Donghan Jin *Editor*

# Reconstructing Our Orders

## Artificial Intelligence and Human Society

上海大学出版社

Springer

# Reconstructing Our Orders

Donghan Jin
Editor

# Reconstructing Our Orders

## Artificial Intelligence and Human Society

上海大学出版社

Springer

*Editor*
Donghan Jin
Shanghai University
Shanghai, China

Translated by Qiang Zhang, Jiajun Xu, Wen Shi, Jingming Fu, Fuguang Miao, and Fan Xue

ISBN 978-981-13-2208-2 ISBN 978-981-13-2209-9 (eBook)
https://doi.org/10.1007/978-981-13-2209-9

Jointly published with Shanghai University Press, Shanghai, China
The print edition is not for sale in China Mainland. Customers from China Mainland please order the print book from: Shanghai University Press.



This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Committee

## Editor in Chief

Donghan Jin

## Head Planning

Renhan Li

## Chief Officers

Xiaoyu Yu
Tingyun Wang
Jiabao Wang
Weiping Sun
Renhan Li
Fengzhang Li
Dawei Wang
Ning Wang
Wenhong Zhang
Yong'an Zhang
Jun Luo
Jiangbo Jin
Minrui Fei
Xiangfeng Luo
Na Qin
Hao Yuan

Cong Xu
Yike Guo
Shaorong Xie

## Research Fellows

Jiayu Ding
Tingyun Wang
Ling Wang
Jinwei Wang
Bin Wang
Jie Li
Xiaoyun Shi
Kangjuan Lü
Hong Zhu
Huanhuan Liu
Jianyong Liu
Na Liu
Ying Liu
Ping An
Weiping Sun
Renhan Li
Fengzhang Li
Qing Li
Kai Li
Junfeng Li
Ying Li
Yang Yang
Xiao Yang
Chen Yang
Yang Yu
Jiujun Zhang
Weidong Zhang
Afang Zhang
Shanshan Zhang
Yong Zhang
Tongyi Zhang
Qianwu Zhang
Kun Zhang
Xinpeng Zhang
Qi Zhang
Ling Chen
Qiuling Chen

Hao Chen
Jun Luo
Lin Yue
Fengliang Jin
Xiaoling Jin
Liyun Zhou
Baoqing Pang
Qingbin Hou
Ying Shi
Minrui Fei
Xiangfeng Luo
Na Qin
Yongyou Nie
Shenshen Gu
Qing Gu
Nina Qian
Cong Xu
Chunsheng Guo
Qi Guo
Yike Guo
Qingye Tang
Yan Peng
Zhangyou Peng
Chunxin Dong
Han Dong
Weiqin Tong
Shaorong Xie
Huayan Pu

## Writers

Yangkai Wang
Jingyue Wang
Bin Wang
Xuejiao Yin
Xiaomin Liu
Huanhuan Liu
Na Liu
Ying Liu
Ping An
Longfei Sun
Weiping Sun
Renhan Li

Qing Li
Kai Li
Junfeng Li
Xiaoqiang Li
Yang Yang
Chen Yang
Zhuxin Wu
Tuo Leng
Weidong Zhang
Shanshan Zhang
Qianwu Zhang
Ziyi Zhang
Xinpeng Zhang
Lin Zhang
Huizi Chen
Ling Chen
Weiwei Chen
Zhiyun Lin
Jun Luo
Lin Yue
Fengliang Jin
Xiangfeng Luo
Shenshen Gu
Nina Qian
Cong Xu
Qi Guo
Qingye Tang
Yida Tao
Ning Cao
Xuan Jie
Yan Peng
Yuexing Han
Shaorong Xie
Jiajia Xie
Huayan Pu
Wei Dai

# Foreword

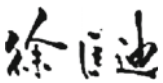
Since its advent at the mid-twentieth century, information technology has been exerting ever-increasing influence on the width and depth of human life. When it has developed to the digital and network-based stage and even to the intelligent period (namely the era of artificial intelligence), IT has brought greater significant impact upon social production and people's living styles, for which some scholars predict that it will further promote the changes in the modes of human thinking.

In March 2016, engaged as a consultant of the research team, I participated in the studies of the prospect of artificial intelligence organized by Chinese Academy of Engineering. In May, 18 academicians (including myself) submitted a recommendation on China's development of artificial intelligence to the Central Committee of Chinese Communist Party and the State Council, respectively, a proposal that was highly valued and adopted by the leaders of the Party Central Committee. In September of the year, Ministry of Science and Technology officially initiated the research on programming China's artificial intelligence and I was engaged to be a counselor for the project. During my participation in the discussions of the issues concerning theory, technology, platform, application and standards, I have gained a deeper understanding of the effect on human life brought by the development of AI. Moreover, the authorities concerned have repeatedly urged the experts to pay adequate attention to this issue from various perspectives. In July 2017, the State Council promulgated "The Program for Developing a New Generation of Artificial Intelligence," which explicitly calls for the due attention to the studies on the influence of AI development on human life.

To my great rejoice, led by Jin Donghan, President of Shanghai University, the teachers of the university working in disciplines such as science, engineering, liberal arts, legal science and humanities have brought forth a monograph *Reconstructing Our Orders—Artificial Intelligence and Human Society* (*Reconstructing Our Orders* in short). It seems to me that the starting point of this book complies with the concept "human destiny community," a book of reference value for social restructuring in the era of artificial intelligence.

*Reconstructing Our Orders* elaborates the great significance of developing AI and the concerning issues, covering the recognition of different social sectors, ethical principles, legal regulations, employment, security and international norms, for each chapter of which a cartoon is furnished so that the readers from various walks of life may be clear what the chapter means at a glance.

I firmly believe that *Reconstructing Our Orders* will certainly arouse the attention and concern of both Chinese and foreign readers. Meanwhile, I expect that the team compiling this book will continue to keep track of the developing trend of AI and its influence on human society, especially the uncertain impact. Moreover, Shanghai University should give full play to its advantages based on its solid polytechnic foundation and its complete disciplines in humanities, fine arts, legal science and social sciences, and constantly improve its capacity of discovering and settling problems so as to cultivate more competent professionals.



December 2017 Kuangdi Xu

# Acknowledgements

Under the leadership and participation of Prof. Donghan Jin, Member of Chinese Academy of Engineering and President of Shanghai University, Shanghai University mobilized 92 professors, associate professors, lecturers, postgraduates and relevant experts from disciplines such as science, engineering, liberal arts, legal science and social studies to work on the monograph *Reconstructing Our Orders—Artificial Intelligence and Human Society*. After five-month painstaking toil, they came off eventually and presented this voluminous works to the readers.

First of all, we would like to extend our heartfelt gratitude to Prof. Kuangdi Xu, Former President of Chinese Academy of Engineering, for his care and encouragement. We also feel indebted to Profs. Yunhe Pan, Tongyi Zhang and Jiujun Zhang who are all Members of Chinese Academy of Sciences or Chinese Academy of Engineering; Meng Li, Vice-Minister of Ministry of Science and Technology, PRC; and other leading comrades of Ministry of Science and Technology for their ardent concern and support.

We are also thankful to all of the compilers of this book, who are listed according to the sequence of each chapter they wrote.

Chapter 1: Shanshan Zhang, Cheng Yang, Nina Qian, Qingye Tang, Xiangfeng Luo, Tuo Leng, Xiaoqiang Li and Yuexing Han.

Chapter 2: Weiping Sun.

