as the number of effective evaluation,  $y_{ij}$  as the number of index  $i$ 's being graded as  $V_j$ , hereby, we may reach to the following equation:

$$R_j = y_{ij} \tag{100.1}$$

After normalizing the obtained results, we may get the membership degree of this index, with its fuzzy vector to be:

$$R = \{R_1, R_2 \dots R_n\} \tag{100.2}$$

4. Fuzzy Hierarchy Comprehensive Evaluation. The detailed process is shown as follows:

To figure out the lower hierarchy index set related with index  $U$ , i.e.  $U = (u_1, u_2 \dots u_n)$ ;

To establish the evaluation description set,  $V = (v_1, v_2 \dots v_m)$ ;

To implement single factor evaluation and to build fuzzy relation matrix according to single index fuzzy vector establishment method mentioned in (3);

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{1m} \\ r_{211} & r_{22} & r_{2m} \\ r_{n1} & r_{n2} & r_{nm} \end{bmatrix} \tag{100.3}$$

To work out the evaluation weight vector  $A$ ; if the weight for  $u_i$  is  $a_i$ , we therefore could reach to a fuzzy sub-set:

$$A = \{a_1, a_2, \dots, a_n\} \tag{100.4}$$

By choosing the correct operator, we may figure out the evaluation vector for  $U$ :

$$S = A \cdot R \tag{100.5}$$

Repeating the procedures upwards from bottom hierarchy until generating out the evaluation value for top hierarchy.

## 100.4 Research Process and Result

### 100.4.1 Questionnaire Survey and Quality Inspection

#### 100.4.1.1 Figuring out Index Weights via Questionnaire Survey

In order to figure out the index weight of each hierarchy corresponding to the higher hierarchy, we released questionnaire to 50 experts engaged in clinical work. The major content of the questionnaire include the significance degree of indexes in clinical nursing quality evaluation system we have established (shown in Diagram 1), as well as the improvement suggestions to the evaluation system. Among all 50 questionnaires handed out, 48 were returned. According to experts' judgment on the significance degree of indexes in the clinical nursing quality evaluation system, we then calculated the weight for each index with analytic hierarchy process in decision-making science. On this basis, all weights were normalized, so as to figure out the weight for each index.

We set the evaluation target to be A, the first hierarchy evaluation indexes from left to right to be B1, B2, B3, B4 and second hierarchy evaluation indexes separately to be C1, C2, C3... C12. Hereby, the weight result can be described as:

- A (0.338, 0.156, 0.301, 0.205)
- B1 (0.356, 0.159, 0.485)
- B2 (0.398, 0.288, 0.314)
- B3 (0.386, 0.226, 0.388)
- B4 (0.302, 0.278, 0.420)

#### 100.4.1.2 To Figure out Second Hierarchy Evaluation Indexes by Quality Inspection

In order to work our the values of C1, C2...C12, fuzzy hierarchy analysis was carried out from bottom to top, so as to further figure out evaluations on clinical nursing quality. We invited 20 experts to form a professional quality inspection team. The team was designed to inspect clinical nursing quality for 3 times, and the inspection results are shown in Table 100.1.

**Table 100.1** Clinical nursing quality inspection result

Index	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Very good	12	19	17	14	11	20	24	16	31	22	15	19
Good	23	26	29	35	10	32	28	38	28	29	38	29
Medium	15	11	9	7	33	6	4	3	1	7	5	10
Bad	7	2	3	4	6	2	3	3	0	2	2	2
Very bad	3	2	2	0	0	0	1	0	0	0	0	0

### 100.4.2 Calculation of Evaluation Results

Based on the data acquired via the aforementioned analytic hierarchy process and quality inspection method, we may introduce multi-hierarchy fuzzy comprehensive evaluation method into the calculation.

1. Firstly, we are to calculate the second hierarchy indexes, with nursing management as the example: In accordance with data in Table 100.1, we are able to get the corresponding index weight matrix:

$$R_{B1} = \begin{bmatrix} 0.200 & 0.383 & 0.250 & 0.117 & 0.095 \\ 0.317 & 0.434 & 0.183 & 0.333 & 0.333 \\ 0.283 & 0.483 & 0.151 & 0.050 & 0.333 \end{bmatrix} \quad (100.6)$$

Furthermore, as  $B1 = (0.356, 0.159, 0.485)$ , fuzzy evaluation vector  $B = A \cdot R$ , hereby:

$$S1 = (0.356, 0.159, 0.485) \cdot \begin{bmatrix} 0.200 & 0.383 & 0.250 & 0.117 & 0.095 \\ 0.317 & 0.434 & 0.183 & 0.333 & 0.333 \\ 0.283 & 0.483 & 0.151 & 0.050 & 0.333 \end{bmatrix} \quad (100.7)$$

$$= (0.2589 \quad 0.4403 \quad 0.1913 \quad 0.1188 \quad 0.2482)$$

Thus, the evaluation value shall be “Good”.

2. When calculating according to the above method, we may reach to the following results:

$$S2 = (0.2439 \quad 0.3403 \quad 0.1145 \quad 0.2388 \quad 0.1934), \text{ Good}$$

$$S3 = (0.1989 \quad 0.5403 \quad 0.1313 \quad 0.0988 \quad 0.0882), \text{ Good}$$

$$S4 = (0.2009 \quad 0.2503 \quad 0.3305 \quad 0.2232 \quad 0.1562), \text{ Medium}$$

$$S = (0.1989 \quad 0.4503 \quad 0.1063 \quad 0.1988 \quad 0.0682), \text{ Good}$$

### 100.5 Conclusion

According to the afore-listed calculation results and based on the principle of maximal subordinate degree, we may come to the following conclusion:

1. In general, clinical nursing quality of this department is evaluated to be “Good” and could still be improved;
2. The evaluation for B4 is “Medium”, and Nursing Skill needs to be further improved. As for this, nursing engagers can be trained in aspects of basic nursing technology, professional nursing technology and nursing knowledge system, etc. The aim is to improve clinical nursing quality in a more customized way.

**Acknowledgments** This work was supported by grants CX2010B069 from the Hunan province Doctoral innovation subject.

## References

1. Mahler C, Ammenwerth E (2007) Effects of a computer-based nursing documentation system on the quality of nursing documentation. *J Med Syst* 31(4):274–282
2. Liechty D (2000) Touching mortality, touching strength: clinical work with dying patients. *J Relig Health* 39(3):247–260
3. Jiangrong W, Liming Z, Yanlan M et al (2005) Hospital comprehensive assessment indexes of nursing process quality. *Chinese J Hosp Adm* 21(10):684–686
4. Mardle S, Pascoe S, Herrero I (2004) Management objective importance in fisheries: an evaluation using the analytic hierarchy process (AHP). *Environ Manage* 33(1):1–11
5. Liu C-H, Huang J-C (2012) The study of fuzzy theory applied to cool guys looking for beautiful girl. *JCIT* 7(5):81–89
6. Wang S, Li S, Zhou J, Li Q, Kang L (2012) Reliability allocation for CNC machine based on improved fuzzy analytic hierarchy process. *AISS* 4(1):320–327

# Chapter 101

## Study on Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System

Yun Lu and Zhenzi Xu

**Abstract** Promoting the establishment of the social security fund revenue and expenditure risk warning system is helpful for improving the risk management of the fund and transforming the risk management from post-discovering risk and post-reducing loss to prior-warning and prior-resolving risk. In this paper, by taking the urban labors basic medical insurances fund revenue and expenditure risk warning as a study point and referring to domestic and foreign literatures, the necessity, intension, principle, and warning indexes selection for the establishment of risk early warning system are analyzed and studied. On such a basis, a certain number of indexes are selected for preliminarily constructing a risk early warning system, and then risk early warning system solutions are proposed.