Chapter 3: Junfeng Li, Ying Liu, Lin Yue, Fengliang Jin, Qi Guo and Cong Xu.

Chapter 4: Jingyue Wang and Xuan Jue.

Chapter 5: Bin Wang, Huanhuan Liu, Ping An, Qing Li, Kai Li, Ling Chen, Qi Zhang, Jingwu Zhang, Xinpeng Zhang and Shenshen Gu.

Chapter 6: Jun Lou, Shaorong Xie, Weidong Zhang, Yang Yang, Na Liu, Yan Peng, Huayan Pu, Wei Dai, Ning Cao, Huizi Chen and Jiajia Xie.

Chapter 7: Jiabao Wang, Xiaoyu Yu, Jie Li and Xiaoling Jin.

We also owe our indebtedness to Na Qin, Director of academic periodicals of Shanghai University and relevant editors for their efficient coordination and organizing work; to Junhao Dai, Director of Shanghai University Press and relevant editors for their enthusiastic and diligent work; to the leaders and team led by

Prof. Ning Wang of Shanghai Academy of Fine Arts for their exquisite cover design and insets of inside pages; to the relevant workers of Party Committee and president's offices of Shanghai University for their effective coordination; and to Prof. Huayan Pu for her coordinate work among the contributors. Without the gracious support and selfless assistance from the above-mentioned people, the publication of this book would have been impossible.

As artificial intelligence is rapidly developing with each passing day, there must be the shortcomings and oversights with this book *Reconstructing Our Order—Artificial Intelligence and Human Society*. All the critical comments and suggestions for improvement will be very much appreciated. Finally, all the contributors will act as instructed by Prof. Kuangdi Xu in his "Foreword" to this book and continue to spare no efforts in keeping track of and studying the developing trend of artificial intelligence and its influence to human society, the uncertain impact in particular.

December 2017 Renhan Li

# Contents

# Chapter 1
# Artificial Intelligence and People's Consensus

**Shanshan Zhang, Cheng Yang, Nina Qian, Qingye Tang, Xiangfeng Luo, Tuo Leng, Xiaoqiang Li and Yuexing Han**


S. Zhang (✉) · C. Yang · N. Qian · Q. Tang · X. Luo · T. Leng · X. Li · Y. Han
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 200444, China



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_1

**Abstract** With its ever-going development, artificial Intelligence (AI for short) is profoundly changing people's way of life and our world. In recent years, AI development has aroused widespread concern from the international community. Some developed countries such as the USA, Japan, Britain, and Germany have successively formulated their programs for developing artificial intelligence. In July, 2017, Chinese Government promulgated "The Program for Developing A New Generation of Artificial Intelligence." Before AI was available, people were living in a binary space which consisted of physical space (P for short) and human social space (H for short). In this binary space, the orders for human activities are decided by the interactions and interrelations among the people and between man and object and man acts as the formulator and dominator in human social orders. With the rapid development of mega-data, cloud computing and IOT, intelligent mobile devices, wearable alliances, and "Internet+" react on different sectors of human society and promote the advent of the third industrial revolution and the intelligence era, which drive people to the ternary space (PHC) marked by physical space (P), human social space (H), and CyberSpace (C for short). In the ternary space (PHC), the orders of human society will be invariably restructured. Whether you are aware of such change or not, the profound influence upon human social life which is brought by artificial intelligence becomes a consensus of all walks of life. Therefore, mankind should take the initiative measures so that they may adapt themselves to such change.

## 1.1 The Origin and Present Conditions of Artificial Intelligence

In recent years, artificial intelligence (AI) is a term familiar to everybody. To what extent will AI affect human social life? This is the issue that people care most.

### *1.1.1 Artificial Intelligence and Human Social Orders*

Artificial intelligence refers to the process during which people make the reasonable decisions and judgment on the basis of their perceptions to the external world and their understanding and cognition of the perceived information. AI amalgamates the achievements made in human production activities, and it propels social progress and development in turn. The developing degree of human society not only depends on human recognition level of the objective world, but also is closely related to complexity caused by the interactions and mutual effect between mankind (human society) and objective world. The aggravation of such complexity or the constant changes of the complex relation will directly influence the interactive and interinfluential ways between man and man or between man and object in human society. In other words,

while affecting the normal social orders, the aggravation and changes are propelling the progress of human society in a spiral way.

Ever since the second industrial revolution, the advent of the third industrial revolution characteristic of artificial intelligence, mankind is capable of rapidly mastering and applying multifarious intelligent tools, with which people will improve the productive forces and their living quality by leaps and bounds on one hand, and they will promote the explosive development of science and technology on the other and bring mankind to a brand-new times—data-driven intelligent era, during which human sensory power, supported by various intelligent tools (such as intelligent mobile equipment and robots, etc.), will be strengthened in an unprecedented way. At the same time, with various human activities perceived, massive data yielded by the activities will be constantly recorded. The analysis of the massive data will further our understanding of this objective world, and it will also improve the restructuring of our social orders formed by the interactions and the interrelations of all the natural things as well as our ability to perceive and predict the restructuring the process.

Mankind is confronting the ever-increasing uncertainty in its social development, which a result caused during the restructuring human social orders. The advent of intelligent era promotes the formation of ternary space. With people's in-depth understanding of the ternary space, they will discover that the more factors and relations involving the world's operation, the more difficult for them to control and express in explicit way the complex behaviors and relations, with which the normal orders of human society can be maintained, resulting in greater difficulty in our understanding and prediction for the restructuring of human orders in the ternary space. With regard to this knot, to address the uncertainty we are now confronting, we should enhance our ability to transform the massive data into information and knowledge with intelligent technology so as to reduce the uncertainty of human cognition on a large scale. In a nutshell, artificial intelligence based on mega-data can eliminate the uncertainty during the process of acquiring information and knowledge from the said data and then people may have a better understanding of the normal orders for human society and seek for the way of restructuring human social orders.

With respect to the development in science and technology, we may discover that information technology develops in an inconstant velocity and the rapid development of artificial intelligence based on mega-data, IOT, and cloud computing lies in the maturity of numerous relevant technologies. Firstly, the technical advancement in such hardware as computing equipment, mobile devices, and sensors makes it possible for people to gather the data. Secondly, the development and application of the infrastructure and relevant technology in IOT and "Internet+" stimulate the explosive growth of global data. In the terms of applied topological structure, considerable headway has been achieved in the respects from the distributed system to cloud computing platform, to information storage, transmission, and process. All in all, the above-mentioned factors provide the powerful support from both hardware and software for the advent of intelligent age.

Artificial intelligence will inevitably propel the boom of "original industries+artificial intelligence" and will be widely used in relevant industries. The com-

ing "agriculture, industry, service+artificial intelligence" will present a brand-new industrial form which will promote restructuring the orders of all existing industries.

### *1.1.2 The Development History of Artificial Intelligence*

As far as artificial intelligence is concerned, mathematical logic and computing serve as two cornerstones for AI development. Rene Descartes, French mathematician in the seventeenth century, brought forth an influential hypothesis, in which he claimed that all the issues can be solved by mathematics. All the mathematic issues involve algebraic issues, while all the algebraic issues can be settled by the solutions of algebraic equation. Acting as the mathematic concept of the initial mechanization, this hypothesis has laid down the foundation for the rise of artificial intelligence in that only by mechanization can people make machines to simulate human thinking and logical reasoning. Yet this hypothesis would not be put into practice so easily.

By the end of nineteenth century, several world-famous mathematicians, including Bertrand Russel, Alfred North Whitehead (British), and David Hilbert (German), formalized the structure of mathematical system for deductive reasoning and brought forth the concepts of mathematical logic and mechanized mathematics. Based on their achievement, a number of mathematicians began to make machines perform reasoning and solve equations as mankind. As the earliest experiment of artificial intelligence, the logic machines were put into test with mathematics, the strictest and most reliable tool for mankind.

Alonzo Church (American), Alan Mathison Turing (British), and some scientists embarked on another experimental way. At the beginning of the twentieth century, they made people clear of the computing nature by their in-depth studies. It is through their arduous work that a bridge between the formal reasoning and computing (especially the machines for mega and rapid computing) has been constructed. Since the advent of computer, tremendous changes occur on all the disciplines and the new invention offers great facility for scientist. Firstly, computer is an unprecedented powerful tool for mankind, with which people can further their understanding, prediction, and exploration of this world through computing and perception. Secondly, computer furnishes scientists with new research topics and alters people's standards for evaluating science. Before the application of computer, only structural and logical discipline is acknowledged to the mainstream science. After the invention of computer, the partial, solvable, precise, and pragmatic theories of algorithms deserve unprecedented attention and focus.

As far as modern significance is concerned, the summer of the year 1956 is universally acknowledged to be the time of AI advent. In that year, a young American scholar John McCarthy initiated a two-month seminar in Dartmouth College, the USA, during which the issues concerning AI were the focusing points for discussion and the term "Artificial Intelligence" was first used by the scientists attending the seminar. This seminar, the first one on the issues of AI in human history, spurred the advent of artificial intelligence discipline. Since the concept "AI" was put forth,

the optimistic predictions for the development of AI were prevalent in scientific and technological circles and artificial intelligence witnesses its gold age for 20-odd years.

With rapid development for over 20 years, scientists gained substantial harvest in their research of AI, but they were also bottlenecked with some technical issues in their research. Therefore, certain optimistic predictions have been revised one after another. In 1973, a report addressed by James Lighthill, a French mathematician, frustrated the AI researchers, in which, based on the accurate and detailed data, this mathematician claimed that most of research in AI was of little value, an assertion that made some institutions suspend their sponsorship for AI studies and thus this newly rising discipline met its waterloo for the first time.

The second frustration on AI research stemmed from Japanese failure in its research of the computer claiming to be the fifth generation. In 1982, Japanese Industrial Ministry initiated its program for developing computer of the fifth generation, in which the scientists expected that the computer might be equipped with the new frame that could perform the functions of direct reasoning and knowledge processing. Yet this program ended up with failure as no breakthrough was made in certain critical technology.

In 1984, scientists in Stanford University tried to reconstruct an encyclopedia with artificial intelligence, expecting that the machine might acquire the reasoning ability as mankind. However, an issue that occurred in the expert system for knowledge acquisition promoted the sharp development in data mining and machine learning.

Anyhow, the declining enthusiasm in AI research in 1980s did not indicate the stagnation and frustration in the studies of this discipline, since the failure due to the excessive expectation on AI research could be anticipated. However, after the fantastic ideas in AI research were discriminated, the research of this discipline proceeded to a relatively stable stage for development and greeted a pragmatic course in a gradual way. To be established as a discipline, artificial intelligence is differentiated into many fields and schools, among which there are cooperation and heated debates in the ways and concepts. Whether cooperation or debates, all these greatly propel the in-depth development of AI research.

The research in AI can be further divided into symbolism, connectionism, and behaviorism. It is especially worth mentioning that expert system and machine learning guided by symbolism and connectionism usher in AI development in different periods. The 1980s marked the golden age of symbolism, during which many well-known expert systems and knowledge engineering projects quickly developed and were put into application, including PROSPECTOR expert system for geological exploration and ELAS drilling data analysis system, etc. From the perspective of symbolism, artificial system is a knowledge processing system in nature, which involves three essential issues in AI, covering knowledge representation, knowledge application, and knowledge acquisition.

Since 2006, what attracted people's attention most in AI realm is neural network-based in-depth learning, a representative achievement made by connectionism. In July, 1986, Geoffrey Hinton, renowned as "father of in-depth learning," worked with David Rumelhart and published an academic paper in "Nature," in which the

two scientists introduced back-propagation into neural network model for the first time. In October, 2012, the research team led by Prof. Sinton applied the updated technology into the contest on large image identification from ImageNet-based photo gallery. Following this event, more and more scholars are engaged in such neural network-based in-depth learning research and application and several practical cases are familiar to us. Among those practical applications, the most significant event was the game between man and machine in 2016, during which AlphaGo developed by DeepMind, a subsidiary of Google, beat Lee Sedol, the world top player of international chess in the contest. The result of the game aroused the public concern over artificial intelligence.

To retrospect the course of artificial intelligence, we may realize that the ups and downs in AI just present the spiral ascending developing trend of this discipline. In this course, the representative achievement reaped in AI is in-depth learning, for which more and more people are engaged in increment learning and transfer learning. With regard to this trend, we must highly value this rising discipline and make greater effort to probe it. Although we are still ignorant of the fact that to what extent AI will affect human society, what David Hilbert, a German mathematician, remarks is to the point, "We must know it and we will know it."

### *1.1.3 New Features of Artificial Intelligence Development*

The year of 2016 marked the 60th anniversary of the proposal of AI concept. In recent years, the major developed countries around the world have take AI development as significant strategy to elevate national competitive edge and safeguard national security, formulated and promulgated the programs and policies related to AI research and application, and intensified the deployment centering the mastery of core technology, the employment of the first-rate scientists, and formulation of standards in an endeavor to occupy the commanding height in the new round of international competition in science and technology. Driven by the intense requirements for the new theories and new technology in mobile Internet, IOT, mega-data, supercomputing, and brain science as well as from economic and social development, the neotype machine learning methods, such as in-depth learning, in-depth intensified learning, generative confrontation learning, transfer leaning and increment learning, keep bubbling up. At present, whether in academia or in industrial circles, there appear many theories and concepts in AI development, of which five ones represent the new trends.

(1) Mega-data Intelligence

Mega-data intelligence completes the transition from sampling learning to whole data learning as well as the transformation from the emphasis on the learning of high-density knowledge to the learning of the sparse valuable knowledge.

Artificial intelligence driven by mega-data aims at in-depth learning and other forms of learning of the mega-data through such technical means as data mining

and machine learning so as to acquire the valuable knowledge. For instance, Google successfully predicted influenza A virus subtype H1N1. At present, intelligence driven by mega-data has played an important role in quantized investment field, risk management in finance, precision marketing in consumption, line optimization in public traffic, and health management in medical sector.

However, mega-data intelligence has to make a breakthrough in certain bottlenecks, including intelligent methods formed by the amalgamation of data driving and transcendental knowledge, intelligent analytical method based on the cognizant data, basic theory, and methods for making intelligent decisions under the circumstances of incomplete and uncertain information.

(2) Cross-media Intelligence

Cross-media intelligence aims at realizing the learning of multi-channel data from the learning of single-channel data. It is known to everybody that human intelligence may process multi-media objects, including text, voice, image, video, etc. However, the present artificial intelligence can handle just only one object, resulting in the mono-channel for artificial intelligence to acquire knowledge. For example, speech recognition technique can process voice only, while image identification technique can only handle image data, which brings a challenge to AI development. For breaking through this bottleneck, an imminent orientation for us to develop artificial intelligence is to blend the cross-media data and make perception, recognition, analysis, and reasoning of these data.