**Keywords** Basic medical insurances fund • Revenue and expenditure risk • Risk early warning system

### 101.1 Introduction

The stable operation of social security fund can't be realized without mature risk early warning system as support. In this paper, the fund revenue and expenditure risk early warning system for the basic medical insurance of urban labors is only explored and studied. In the 1980s, a medical insurance risk early warning system was established in Germany; a medical insurance commission model was established in Australia. In addition, local government medical insurance model and the budget model of the ministry of health were designed by the World Health Organization. In recent years, there is also a certain development in this aspect in China, such as the research model of unemployment insurance fund revenue and expenditure monitoring established by the institute of social security of the Ministry of Human Resource and Social Security of the People's Republic of China, and

---

Y. Lu (✉) · Z. Xu

Department of Insurances, School of Public Health, Southeast University, Nanjing 210096, China  
e-mail: yun345lu@126.com



Nanjing medical insurances fund revenue and expenditure risk early monitoring and warning system. So far, many studies have focused on the single factor qualitative analysis of health care or disease cost. However, quantitative analyses on the factors influencing fund revenue and expenditure risks are insufficient, and have affected the systemic studies and software development to some extent [1, 2].

### 101.2 Necessity for Establishing the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors

Since 2001, the basic medical insurance system of urban labors has been promoted all over the country; its coverage and fund scale are unceasingly expanded, and also the fund runs stably [3]. However, in recent years, because of the problems such as hiding social insurance base, unreasonable rise of hospitalization costs and the acceleration of an aging population, the balance of medical insurance fund revenue and expenditure has been seriously threaten, as shown in Fig. 101.1.

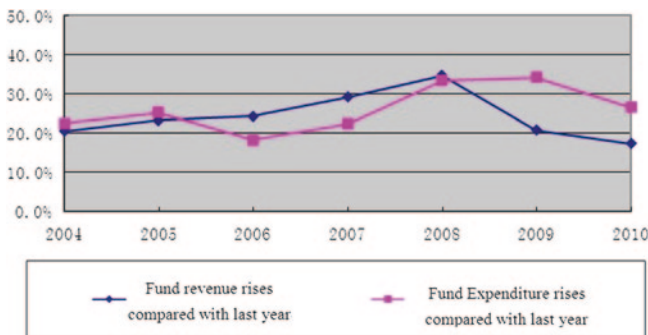
Data source: Statistical Bulletin on the Development of Human Resources and Social Security Undertakings 2004–2010.

On 28–29 Apr 2012, the sixth national population census data was released by the statistical bureau of China, as shown in Fig. 101.2: the speed of an aging population is growing, and also the proportion of young children is rapidly reduced [4].

Data source: the sixth national population census data released by the Ministry of Health and the Statistical Bureau of China.

According to predict, the population of over 60 years old will reach 200 million in 2014, and 300 million in 2026 [4].

In 2009, the Ministry of Human Resource and Social Security and the Ministry of Finance jointly issued the Guidance Suggestions about Further Strengthening



**Fig. 101.1** Basic medical insurance fund revenue and expenditure in China's Urban Areas 2004–2010

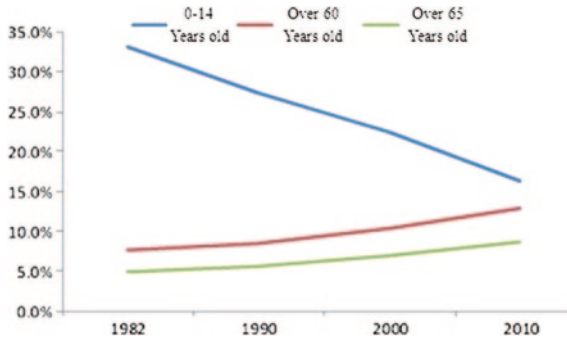


Fig. 101.2 Acceleration of China's aging population

the Management of Basic Medical Insurance Fund, and its article 7 shows that the basic medical insurance fund operation analysis and risk early warning system shall be established.

### 101.3 Intension of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors

Social medical insurance fund risk early warning is to forecast and analyze the risks of medical insurance fund possible appearing in the normal operation and provide alarm and suggestions for management institutions of basic medical insurance fund. The basic medical insurance fund revenue and expenditure risk early warning system is based on the medical insurance fund operation data, and the specific flow is as shown in Fig. 101.3.

First, the data needed by warning information module is acquired through the information management system of medical insurance agencies. Next, according to established risk indexes evaluation system and risk identification module, a judgment on the warning degree of future fund risk can be made. Finally, according to acquired warning degree, relevant strategies and suggestions are proposed. In this chapter, the balance of the medical insurance fund revenue and expenditure in a narrow sense is emphatically studied.

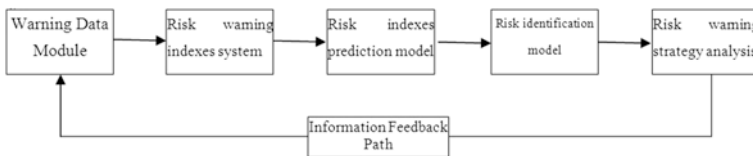


Fig. 101.3 Flow of the basic medical insurance fund revenue and expenditure risk early warning system

## **101.4 Principles of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System**

The establishment of the basic medical insurance fund revenue and expenditure risk early warning system should follow five principles: (1) prevention; (2) feasibility; (3) universality; (4) dynamic guide; (5) integration.

## **101.5 Contents of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors**

The establishment of the fund revenue and expenditure risk early warning system includes two aspects: (1) the risk warning indexes should be determined; (2) the basic medical insurance fund revenue and expenditure risk early warning system of urban labors is established, as shown in Fig. 101.4.

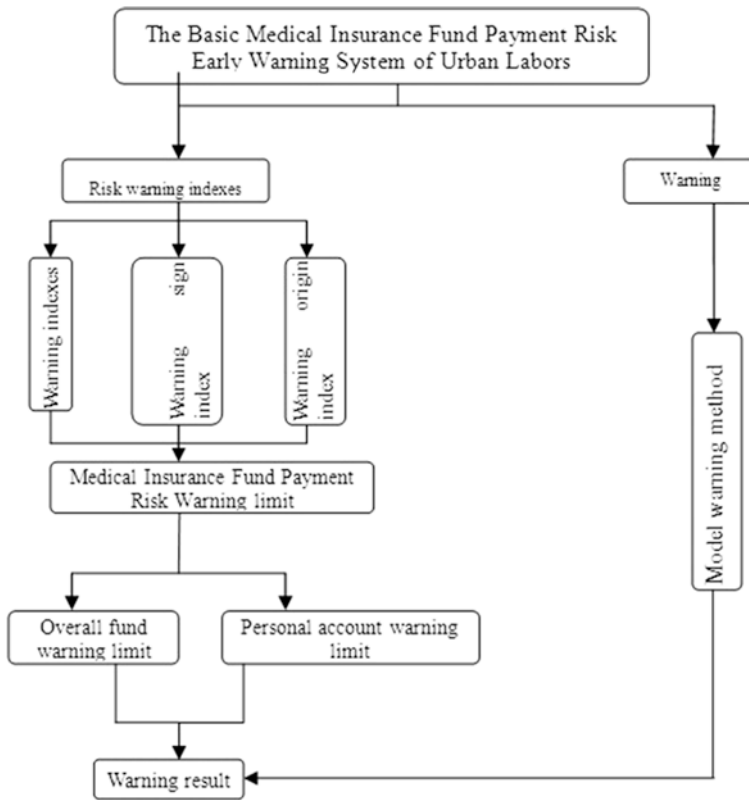
### ***101.5.1 Establishment of the Indexes of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors***

#### **101.5.1.1 Selection Principle of the Indexes**

The selection of the indexes should follow five principles: (1) representativeness; (2) sensitivity; (3) comprehensiveness; (4) stability; (5) comparability [5].

#### **101.5.1.2 Specific Contents of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors**

Indexes of basic medical insurance fund revenue and expenditure risk early warning system are specifically as follows: (1) overall fund warning indexes are the number of months the accumulative balance of the overall fund can pay and the number of months the current-year overall fund accumulative balance can pay; (2) personal account warning index is the proportion of the personal accounts incurring a deficit in the total urban labors with basic medical insurance.



**Fig. 101.4** The basic medical insurance fund revenue and expenditure risk early warning system of Urban Labors

### ***101.5.2 Establishment of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors***

#### **101.5.2.1 Main Contents of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors**

A risk early warning system generally includes defining warning, seeking warning origin, analyzing warning signs and forecasting warning degree. First, defining warning is the basic contents and premise of risk warning [6, 7]. Second, seeking warning origin is the starting point and foundation of the warning process. Third, analyzing warning signs is the key of the warning process [6]. Fourth, risk warning forecast and non-risk warning forecast need to be differentiated in warning, and can be quantitatively described and processed according to two levels. Small intervals of different natures should be divided, namely warning limit. Warning

**Table 101.1** Classification of warning limit (Warning Index)

Serious warning	High warning	Middle warning	Low warning	No-warning
R <sub>4</sub>	R <sub>3</sub>	R <sub>2</sub>	R <sub>1</sub>	R <sub>0</sub>
I	I	I	I	I
R <sub>4(i)</sub>	R <sub>3(i)</sub>	R <sub>2(i)</sub>	R <sub>1(i)</sub>	R <sub>0(i)</sub>
$w \leq i < v$	$v \leq i < u$	$u \leq i < s$	$s \leq i < a$	$a \leq i < b$
w v u s a b				

limit can be expressed with five intervals: No-warning limit (R<sub>0</sub>), low warning limit (R<sub>1</sub>), medium warning limit (R<sub>2</sub>), and high warning limit (R<sub>3</sub>), and serious warning limit (R<sub>4</sub>). After all warning limits and areas are determined, the actual value of warning index as well as its changing interval can be observed for monitoring the development of warning degree and condition (see Table 101.1).

**101.5.2.2 Warning Description of the Basic Medical Insurance Fund Revenue and Expenditure Risk Early Warning System of Urban Labors**

The basic medical insurance fund revenue and expenditure risk early warning is an index reflecting fund financial status, and can be classified into recent warning, medium-term warning, and short-term warning according to time slot. The overall-plan and personal-account combination model is applied in the basic medical insurance fund revenue and expenditure risk early warning system of China’s urban labors. Overall fund is the key of medical insurance fund management. Also, because the principle of “the balance of financial revenue and expenditure with a small surplus” is applied in fund management of China, the overall fund revenue and expenditure risk management is more important.

**101.5.2.3 Description of Warning Degree and Limit of the Warning System**

Warning degree is usually expressed with no warning, low warning, medium warning, high warning and serious warning. In 2009, the Ministry of Human Resource and Social Security and the Ministry of Finance jointly issued the Guidance Suggestions about Further Strengthening the Management of Basic Medical Insurance Fund, and it shows “in addition to the one-time prepayment of basic medical insurance premiums, the accumulative balance of the basic medical insurance overall fund for urban labors in overall-planned area should be controlled at an average payment level of 6–9 months in principle. The overall dun payment risk warning in the current year can be classified into three types (low warning, medium warning and serious warning), which are respectively corresponding to “current-year overall fund revenue is larger than expenditure”, “the fund revenue and expenditure

are basically balanced”, and “the fund revenue is higher than expenditure”. Personal account fund revenue and expenditure risk warning can be classified into medium warning, high warning and serious warning, which are respectively corresponding to “personal account fund revenue and expenditure are basically balanced”, “a small number of personal accounts incurring a deficit”, and “a large number of personal accounts incurring a deficit”. Overall fund warning indexes and limits, overall plan, and personal account warning indexes and limits are shown Table 101.2.

**Table 101.2** The basic medical insurance fund revenue and expenditure risk warning indexes and limits

Warning indexes	Warning limit type	Warning limit scope		Meaning
		Lower limit	Upper limit	
The number of months the current-year overall fund accumulative balance can pay for basic medical expenses	R <sub>0</sub>	1	No	Number of months the current-year overall fund pays basic medical expenses >1
	R <sub>2</sub>	0	1	Number of months the current-year overall fund pays basic medical expenses <1
	R <sub>4</sub>	No	0	Current-year overall fund revenue > expenditure
The number of months the accumulative balance of the overall fund can pay for basic medical expenses	R <sub>0</sub>	15	No	Number of months the accumulative balance of the overall fund pays basic medical expenses = 15 (excessive surplus)
	R <sub>1</sub>	9	15	9 months ≤ Number of months the accumulative balance of the overall fund pays basic medical expenses <15 months
	R <sub>2</sub>	6	9	6 months ≤ Number of months the accumulative balance of the overall fund pays basic medical expenses <9 months (reasonable)
	R <sub>3</sub>	3	6	3 months ≤ Number of months the accumulative balance of the overall fund pays basic medical expenses <6 months
	R <sub>4</sub>	No	3	Number of months the accumulative balance of the overall fund pays pension <3 months of personal account deficit ratio

(continued)

**Table 101.2** (continued)

Warning indexes	Warning limit type	Warning limit scope	Meaning
		Lower limit Upper limit	
Individual account deficit ratio $R_2$		0 5%	Personal accounts incurring no deficit
	$R_3$	5% 10%	A small number of personal accounts incurring a deficit
	$R_4$	10% 1	A large number of personal accounts incurring a deficit

## 101.6 Conclusion

In this chapter, a medical insurance fund risk warning indexes system is established. Certainly, this chapter is with some shortcomings: indexes data should be processed with more scientific mathematical and economic models, and also the medical insurance fund revenue and expenditure risk early warning system model should be further verified and modified through the development of computer software system, etc. These are also the direction of the study in this chapter in the future.