Cross-media intelligence will perform its function based on the computing theory of cross-media perception. Starting from the perceiving channels audio and visual languages, cross-media intelligence acquires multi-dimensional knowledge from cross-media with such means as machine learning, semantic analysis, and reasoning technique and forms a unified framework for semantic representation of cross-media so that people may acquire the cross-media-based machinery pro-active learning skills that go beyond human perceiving ability.

(3) Swarm Intelligence

Swarm intelligence aims at achieving the transformation from singular intelligence to the macro-intelligence marked by the coordination among a swarm. As an individual is not capable of accomplishing the complicated assignment, swarm intelligence manifests itself if the assignment is completed by the concerted effort of a large number of individuals. To deal with the complicated assignment, swarm intelligence is featured by its more powerful robustness and greater flexibility, whose advantage is free from the overall control. The typical example is the ant colony optimization, which offers the new way and new chain of thought for solving complicated issues. In the era of Internet, man, machine, and matter can be bounded together. How to give full play the individual advantage so as to form swarm intelligence has been a challenge for mankind to develop artificial intelligence.

(4) Hybrid Enhancement Intelligence

Hybrid enhancement intelligence focuses the importance of acquiring intelligence from the data amalgamating the information of the external intelligent agents. Artificial intelligence is endowed with incomparable advantages in search, computing, storage, and optimization as against the human being. However, artificial intelligence cannot be comparable with human intelligence in terms of perception of the external environment, reasoning, induction, and learning. If mankind blends artificial intelligence and machine intelligence, a more powerful artificial intelligence will be yielded, a typical hybrid enhancement intelligence.

In the system of hybrid enhancement intelligence, the living organism may accept the information from an intelligent body, and the intelligent body may read the information of the living organism, in which the two kinds of information may achieve seamless interactions and timely mutual feedback. Hybrid enhancement intelligence may further amalgamate the elements in biology, machinery, electron, and information to form an organic integrity so as to elevate the action, perception, and recognition of the system.

(5) Autonomous Unmanned System

Autonomous unmanned system may effectively sense and blend the external environment of the unmanned system, and make independent decision based on the sensed information from the external environment, a system that may adapt itself to the complicated changes of the external environment. Autonomous unmanned systems may cover unmanned boat, unmanned aerial vehicles, and autonomously driving land vehicles. Traditional unmanned systems may accomplish some specified missions according to the preset computer programs, unable to adapt themselves to the altered scenes and sites to doing dynamic changes.

Intelligent car attracts the public attention. Now there are nearly 100 enterprises researching and developing pilotless automobiles, including Google, Huawei, Tesla, Uber, etc. Moreover, importance is being attached to the development of unmanned boat and pilotless aircraft.

### *1.1.4 New Orders in the Era of Intelligence*

The new properties of the above-mentioned artificial intelligence will accelerate the transformation of human society from the binary space to the ternary space, a transition of great importance to the development of human society. Of course, the new development in artificial intelligence will bring challenge to the moral orders of human life. For example, mega-data will infringe individual privacy, an adverse effect that demands restructuring the orders for protecting traditional individual privacy. Once autonomous unmanned systems are widely used, the order of job market will be subject to unfavorable impact and call for restructuring.

With the advent of CyberSpace, the interactions among the people of the world are getting closer and the political, social, economic, and cultural activities of mankind are getting more abundant and colorful. Under such circumstances, people are confronted with challenges and opportunities as well and they are in need of greater space to develop themselves. The first creates a virtual world through Internet and then associates it with the realistic world by means of mega-data and IOT. In this way, mankind digitalizes all the things by 0 and 1, forming organic relations between man and man, man and object, and object and object. It can be predicted that human being will eventually forge an era featured by the unification of the virtual and realistic world and human–machine integrity.

Talking about the prospect of AI development, some people compare artificial intelligence to the coming electric power, whereas some warn that AI will endanger the survival of human being and even claim it to be the terminator of human civilization. Anyhow, the advent of intelligent age will enable mankind to step into the ternary space from the binary space, and the order of latter will inevitably correspond with the order of the former. During this transition, people should conduct special research and anticipation on the influence of AI development upon human society so that human society may make the pertinent preparation for the coming of intelligent era.

## 1.2 The Public View on Artificial Intelligence

After AlphaGo defeated Lee Sedol, the world champion of international chess by 4:1 in March, 2016, this intelligent machine again beats Ke Jie, No. One player of I-Go by 3:0 in May, 2015. That intelligent machine won the two games aroused the popular heated discussions on artificial intelligence. At the same time, the leadership of different countries keeps a close eye on AI development and business elites cannot wait but to plunge themselves into the tide of artificial intelligence. Traditional media bring forth numerous reports on this issue. Some other Chinese and foreign media such as WeChat, Microblog, Facebook, and Twitter surge up endless comments. Obviously, with frequent presence in public vision, artificial intelligence refreshes people's cognition on this discipline.

### *1.2.1 Political Leaders' Views of Artificial Intelligence*

Artificial intelligence is being valued by different countries with each passing day. Firstly, as an important driving force, AI is expected to propel social and economic development in a rapid way and the in-depth exploration of human potential. Secondly, AI development conforms to social requirements, needed by Internet enterprises and even traditional companies. To meet the requirements, the developed countries in Europe and the USA have formulated their strategic programs of AI development.

In 2006, German Government promulgated "Hi-Tech Strategy," which was expanded to "2020 Hi-Tech Strategy" in 2010. It further put forth "Industry 4.0" strategy in 2013, specifying the orientation for AI development. In October, 2016, US Government issued "Preparing for the Future of Artificial Intelligence," in which AI development is elevated to national strategy. Following that, it brought forth "The National Artificial Intelligence Research and Development Strategic Plan," eradicating seven strategies and the paths for implementation. In November, 2016, British Government released a report "Artificial Intelligence: Opportunities and Implications for the Future of Decision Making," predicting the possible influence brought by AI development. European Union initiated "Human Brain Project" (HBP for short), launching civilian robots program. In January, 2015, Japanese Government promulgated "New Strategy for Robots" and released "The Fifth Issue Basic Program for Science and Technology" one year later. Meanwhile, it formulated three-stage road map for AI development, which takes AI as the core technology in "the fourth industrial revolution." France, South Korea, and India have successively released their respective AI programs.

Reluctant to lag behind European countries and the USA, Chinese Government attaches due importance to AI development. In 2015, Chinese Government ranked artificial intelligence as one of the eleven national "Internet+" programs. In the following year, National Development and Reform Commission, Ministry of Science and Technology, Ministry of Industry and Information Technology, Central Network and Information Office jointly released "Three-Year Action Plan for 'Network+' Artificial Intelligence," the first strategic program for artificial intelligence by Chinese Government. In the same year, Ministry of Industry and Information Technology, National Development and Reform Commission, and Ministry of Finance jointly promulgated "The Program for Developing Robot Industry (2016–2020)," a strategic program of milestone significance that deploys China's artificial intelligence development, in light of which China will strive to be one of the world's major AI innovation centers by 2030 through "three-step development" targets.

With regard to AI development, we may acquire the knowledge of the emphasis, views, and development goals of different countries through the speeches and statement on AI by their state leadership.

Xi Jinping, president of the People's Republic China, repeatedly iterates the importance of AI for the coming society in his speeches. In the conferences of both Chinese Academy of Sciences and Chinese Academy of Engineering in 2014 and 2016, President Xi emphasized China's firm resolution to develop artificial intelligence in his speeches. On September 3, 2016, in his keynote speech in the "Opening Ceremony of the G-20 Business Summit Conference," Xi Jinping reiterated, "As such technologies as artificial intelligence and virtual reality are developing with each passing day, the amalgamation of virtual economy and entity economy will spur revolutionary changes in the mode of production and people's life styles. Such changes will not be accomplished overnight, nor can we deal with them in smooth way, which calls for the concerted efforts from different countries for its development. While amplifying and accelerating its positive effects to a great extent, we should reduce the possible negative impact to minimum degree." On July 8, 2017, at "The Twelfth Summit

Conference of G-20 Leaders" in Hamburger, Germany, President Xi again appealed for due attention to the influence on employment brought by digitalized life and AI and proposed that all the member states adopt the positive policy for employment.

In the USA, what Americans were concerned most is whether Trump would continue AI policy adapted by Obama Administration after he won the presidential campaign, as Obama held optimistic attitude to AI development. In October, 2016, President Obama presided over "The White House Frontline Summit," during which two documents were adopted, namely "The National Artificial Intelligence Research and Development Strategic Plan" and "Preparing for the Future of Artificial Intelligence," iterating "It seems to this Administration that the critical point lies in the concerted efforts from all the industries, non-governmental organizations and governments at different levels to give full play to AI advantages while we should try to bring its risks and challenges under control so that everybody will have a chance to participate in forging an AI-based society, from which people will benefit." On October 12, 2016, "Wired" carried President Obama's article "This Is the Greatest Living Age." The author held that AI would bring higher efficiency to economy and people's life would be significantly improved. The unemployment caused by AI would be settled by formulating new social contract. On October 14th of the year, President Obama, together with Prof. Joi Ito, Director of MIT Media Lab, accepted an exclusive interview by "Wired," during which Obama pointed out that AI was profoundly affecting people's life in various ways. Yet they did not well recognize this, and the prejudice from the people engaged in popular culture should be blamed for this ignorance. For this oversight, President Obama called for the studies on the effect brought by AI.

Different from his predecessor, Trump rarely mentioned AI after he assumed the presidency, which incurred many guesses from Americans, holding that President Trump did not pay due attention to AI development. On April 22, 2017, Rishon Blumberg, an influential entrepreneur, criticized President Trump in this article, claiming that the long-term negligence of AI development by the president would bring negative effect on American innovation ability and economic development and it would be possible that American AI industries would lag behind other countries. In addition, Steven Mnuchin, Secretary of Treasury, declared in one of his speeches that AI issue was excluded from Administration's consideration. For Government's attitude, Los Angeles Times issued an editorial on March 28, 2017, which retorted the view of this official, "dangerous and ignorant."

Modi, Indian Prime Minister, showed his strong support for AI development in his country. On May 10, 2017, while attending a releasing ceremony of digitalized system of Indian Supreme Court, Modi reiterated his standpoint on AI, holding that AI would drive human progress. Meanwhile, he pointed out that AI thinking mode constituted the biggest challenge to the adaptation of this new technology. To Indians, with the increasing AI influence, India should remold a favorable environment for the growth of digitalized technology.

Shinzo Abe, Japanese Prime Minister, declared his optimistic attitude to AI development. In CeBIT held on March 19, 2017, they claimed that Japan would not be worried about technical progress and artificial intelligence, free from any anxiety

of unemployment due to this new technology. Nor did Japanese fear that machine would replace mankind. To Japan, even the country is troubled by population aging, it will prove that technical innovation may boom economic growth under adverse tendency that its population is on declining state.

All the state leaders, whether developed countries or developing countries, hold that artificial intelligence is of huge potential in accelerating technical innovation, driving economic development and changing people's ways of life and they express their strong support for AI development in their own countries.

### *1.2.2 Artificial Intelligence in the Eyes of Entrepreneurs*

As the above text discusses, artificial intelligence meets three frustrations in its development course. Ever since 2008, a bright prospect for this industry appears, as this emerging industry attracts more attention from all walks of life. International technological tycoons, such as Google, or the enterprises in developing countries, all of them attach importance to this area, attempting to gain leading edge in this field, which constitutes the driving force for AI development. So long as there is strong demand from market, artificial intelligence will be bound to be developed.

On May 18, 2017, in his speech addressed at Google's tenth developer conference, Sundar Pichai, the company's CEO, reiterated that the developing strategy of Google was experiencing the transition from "mobile first" to "AI first" and claimed that Google would reconsider all its products, while it would apply AI into academic studies and medical field. Obviously, Google attaches great importance to the huge potential of artificial intelligence.

On July 25, 2017, in a live Web casting, Mark Zuckerberg, founder of Facebook, retorted the view that AI would endanger human civilization. He held that AI would make human life better and he reproached the assertion that AI would lead to Domesday to "be extremely reckless." He held that those opponents were really ignorant of artificial intelligence. He once again expressed his firm optimism for artificial intelligence.

Elon Musk, CEO of Tesla, claimed "Domesday" in his Twitter for several times, in which he held that AI would trigger the Third World War. It seemed to him that in the era when AI threat becomes prevailing, mankind should be blended with machine. Otherwise man is useless and will be replaced by machine. Musk once remarked, "It seems to me that this field will lead to a hazardous result, but I care about AI or perhaps it will yield unfavorable result, but we must ensure the favorable one." Obviously, being a pessimist as Musk, he still persisted in developing AI and tried to bring the unfavorable result under control.

Three Internet tycoons in China, including Baidu, Alibaba, and Tencent, attach great importance to developing AI as this industry is brimming with enormous commercial opportunities and potential, who share the same view with world's corporate giants in this area. In 2017, "Fortune" distributed questionnaires among the Fortune-500 on the prospect of artificial intelligence, the statistics proving that 81% of the

interviewees considered AI/machine learning to be the important area for investment, only after cloud computing and mobile computing. The questionnaires also prove the positive view of the commercial elites and the huge business potential in AI.

### *1.2.3 Artificial Intelligence in the Eyes of Scholars*

Different from the ardent enthusiasm displayed by political and commercial elites, intellectual elites show their multi-elemental and more complicated views on artificial intelligence. Apart from the discussions on the facilities on human life brought by AI, scholars are concerned more about its potential threat to human society and show their prudence on "machine–man relationship" that AI professionals are studying.

As to AI development, Ray Kurzweil, American futurist, expresses his optimist attitude, who predicts in his book "The Approaching Singularity" that by 2045 or so, artificial intelligence will develop to a singularity, across which AI will surpass human wisdom and human history will be thoroughly changed.

Tan Tieniu, Vice Chairman of China's Artificial Intelligence Society, warns that we should keep a sober mind amid the new heat in AI. We should draw both experience and lesson in AI development, free from the rash action in encircling land for industrial park and pooling huge investment funds in the upsurge of AI development. Moreover, we are not supposed to set unrealistic goals and place excessive expectation in this industry. According to this expert, AI is far from omnipotent and there leaves much to be desired in this field. It is very important for us to set the scientific and feasible goals.