**Acknowledgments** The State Natural Sciences Foundation Youth Project—Research on the Social Medical Insurance Fund Operation Balance Mechanism Based On the Chronic Health Educational Experiment of Insured Labors (No. 71103033).

## References

1. Meng Q (2010) Study on the risk warning and countermeasures of the basic medical insurance fund for urban labors in Zhenjiang Town, Master's Degree Thesis of Jiangsu University, Jiangsu, China, pp 234–239
2. Zhong S (2006) Exploratory study on the risk warning system of the basic medical insurance overall fund for urban labors, Master's Degree Thesis of Jiangsu University, Jiangsu, China, pp 186–188
3. Dai Z (2005) Institute of Minsheng securities. Supporting medical needs of an aging population—analysis on the sixth population census data. *Pharmaceuticals Ind* 05(3):56–60
4. Zhou C (2004) Establishment of the risk warning system of securities companies. *Prod Res* 12(06):78–85
5. Ping W (2006) Study on China's social security crisis warning from the perspective of Endogenous alarm origin and exogenous alarm origins. *China Soft Sci* 26(05):134–138
6. Ping W (2006) Social security crisis warning necessary to get rid of five errors. *Chinese Public Adm* 16(07):89–94
7. Lei X, Li Q (2007) Study on social insurance fund income and expense forecasting and warning system. *Comput Era* 18(04):27–34

# Chapter 102

## Anti-Arthritic Effects of Chondroitin Sulfate and Type II Collagen in Collagen-Induced Arthritis Mice

Anjun Liu, Hui Zhang, Ying Chen, Hongshuo Chen,  
Huihui Liu and Xiaodan Guo

**Abstract** The anti-arthritic effects of the Chondroitin Sulfate and Type II Collagen in Kunming mice with type II collagen-induced arthritis (CIA) were investigated in the present study. 50 mice were randomly divided into 5 groups: control group, model group, chondroitin sulfate (CS) group, type II collagen (CII) group and mixed (MX) group. CIA mice model was set up by injecting with 100  $\mu\text{g}$  of CII emulsified in ICFA at the right rear foot after oral administration of Chondroitin Sulfate and Type II Collagen for 3 weeks. Arthritis index was analyzed. We detected the serum levels of interleukin-1 $\beta$  (IL-1 $\beta$ ), tumor necrosis factor (TNF- $\alpha$ ) and gelatinizes MMP-9. Splenic lymphocyte proliferation, natural killer (NK) cell activity and peritoneal macrophage phagocytic activity were determined. Results indicated that pre-treatment of chondroitin sulfate and type II collagen could effectively attenuate the severity of rheumatoid arthritis.

**Keywords** Chondroitin sulfate • Type II collagen • Mice • Type II collagen-induced arthritis

### 102.1 Introduction

Rheumatoid arthritis (RA) is an autoimmune disease characterized by these quest ration of various leukocyte subpopulations within both the developing pan-nus and synovial space. Although this disease has a worldwide distribution, its

---

A. Liu (✉) · H. Zhang · Y. Chen · H. Liu · X. Guo  
Tianjin Key Laboratory of Food Nutrition and Safety, College of Food Engineering and Biotechnology, Tianjin University of Science and Technology, 300457 Tianjin, China  
e-mail: aijunliu23ls@126.com  
H. Chen  
College of Electrical Engineering, Hebei Union University, 063009 Tangshan, China



pathogenesis is not clearly understood [1, 2]. CIA in mice has been proposed as a useful animal model of chronic inflammatory diseases that has a number of characteristics in common with human rheumatoid arthritis [3, 4]. Moreover, the recruitment and activation of neutrophils macrophages and lymphocytes into joint tissues and the formation of the pannus are hallmarks of the pathogens are of both CIA and human RA. The development of CIA is dependent on a T cell-mediated activation of autoreactive B cells [5, 6]. The major role of B cells is production of arthritogenic anti-CII antibodies, which is clearly shown by the fact that antibodies reactive with CII can bind to cartilage and induce arthritis [7]. In the present study, we evaluated effectiveness of CS and CII on immune responses to CII in the murine CIA [8]. We analyzed the serum levels of interleukin-1 $\beta$  (IL-1 $\beta$ ), tumor necrosis factor (TNF- $\alpha$ ) and gelatinases MMP-9. Furthermore, to clarify the immunomodulatory effects of CS and CII on CIA, proliferation of splenic lymphocytes, NK cell activity and peritoneal macrophage phagocytic activity were analyzed [9, 10].

## **102.2 Materials and Methods**

### ***102.2.1 Animals***

50 female mouse of Kunming (9 weeks; Harlan Nossan, Italy) were used for these studies and provided by PLA Military Academy of Medical Sciences Laboratory Animal Center.

#### **102.2.1.1 Induction of Type II Collagen-Induced Arthritis**

Bovine CII was dissolved in 0.01 M acetic acid at a concentration of 2 mg/ml by stirring overnight at 4 °C Incomplete Freund's adjuvant (ICFA) was prepared. Before injection, CII was emulsified with an equal volume of ICFA. Mouse was injected intradermally at the toe of the right leg with 100  $\mu$ l of the emulsion containing 100  $\mu$ g of CII [11].

#### **102.2.1.2 Clinical Assessment of CIA**

Compared with normal mice, increased 0.1–0.2 mm mild swelling, increased 0.3–0.4 mm moderate swelling, severe swelling by more than 0.5 mm: 0 = no signs of arthritis; 1 = swelling and/or redness of the paw or one digit; 2 = two joints involved; 3 = more than two joints involved; and 4 = severe arthritis of the entire paw and digits.

### 102.2.1.3 The Determination of Related Indexes in Mice Serum

The MMP-9, TNF- $\alpha$  and IL-1 $\beta$  levels were evaluated in the serum from CIA. The assay was carried out using colorimetric commercial ELISA kit.

### 102.2.1.4 Splenic Lymphocyte Proliferation Assay

Splenic lymphocyte preparation: These mixtures were incubated at 37 °C in a humidified atmosphere with 5 % CO<sub>2</sub>. After 44 h cultures, centrifuged at 1,000 rpm for 5 min and abandoned supernatant fluid. Then 20  $\mu$ l MTT was added to each well and continued to cultivate at 37 °C for 4 h, centrifuged and abandoned supernatant fluid [12]. 150  $\mu$ l DMSO was added to each well to dissolve Formosan particles and stayed for 20 min after fully oscillation. The absorbance at 570 nm was measured with an ELISA reader. Calculated stimulate index (SI) and judged lymphocyte proliferation degree. B lymphocyte transformation experiment: method with T lymphocyte transformation just changed the ConA for LPS of the end concentration 10  $\mu$ g/ml [13, 14].

### 102.2.1.5 NK Killer Cell Activity Assay

100  $\mu$ l of H22 cell was dispensed into each well of 96-well flat-bottomed micro culture plates. Effector cell 100  $\mu$ l each well. Control well added equivalent effector cells or target cells [15]. Adjusted total volume to 200  $\mu$ l with culture solution 10  $\mu$ l MTT (0.5 g/L) was added to each hole, Then these mixtures were incubated at 37 °C in a humidified atmosphere with 5 % CO<sub>2</sub>, After 4 h culture, centrifuged at 1,000 rpm for 5 min and abandoned supernatant fluid. 150  $\mu$ l DMSO was added to each hole to dissolve the reduction product of MTT and micro oscillator for 5 min. The absorbance at 570 nm was measured with an ELISA reader.

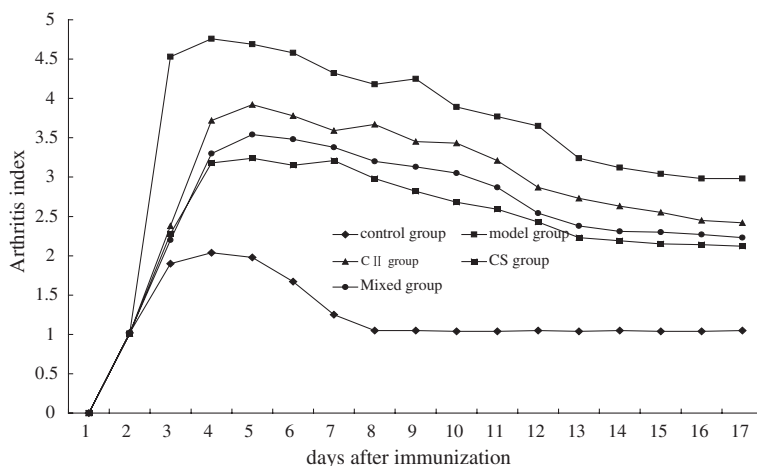
### 102.2.1.6 Statistical Analysis

Statistical comparisons were performed by using the Student's t test or Schaffer's method after an analysis of variances. All values are expressed as mean  $\pm$  S.D.

## 102.3 Results

### 102.3.1 *The Influence of Treatments on the Development of Arthritis*

Figure 102.1 shows the change trend of the joints of right rear foot. Control group has the modest changes, 2–3 days after the injection of physiological saline, the joint swelled up a slight, and returned to normal soon after.



**Fig. 102.1** The influence of treatments on the development of arthritis

**Table 102.1** The content of MMP-9, TNF- $\alpha$ , IL-1 $\beta$  in serum

Group	MMP-9 (ng/ml)	IL-1 $\beta$ (pg/ml)	TNF- $\alpha$ (pg/ml)
Control group	27.54 $\pm$ 4.33	57.08 $\pm$ 2.48	2.76 $\pm$ 0.07
Model group	43.16 $\pm$ 4.77	128.34 $\pm$ 6.59	4.67 $\pm$ 0.08
CS group	34.61 $\pm$ 2.92	106.92 $\pm$ 7.08	2.94 $\pm$ 0.03
CIIgroup	41.03 $\pm$ 2.68	112.35 $\pm$ 8.26	3.11 $\pm$ 0.09
Mixed group	36.41 $\pm$ 6.45	134.31 $\pm$ 7.26	3.03 $\pm$ 0.04

The inflammation of the joints in mice of model group achieved maximum on day 3, began to have a lower trends on day 4 and reached a plateau 15 days after immunization. The inflammation of the joints in mice of CS group achieve maximum on day 4, began to have a lower trends on day 7 and reached a plateau 14 days after immunization, on day 17 days basically returned to normal. CII group achieve maximum on day 3 and began to have a lower trends on day 12, reached a plateau on day 17. Mice in mixed group reached maximum on day 4, began to have a lower trend on day 9 and 14 days later reached a plateau (Table 102.1).

### 102.3.2 The Determination of Related Indexes in Mice Serum

Compared with control Group, TNF- $\alpha$  had a significantly higher ( $p < 0.01$ ) in model group of mice, CS groups had significantly reduced ( $p < 0.01$ ), CII and Mixed group had obviously reduced ( $p < 0.05$ ). The MMP-9 level of the

**Table 102.2** Result of splenic lymphocyte proliferation assay

Group	T cells stimulate index	B cells stimulate index
Control group	17.18 ± 0.62	26.52 ± 0.67
Model group	11.07 ± 0.78	14.75 ± 0.63
CS group	14.21 ± 0.63	23.29 ± 0.55
CIIgroup	13.02 ± 0.58	26.17 ± 0.69
Mixed group	12.07 ± 0.72	24.13 ± 0.70

serum from the model groups by gavage was significantly higher than that of the control groups. The MMP-9 levels of the serum from the CS groups and the mixed groups were significantly lower than that of the model groups. CII groups were also lower than that of model groups. The IL-1 $\beta$  level of model groups was significantly higher than that of the control groups. Both the IL-1 $\beta$  level of the CS groups and CII groups were lower than that of the model group (Table 102.2).

### 102.3.3 Splenic Lymphocyte Proliferation

Mice T cells and B cells stimulate index are both changed. The T cells stimulate index and B cells stimulate index of the model groups were significantly lower than that of the control groups. The T cells stimulate index and B cells stimulate index of the other groups were higher than that of the control groups, and the CS groups was the most obvious.

### 102.3.4 NK Killer Cell Activity

The damage percentage of NK cells in the splenocytes from the control mice was 57.38 %, whereas those of mice from the model groups were 38.11 %. The damage percentage from the CS groups, CII and Mixed group was significantly different from those of the model groups. They were 47.68, 43.49, and 45.13 % (Table 102.3).

**Table 102.3** Result of NK cells activity assay

Group	Control group	Model group	CS group	CII group	Mixed group
Damage percentage (%)	57.38 ± 0.82	38.11 ± 0.74	47.68 ± 0.75	43.49 ± 0.48	45.13 ± 0.55

## 102.4 Discussion

In this experiment, we observed that the right foot appeared red-swelling and hot the day after induced by collagen. We see that through oral administration chondroitin sulfate, type II collagen can better relieve the acute inflammation; however, the mechanisms by which CS and CII modify the clinical status of RA are not well understood. There is general consensus that CD4 T cells act as initiators of RA, by migrating to the affected joints, recognizing peptides derived from processed antigens, and releasing several types of cytokines. Such cytokines, in turn, enhance the function of other cells, especially macrophages to produce pro-inflammatory cytokines including IL-1 $\beta$  and TNF- $\alpha$ . MMP-9 is called gelatinases and is an important ingredient of articular cartilage. Through injected intradermally with 100  $\mu$ g of CII emulsified in ICFA at the foot toe can make the MMP-9 level increased and articular cartilage damaged to some extent. CS and CII can improve stimulate index of T cells and B cells to different degrees in the splenic lymphocytes. In the experiment, the cytotoxic activity of NK cells improved obviously, explaining CS on some extent could improve the mice immunity to prevent the occurrence of arthritis. We can measure the drug to macrophage immune response, and the role of the influence of the body's immune ability [16]. Taken together, results of the present study showed that CS and CII have significant roles in preventing CIA, which might be related to their antioxidant and immunomodulatory effects. CS and CII could be attractive candidates for the prevention of RA.