In contrast to the prudence of some experts in AI, certain well-known science elites express their alert and pessimism to AI, of whom Stephen W. Hawking, a British physicist, published "This Is the Most Dangerous Time for Our Planet" in "The Guardian" in 2016, in which the author holds that automation in factories has brought negative impact on traditional manufacturing, the rise of AI will continue to spoil the work of bourgeois, leaving the attendant, creative, and managerial posts. He even asserts that the emergence of artificial intelligence will lead to the destruction of mankind and termination of human civilization. Yet, in spite of his worries on AI, Hawking still cherishes appreciative view on AI technology.

In addition, in his "The Capacity and Limitation of Computer," Harry Collins, British sociologist of scientific knowledge, takes education and cultural communication for an example and warns scholars that the reform human behaviors by AI may incur the losses of the peculiarity and diversity of human civilization. Moreover, he emphasizes that human peculiarity lies in its philosophical reflection, whereas the abuse of AI will help strengthen the force of anti-intellectualism in modern society. On June 24, 2017, Le Monde carried a book review on the novel "La Chute de L' Empire Humain," in which the author keeps an alert on AI while retrospecting the past, present, and future of artificial intelligence in the robot's memory and displaying the functions of the coming machines and the scenes of human civilization under the operation of robots.

Amid the introspection on AI, apart from the supports and oppositions, some scholars begin to figure out the solutions to the social concerns in the times of AI, among which the one proposed by Danièle Bourcier (Frenchman) is of realistic significance. In his article "From Artificial Intelligence to Virtual Man: Does A Legal Person Emerge?", he asserts that once the machines made by man can be continuously studied in both virtual and realistic worlds, they may acquire autonomy. How will man bring the virtual world under control by legal means? If man-made robots live with us, what kind of legal rights will we grant robots. With regard to this dilemma, he puts forth the hypothesis for virtual man from the legal perspective, in which he takes the virtual man as a legal artifact and then he proposes that different kinds of law be formulated on the basis of the features of the virtual man so as to settle the disputes and conflicts between intelligent robots and human beings.

Obviously, scholars harbor different and complicated attitudes toward AI, among which some hold prudence, while Hawking, a world-famous scientist, cherishes his vigilance and anxiety. Of course, there are still some other scholars retrospecting the AI issues and offer their constructive recommendations with open-minded attitude.

### *1.2.4 Artificial Intelligence Reported by Media*

(1) Artificial Intelligence in News Media

Once a new technology attracts the public attention, people will form their cognition on the benefits and the potential risks brought the technology and this cognition will influence people's view on new technology. To what extent the public supports and applies the technology will also influence its dissemination and acceptance. However, before the people know very well a new technology, media reports will exert greater impact on public cognition.

Regarding the reports on AI, Ethan Fast and Eric Horvitz conducted a special research on reports of "The New York Times" from 1986 to 2016. They discovered a fact that since 2009, the reports on AI by the newspaper have increased considerably, three times as many as those in 1980s. An analysis into the key words adopted from the report samples reveal that the key words associated with AI keep constantly changing. For example, the key word in AI in 1986 was "space weapons," "I-go" in 1997, "search engine" in 2006, and "pilotless automobile" in 2016. Those key words mirror the transitions of focus on AI by "The New York Times" and the readers at different ages.

Generally speaking, news media focuses more the positive effects on human society brought by artificial intelligence. On August 29, 2016, "The Times of India" carried an article "Artificial Intelligence Influences Global Business," in which India lists the top-three countries who apply automation into the commercial core areas, proving that AI improves commercial efficiency and accuracy. In India, over 64% of financial experts appeal for extending the scale of mechanical automation in that it saves up time and costs. At the same time, to attract the public attention, news

media will report the negative shocks and effects of AI upon human society. On May 17, 2017, "La Tribune" carried "Artificial Intelligence Will Cause A Tsunami," asserting that AlphaGo and AI industry boomed by commercial tycoons will forebode the coming of a new era. According to the author, portable AI devices with mobile phone as the carrier will experience a flourishment in the coming 10–20 years. In addition to the change of people's living styles, the survey also shows that AI will take place of 42% of people's work.

Nevertheless, confronted with the challenge and threat from AI, news media cherishes its optimistic view in many reports. On March 19, 2017, "Outlook," an Indian newsweek, issued "Robots and Artificial Intelligence Make Certain People Unemployed. Workers Should Adapt Themselves to This Change and Acquire New Skills," predicting that 12% of working posts will be eliminated due to AI development. In the coming decade, AI will be applied in all white-collar work and people's focus will be placed on cultivating the comprehensive professionals.

(2) Artificial Intelligence in Social Media

At present, in addition to traditional media, the new-type social media has been an important carrier for people to conduct mutual communications, acquire information, and free their views. Under certain circumstances, it will surpass traditional media and turn to be a major source for people to form their cognition of certain things. We would like to conduct a brief analysis into the public opinions extracted from the domestic and foreign social media.

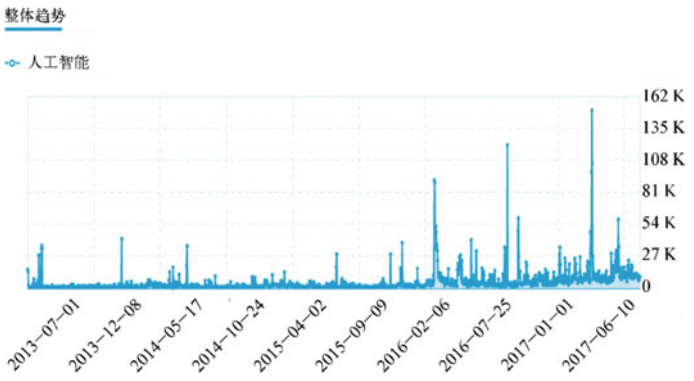
With "Artificial Intelligence" as the key word for surfing the four influential social media, including Facebook, LinkedIn, Twitter, and Pinterest in BuzzSumo Web site, we may discover that the report "President Obama on Artificial Intelligence, Pilotless Automobile and Human Future" in "Wired" (on October 12, 2016) ranks the top in terms of the relay volume in the four media, accounting for 59,000 times, among which 42,000 times are attributable to Facebook, 10,000 to LinkedIn, 7000 to Twitter, and the rest to Pinterest. To take Facebook for an example, the largest reply volume lies in the article "A Ten-Year Program for Facebook: Unicom, Artificial Intelligence and Virtual Reality" in Forbes Web site on August 15, 2016, totalizing 47,000 times.

Following ways may be adopted for surveying the comments on AI in China's social media.

Firstly, to survey the pubic attitude toward AI, we establish monitoring program "Artificial Intelligence" through Qingbo monitoring system and exercise analysis. The time span on data acquisition ranged from July 23, 2017 to July 29, 2017, during which we got 17,040 entries on "AI." In view of media distribution, the discussions on AI concentrate on Web pages MicroBlog and WeChat. Regarding emotional attributes, the entries of positive emotion account for 81.69%. To be specific, the distribution of emotional attributes on WeChat shows positive (89.3%), neutral (8.4%), and negative (2.3%), with 994 articles carried on the front pages. The distribution of emotional attributes on MicroBlog shows positive (63.5%), neutral (22.7%), and negative (13.8%). The sex distribution based on MicroBlog accounts shows male clients amount to 75.4%, which proves that male netizens concerning AI accounts for a great majority of the people involved.