## References

1. Bourgeois P, Chales G, Dehais J, Delcambre B, Kuntz JL, Rozenberg S (1988) Osteoarthr Cartil 6:25–30
2. Beren J, Hill SL, Diener-West M, Rose NR (2001) Exp Biol Med 226:144–151
3. Ishizeki K, Hiraki Y, Kubo M, Nawa T (1997) Int J Dev Biol 41:83–89
4. Conte A, Volpi N, Palmieri L, Bahous I, Ronca G (1995) Arzneimittel Forsch 45:918–925
5. Thompson HS, Staines NA (1986) Suppression of collagen-induced arthritis with pregastrically or intravenously administered type II collagen. Agents Actions 19:318–319
6. Myers LK, Brand DD, Ye XJ, Cremer MA, Rosloniec EF, Bodo M, Myllyharju J, Helaakoski T, Nokelainen M, Pihlajaniemi T et al (1998) Characterizati of recombinant typeII collagen: arthritogenicity and tolerogenicity in DBA/1 mice. Immunology 95:631–639
7. HarrisJr ED (1990) Rheumatoid arthritis: pathophysiology and implication for therapy 322:12–77
8. Stuart JM, Townes AS, Kang AH (1984) Collage autoimmune arthritis. Annu Rev Immunol 1:21–99
9. Pan M, Kang I, Craft J, Yin Z (2004) Resistance to development of collagen-induced arthritis in C57BL/6 mice is due to a defect in secondary, but not in primary, immune response. J Clin Immunol 124:481–491
10. Holmdahl M, Vestberg M, Holmdahl R (2002) Primed B cells present type-II collagen to T cells. Scand J Immunol 55:382–389
11. Nandakumar KS, Backlund J, Vestberg M, Holmdahl R (2004) Collagen type II (CII) specific antibodies induce arthritis in the absence of T or B cells but the arthritis progression is enhanced by CII-reactive T cells. Arthritis Res Ther 6:544–550

12. Nandakumar KS, Holmdahl R (2005) Efficient promotion of collagen antibody using four monoclonal antibodies specific for the major epitopes recognized in both collagen induced arthritis and rheumatoid arthritis. *J Immunol Methods* 304:126–136
13. Asano K, Yu Y, Kasahara T, Hisamitsu T (1997) Inhibition of murine chronic graft-versus-host disease by the chloroform extract of *Tripterygium wilfordii* Hook f. *Transplant Immunol* 5:315–319
14. Firestein GS, Zvaifler NJ (1990) How important is T cells in chronic rheumatoid synovitis? *Arthritis Rheumatol* 33:768–773
15. Gattorno M, Facchetti P, Ghiotto F, Vignola S, Buoncompagni A, Prigione I, Picco P (1997) Synovial fluid T cell clones from oligo articular juvenile arthritis patients display a prevalent Th1/Th0-type pattern of cytokine secretion irrespective immune phenotype. *Clin Exp Immunol* 109:4–11
16. Griffiths MM, DeWitt CW (1984) Genetic control of collagen-induced arthritis in rats: the immune response to type II collagen among susceptible and resistance strains and evidence for multiple gene control. *J Immunol* 132:2830–2836

# Chapter 103

## Different Ozone Processing Conditions on Grapes Storage Quality

Jie Wu, Jing Xu and Fei Zhu

**Abstract** Studied on the grapes ozone treatment effect of storage, to determine the quality in grapes in fresh-keeping ozone water treatment concentration and storage temperature. Choose different ozone concentration (0.5, 1.0, 1.5 mg/L) and different storage temperature (0, 5, 20 °C). Examined the grape polyphenols (PPO) of the enzyme activity, soluble sugar, Vc, soluble solids (SSC) and the titration acid (TA) content changed. Research showed that 1.0 mg/L ozone water concentration and 0 °C storage temperatures for optimal collocation.

**Keywords** Ozone water • Storage • Quality

### 103.1 Introduction

Grapes are a plant that is planted the earliest in the world. It has the widest distribution in the world. During the storage process, it is easy to have such phenomena as decay, degranulation, and dewatering and so on. The storage and process of the grapes has played an important role to satisfy the requirements of the market [1].

Ozone, which is also called strong oxygen, is equipped with a kind of “fresh” smelt for a small amount. Ozone is a kind of strong oxidant, disinfectant and catalyst. At the beginning of this century, France applied ozone to deal with the drinking water in order to get sterilization. Since the application in France, its application effect in sterilization has become more and more popular. In the aspect of food sterilization, it is first used in the storage of frozen port in

---

J. Wu (✉) · F. Zhu

The Department of Biology and Food Engineering, Bengbu College, Bengbu 233030, China  
e-mail: wujie@cssci.info

J. Xu

The Department of Tourism, Bengbu Institute of Business and Technology, Bengbu 233000, China

Cologne City in France in the year 1909 [2]. It has three major effects in terms of food: the first is the sterilization and disinfection; the second is the purification and odor removal; the third is the decomposition of metabolic products of fruits and vegetables so as to restrain ripening. The ozone has played the effect of fresh-keeping, which is called preservation. In order to further expand the application fields, it studies on the storage and process effect of ozone to grapes. In addition, it aims to determine the best conditions to apply ozone water in the storage and process of grapes. In this way, it acquires a relatively good storage and process result.

## **103.2 Materials and Methods**

### ***103.2.1 Materials***

The grape is the fresh Kyoho produced in Bangbu in Anhui Province. The selection of the grapes is strict. It should select standardized grapes. The grape fruits should be even and consistent. There should not be any damage and diseases and insect pests. The grapes should be pre-cooled for eight hours under the normal temperature. It should select grape fruits of eighty percent mature and no mechanical damages.

### ***103.2.2 Instruments and Equipment***

PEM-002 Ozone generation machine (ozone generation amount is 160 mg/h, Wuhan kangQiao Environment Equipment Corporation Limited).

Cool store for each  
Three temperature controlling refrigerator  
12.085 L Retention tanks.

## **103.3 Experimental Methods**

### ***103.3.1 Experimental Processing Methods***

Place respectively four storage boxes under 0, 5 and 20 °C the the cool store. When the grapes are collected, place the fruits under each temperature in their own cool store to do pre-cooling for eight hours. Apply the following ozone process methods:



Comparison, non-ozone process;

Process 1, 15 min continuous ozone process (ozone water concentration is 0.5 mg/L);

Process 2, 30 min continuous ozone process (ozone water concentration is 1.0 mg/L);

Process 3, 45 min continuous ozone process (ozone water concentration is 1.5 mg/L).

### ***103.3.2 Experimental Index and Measurement Methods***

#### **103.3.2.1 Measurement of Ozone Water Concentration**

Add 20 ml 20 % Ultraviolet spectrophotometer into the 500 ml beaker flask. Record the total amount of hypo solution [3]. Calculate with the following formula at last:

Ozone water concentration  $N = 24 \cdot M \cdot V/W$  (mg/L)

M: Molar concentration of hypo solution;

V: ml milliliter of consuming hypo solution;

W: The amount of sample for ozone water;

Note: when M is 0.005 mol/L, W is 0.2 L, the formula can be simplified as:

$$N = 0.6 V \text{ (mg/L)}.$$

#### **103.3.2.2 Extraction of Polyphenol Oxidase and Its Activity**

##### **Determination: Use Colorimetric Method**

Preparation of extracts. Take 20 g peeling fresh and add 1 g PVPP into 20 mL 0.2 mol/L phosphate buffer (pH = 6.4). Centrifuge 30 min with 4 °C refrigerated centrifuge 13,000 × g, take supernatant and measure and the activity of enzyme.