Qingbo Index is a leading search engine for the third-party new media data in China as well as a domestically leading mega-data platform by "MicroBlog, WeChat and News Client." By July, 2017, it has had over 60000 registered clients, who generate 640000 WeChat entries per day. It issues 2000 lists. Its unique canonical algorithms including WCI, BCI, and OCI become the evaluation standards adopted by the ministries of Central Government, state-owned enterprises, and top-500 in China. An analysis into both positive and negative emotions shows that the positive one on WeChat and MicroBlog concerns the issues on changes of people's life by AI, such as robot coach, precision teaching by AI, labor saving, efficiency elevation, precision medical service attracting considerable investment, AI applied in legal field and its development process, the application AI in education to offer opportunities for blending governmental and non-governmental education, etc. Similar to the cases in WeChat, the positive emotion in MicroBlog also centers AI application in the improvement of social life and efficiency, covering AI to be the tool for case-handling system in Chinese courts. The view that AI may bring "more employment" and importance should be attached to AI development has become the global consensus. Yet, the negative emotion in MicroBlog was ignited in a speech by Elon Musk delivered at the conference of US State Governor Association in July, 2017, in which he claimed that AI would bring cost risks to human civilization and that AI would replace mankind's work and even trigger war.

Secondly, to refine the analytical results, we sort out the index data in Sina MicroBlog based on AI as the key word, involving the contents on the Web site platform from 2013 to 2017. A survey proves that public interest in AI keeps increasing and the crest value for this hot word reached 106,053 persons/times on March 24, 1014. The peak value on this word was up to 6,108 persons/times on August 4, 2013, 1,522 on February 13, 2014, 8233 on December 22, 2015, and 121,150 on September, 1, 2016. For details, please see Fig. 1.1.




**整体趋势：The overall trend**
**人工智能：Artificial Intelligence**

**Fig. 1.1** Overall trend on Sina micro-index for artificial intelligence

Two indexes on regional heated discussion and client heated discussion show that the top-three cities are Beijing, Guangzhou, and Shanghai. In terms of sex, the male clients pour greater enthusiasm in AI (70%) and the rest is for female. From the age perspective, the clients aged from 25 to 34 account for the top, those aged from 19 to 24 came to the next, followed by the ones aged from 35 to 50.

Thirdly, when surfing this topic on Zhihu Web site, we find 16,715 entries on AI on Zhihu Forum, involving 876,176 people, among whom they brought forth 999 elite posts. Among the elite posts, the top-five ones are listed in the declining order. The first one is "Why do so many celebrities keep alert on AI?" approved by 23,000 clients, with 1870 comments. Then comes to "How about the recommended algorithm for NetEase cloud music sheet?" approved by 16,000 clients, with 826 comments. "Is it true that Gao Xiaosong claimed that performance of AlphaGo was of little aesthetic feeling and it was unable to exercise 'go'?", approved by 16,000 clients, with 529 comments. The fourth is "What do you think of the two mysterious aces in AI (Master P and Xing Tian P) on Yixheng I-go Web site and Yehu I-go game organized by Tencent?", approved by 13,000 clients, with 499 comments and the last one is "Can you try to write a story on the topic 'Siri is out of control'?", approved by 13,000 clients, with 532 comments. All the above figures prove that the public harbors strong interest in both technical conditions and application prospect in AI technology as well as the potential threats that it may bring to human society.

As a matter of fact, there is striking opinion in contrast to AI network discourse before and after a hotspot event. To take AlphaGo for an example, the network discussions quoted the cases mostly from the movies before the game, while the network discourse focused the threats from AI (such as the replacement of man's work). After the game, people's interest in AI kept rising, with more discussions on pilotless automobiles. Obviously, the positive or negative cognition from the public is closely related to the direction public opinions.

(3) Artificial Intelligence Applied in Movie Making

Mass media usually exerts significant influence on public cognition of certain things. Before the term "Artificial Intelligence" was coined, novels and movies imagined what it was like and represented it. In 1868, in his science fiction "The Steam Man of the Prairies," Edward Ellis, American novelist, remolded the early robots." In 1886, French writer Villiers Adam coined the term "Android" in his work "La Eve Future," a classical science fiction, a case of robot concept shown in popular literature for the first time. In 1020, Karl Capek, Czech writer, composed a play "Rossum's Universal Robots," in which the playwright described a man-shaped machine society and coined a term "robot."

At the beginning of the twentieth century—with the rapid development of an intermediary—movie, robots, and other machines equipped with AI appeared in the early films. According to the statistics on AI movies made by Robert Fished, professor of Informatics, Edinburg University, Britain, there are altogether 351 AI movies from 1927, the year greeting the first AI movie "Metropolis" to 2016. The distribution on AI movies is shown in Fig. 1.2.

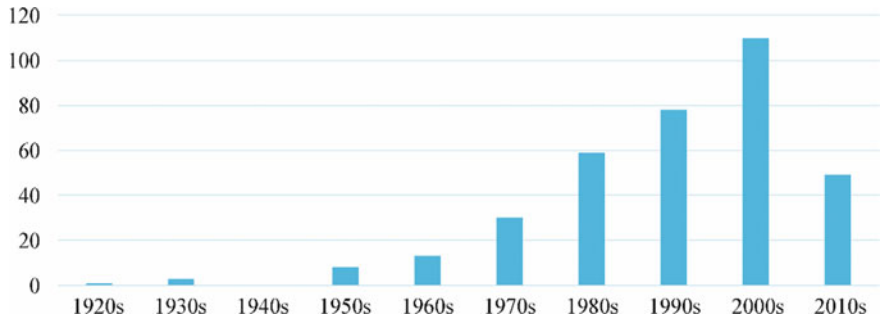



**Fig. 1.2** Movies related to Artificial Intelligence (1927–2016)

As far as the theme is concerned, the early robot and AI movies mainly focus "anti-intelligence." From 1920s to 1960s, the movie showed people's horror on AI development, such as "The Mechanical Man" shot in 1921, "Undersea Kingdom" in 1936, and "The Phantom Creeps" in 1939, which tried to depict the terrible scenes under the rule of the evil robots. In "The Mechanical Monsters" showed in 1941, vicious robots made by a scientist attacks a human city and only superman can frustrate their intention. In the movie "2001: A Space Odyssey" shot in 1968, people's horror for AI is elevated to a new height in which intelligent computers are capable of sensing and reasoning, trying to murder the astronauts, and their conspiracy was not frustrated until the computers were forcefully shot off. The director of the movie tries to answer such a question: What will our world be like if computer intelligently surpasses mankind? Many subsequent movies also attempt to solve this problem. Unfortunately, this issue is still troubling human beings.

From 1970s to 1990s, the movies began to show multiple attitudes toward robots, yet the horrific scenes still exist on the screen. For example, "The Terminator" in 1984 presents the situation that AI machines headed by WebGather try to eliminate all the human beings. But there are movies probing into the possibility of forging friendship between robots and mankind. In 1977, the popular movie "Star Wars" aroused the public strong interest in robots, which initiated the succedent interplanetary films attracting numerous fans in AI. The robot C-3PO in this movie is one of the most benevolent robots in robot theme.

Since 2000, the depiction of AI in Hollywood movies turns to be multifarious, with more forms and ways to deal with the terminal question whether AI benefits or destroys human beings in the movies. For example, "I, Robot" shown in 2004, which is adopted from the novels of Isaac Asimov, an American fiction writer, embarks on the relationship between the robot with human intelligence and sentiment and mankind, a theme that arouses the popular heated discussions. Indian directors also produce three movies related to AI, covering "Robot of Love, 2010," and "Ra.One, 2011," and "Action Replay, 2010." All these works show the interactions between AI and mankind, but the producers tend to believe that human wisdom gets an upper hand over AI and that robots can be controlled. Meanwhile, they realize that more

and more robots will be used in human life and these intelligent machines will be a good helper to deal with the crisis of human feelings. After seeing those movies, people will gain an insight into the relationship between mankind and intelligent machines.