Polyphenol Oxidase (PPO) activity measurement. Add 3 mL 0.5 mol/L pyrocatechol solution (compound of 0.2 mol/L pH = 6.4 phosphate buffer solution) into 0.5 mL crude enzyme extracts. The reactive temperature is 25 °C. Scan the 398 nm absorbance value within 10 s 5 s after the enzyme preparation is added. Enzyme activity is to be represented with  $\Delta OD_{398nm} \cdot min^{-1} \cdot g^{-1}FW$ .

Measurement of the Content of Soluble Sugar (GB6194-86): Fehling Reagents Direct Titration. Take the Average Value for Three Titrations, Show by % [4].

Measurement of Vc Content: Iodimetry. Take the Average Value for Three Times, Show by Mg/Kgfw [5].

Measurement of the Content of Soluble Solids: Use Refractometer. Take the Average Value for Three Titrations, Show by %.

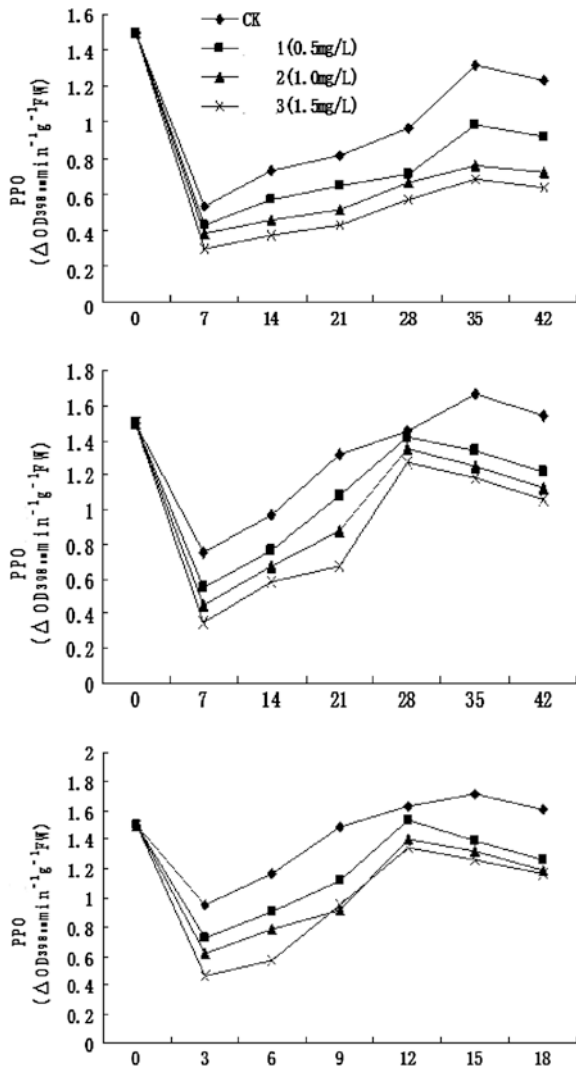
Measurement of the Content of Titratable Acidity. Measure by Neutralization [6]. Take the Average Value cor Three Titrations, Show by %.

### 103.4 Results and Analysis

#### 103.4.1 Effects of Ozone Water Treatment at Different Concentrations on PPO Activity During Different Storage Conditions

It can be seen from Fig. 103.1 that ozone treatment of certain concentration can effectively restrain the activity of PPO, which has good effects to stop grapes from becoming brown.

**Fig. 103.1** Effects of ozone water treatment at different concentrations on PPO activity during different storages of 0, 5 and 20 °C



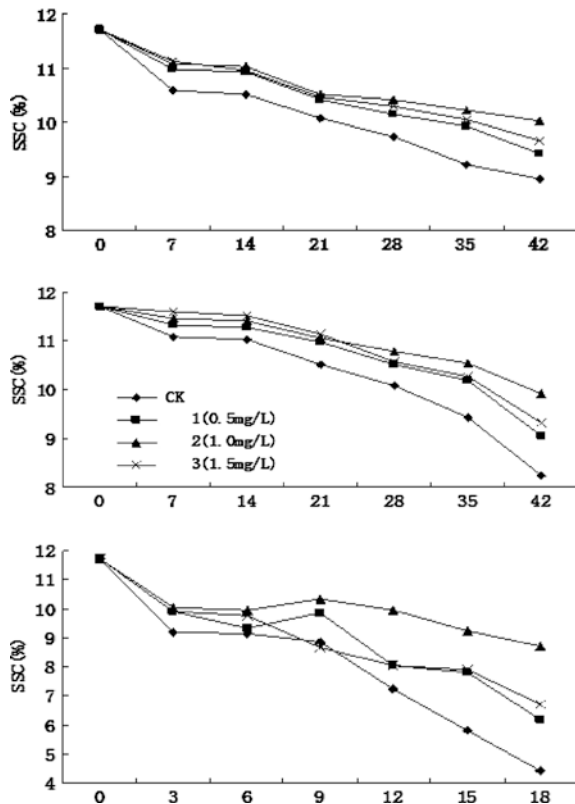
### 103.4.2 Effects of Ozone Water Treatment at Different Concentrations on SSC During Different Storages Conditions

It can be seen from Fig. 103.2 that the lower the storage temperature is, the smaller the SSC changes is, which refers to smaller loss.

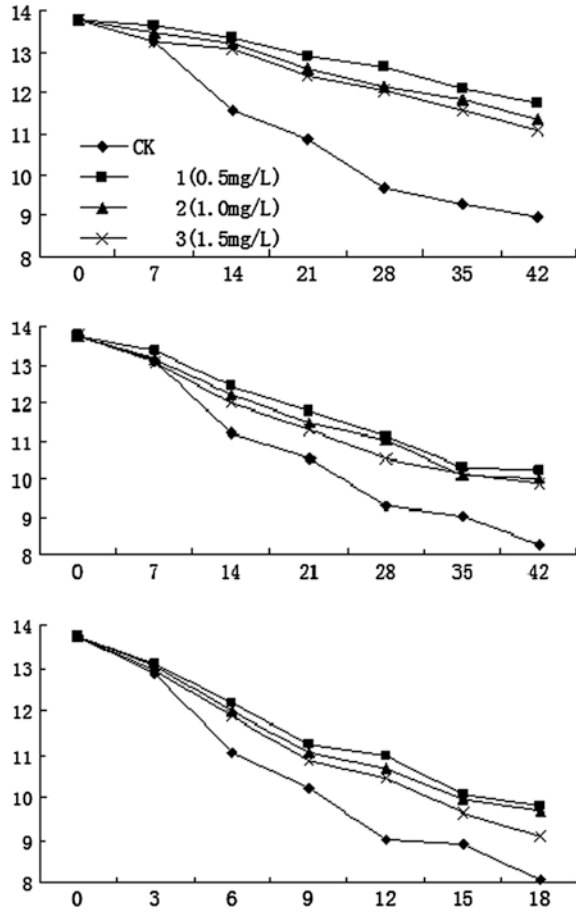
### 103.4.3 Effects of Ozone Water Treatment at Different Concentrations on Soluble Sugar Contents During Different Storages

It can be seen that there are certain relationship between the decrease speed of soluble sugar content and ozone concentration (Fig. 103.3).

**Fig. 103.2** Effects of ozone water treatment at different concentrations on SSC at 0, 5 and 20 °C



**Fig. 103.3** Effects of ozone water treatment at different concentrations on soluble sugar contents at 0, 5 and 20 °C



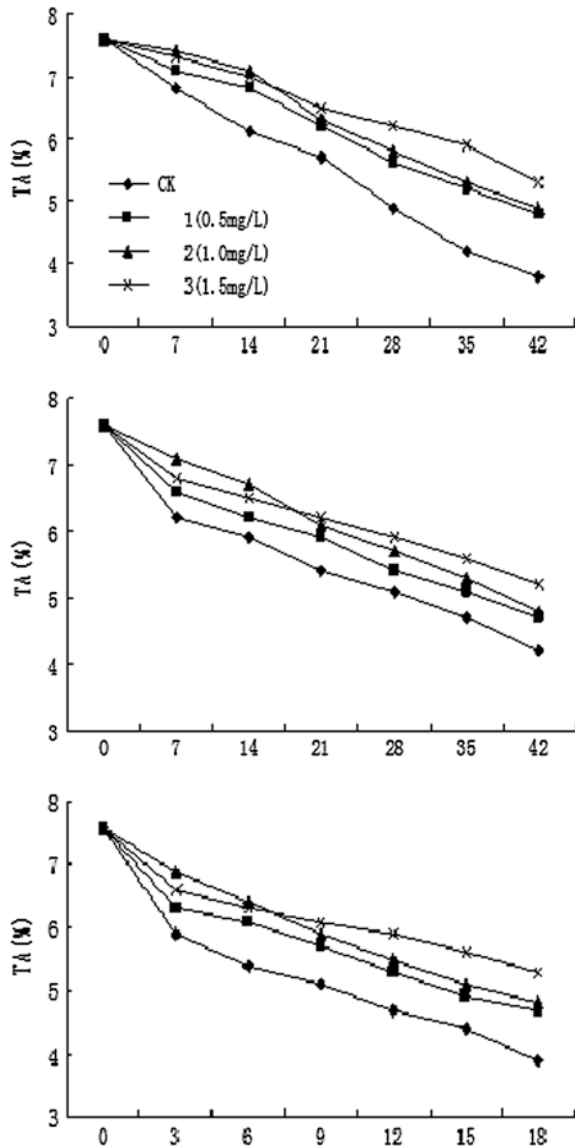
**103.4.4 Effects of Ozone Water Treatment at Different Concentrations on TA Contents During Different Storages**

It can be seen that the TA contents tends to be on the decrease with the extension of the time (Fig. 103.4).

**103.4.5 Effects of Ozone Water Treatment at Different Concentrations on Vc Contents During Different Storages**

It can be seen that the Vc contents of grapes tends to be on the decrease in the whole in the storage condition (Fig. 103.5).

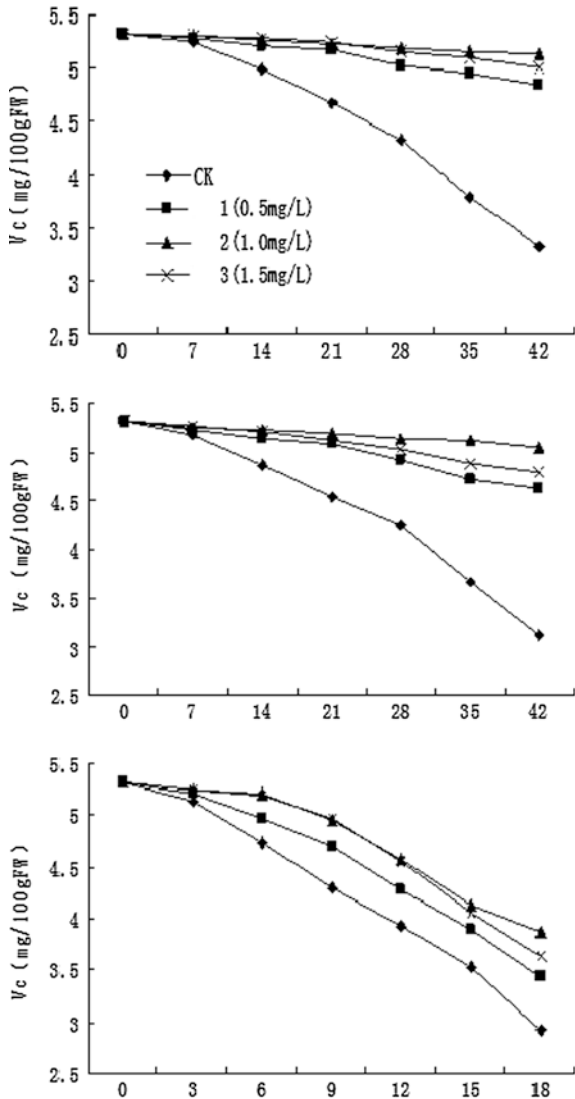
**Fig. 103.4** Effects of ozone water treatment at different concentrations on TA contents during different storages at 0, 5 and 20 °C



### 103.5 Conclusion and Discussion

#### 103.5.1 The Best Ozone Water Concentration Under the 0 °C Storage Conditions

The low concentration is relatively appropriate when adopting the ozone water treatment. The best ozone treatment concentration is 1.0 mg/L and next is 0.5 mg/L under 0 °C storage environment for grapes.



**Fig. 103.5** Effects of ozone water treatment at different concentrations on Vc contents at 0, 5 and 20 °C

### 103.5.2 The Best Ozone Water Concentration Under the 5 °C Storage Conditions

Considering the factors of storage qualities and so on, the best ozone water treatment concentration can be determined within 1.0–1.5 mg/L under 5 °C storage environment.

### ***103.5.3 The Best Ozone Water Concentration Under the 20 °C Storage Conditions***

From the effect made on enzyme activity, it can be found that the treatment concentration of 1.5 mg/L is relatively good. From the consideration of qualities, the ozone water treatment of 1.0 mg/L has the best effect.

### ***103.5.4 The Best Combination of Storage Temperature and Ozone Water Treatment Concentration***

From the results of the comprehensive analysis of different storage temperature and different ozone water concentration, it can be found that the ozone water concentration of 1.0 mg/L and the 0 °C storage temperature is the best combination.

## **References**

1. Wang HF, Wang J (2006) Recent advance in post-harvest physiology and storage freshness retention technique of grape. *Shanxi Fruits* 7(4):39–40
2. Chu JY, Wu CD, Chen WJ, Zhan ZG (2002) Application and generation technology of ozone, vol 5, issue 1. Chemical Industry Press, Beijing, pp 55–67
3. Wang WS, Luo YB, Shi ZP (2005) Effects of gas component on attenuation rate of ozone atmosphere. *Storage Process* 30(1):21–22
4. Li HS (2001) The principles and technology of physiology and biochemistry experiment of plants, vol 25. Higher Education Press, Beijing, pp 164–248
5. Han YS (1992) Food chemical experimental guidance, vol 78. China Agricultural University Press, Beijing, pp 110–122
6. Zhang SH (2006) Food analysis, vol 66. China Light Industry Press, Beijing, pp 118–121