Compared with news media and social media, movie is another straightforward media with entertaining function. Yet, it is by no means disposal consumer goods, but conveys special political and cultural norms which bring imperceptible impact on the individual worldview, outlook on life and values. Based on this understanding, we may realize that movies in AI are of great help for people to know, perceive, and judge AI potential and its threats.

(4) China's AI Development Reported by Foreign Media

Foreign mainstream media pay close attention to the momentum of growth in China's AI development. While reporting China's rapid development and huge potential, some foreign media take China as a tough rival in this field and even hint that China harbors the intention to dominate the world.

Since 2017, several western media reported that China might catch up with and even surpass the USA in AI. On February 4, "The New York Times" issued an article entitled "It Won't Be A Daydream that China Will Overtake the United States in AI," in which the author held that China's researchers and enterprises were making great leap in AI, whereas the USA would no longer be a dominator in this uprising technology. With regard to the issue whether China would be the leader in AI and robot technology, there appeared heated controversy between American military strategists and science experts.

On July 15, "The Economist" released "The Kingdom of Algorithm" and its Web site published "China May Be A Rival to or Even Surpass the United States in Artificial Intelligence," claiming that China was only second to the USA and was possible to overtake it in certain respects of AI. The article attributed two reasons to the rapid development of China's AI. Firstly, as some technical tycoons such as Baidu, Tencent, and Ali Baba highly evaluate AI development, they plunge into this field and acquire adequate capital backing. Secondly, China boosts two incomparable resources, numerous scientific professionals and huge volume of user data.

On July 27, the Web site of "The Diplomat" circulated "China's Revolution in Artificial Intelligence," in which the author conducted a meticulous analysis into "The Development Program of A New Generation of Artificial Intelligence" newly released by Chinese Government, and the American held that China would desperately seize this opportunity of revolutionizing AI to strengthen its comprehensive national strength and competitive edge and try to become a leading country in science and technology. For this purpose, Chinese Government would program its AI development from the perspective of national strategy. The author also asserted that AI was not the panacea for solving the economic and social issues troubling China and close attention should be paid to what measures would taken in the program.

Obviously, with more and more people involved into the discussions on AI, social elites begin to prepare for the opportunities and challenges in this new round of

technical revolution from their respective professional perspectives and evaluate the impact brought by AI development.

## 1.3 The Opportunities and Challenges Brought by AI Age

Since 2016, the emergence of new theories and technology in mobile Internet, mega-data, supercomputing, sensor network, and brain science has expedited a new era of AI. At present, breakthroughs in intelligent technology are being made in an accelerating speed and they will be soon put into application, bringing far-reaching influence on every respect of human life, which will forces mankind to seek for new developing ways in intelligent age.

### *1.3.1 Opportunities for Economic Development in Intelligent Age*

Now, all the countries have successively released their programs for AI development, aiming at elevating productivity and competitive edge so as to invigorating economic development. This trend shows that AI will be loaded with the mission to promote economic development ad industrial advancement, during the process of which numerous opportunities will be available.

(1) Artificial Intelligence Will Revitalize Traditional Enterprises

Nowadays, the capital-intensive and labor-intensive production modes are sluggish to promote enterprises' development in a rapid way. Nor can they sustain speedy economic development. In this case, AI will serve as a rising production factor for upgrading traditional enterprises. As a result, production will be considerably increased while production capital will be saved up, and the traditional enterprises will be revitalized.

An analytical report by Accenture made on April, 2017, proves that by 2026, ten clinical AI applications will save up 150 billion $US in American medical industries. The ten applications cover:

(1) robot-aided surgical operation (40 billion $US);
(2) virtual nursing assistants (20 billion $US);
(3) work-flow management assistants (18 billion $US);
(4) fraud check (17 billion $US);
(5) reduction of drug–dose mistakes (16 billion $US);
(6) conjunctive machines (14 billion $US);
(7) identification clinical trial participants (13 billion $US);
(8) preliminary diagnosis (5 billion $US);
(9) automatic imaging diagnosis (5 billion $US);
(10) network security (2 billion $US).

A report made by Price Waterhouse Coopers shows that by 2030, AI will contribute 15.7 trillion $US to the global economic growth, among which commercial automation and AI helper will greatly elevate productive forces, a contribution of 6.6 trillion $US in this part. Consumption will account for 9.1 trillion $US, during the course of which customers will purchase individualized and high-quality commodities. Artificial intelligence will enable global GDP to grow by 14% in 2030. Accenture predicts that by 2035, AI will remarkably promote China's annual economic growth rate from 6.3 to 7.9%. Both reports presage that upgrading traditional industries may save up production costs while propelling economic development.

(2) Artificial Intelligence Brings Along Rapid Development of Emerging Industries

Every strategic emerging industry signifies an orientation of a new round technical revolution and industrial reform, a transition that serves as a critical point for developing new functions and acquiring new advantages in the coming competition. Newly springing strategic AI industries cover pattern recognition, face perception, intelligent robot, intelligent vehicle, augmented reality and virtual reality, intelligent terminal, fundamental devices for IOT, all of which are the new fields created by AI.

In July, 2017, "The Program for Developing A New Generation of Artificial Intelligence" promulgated by Chinese Government serves as the top design and strategic plan for AI policy, which prescribes "Three-Step" developing stages after a comprehensive consideration of China's situation, and specifies the strategic goals for China's artificial intelligence. By 2020, the overall AI technology and application should keep abreast with world advanced level and the core industries will yield the output value worth 150 billion yuan and mobilize the relevant industries to turn out the products worth over one trillion yuan. By 2025, part of technology and application will reach world's leading level, 400 billion yuan for core industries and 5 trillion yuan for relevant industries. By 2030, the overall technology and application advances to world's leading level, one trillion yuan for 10 trillion yuan for relevant industries. The program will offer enormous opportunities for the development of the rising industries.

(3) Artificial Intelligence Will Expedite the Emergence of New Commercial Modes and New Trades

Commercial AI will be a major industry in the coming years. Whether traditional industries or emerging industries, they aim at improving their operation by intelligent machines and mega-data, constantly meeting the requirements from customers by application of intelligent devices and mega-data, a direction attracting the commercial tycoons.

At present, the feasible track is the artificial intelligence driven by realistic application requirements and application defect of "Internet+," based on which a new commercial mode marked by "AI+Finance" emerges. The new commercial mode must be applied at large scale in the relevant fields, covering intelligence used in manufacturing, agriculture, logistics, traffic, power grid, medical care, finance, learning housing, commerce, and city. Once AI is applied in these fields, we may elevate

intelligence level for industrial development in an all-round way and assist in rapid economic development.

### *1.3.2 Challenge for Human Society in Intelligence Age*

A report made by Gartner in 2017 shows that AI will turn to be a subversive technology in a decade to come. In short term, machine learning and in-depth learning are in the peak period. In two to five years, it will become the mainstream application technology. Obviously, the rapid development of AI is changing people's life and our world. Human society transits from binary order to ternary one. Although the transitional course will not proceed so smoothly, ethics and morality, law and regulations, employment and education, security and international norms on which human society is based are undoubtedly met with severe challenge.

In ethics and morality, with the extensive application AI, man's privacy will be thoroughly laid bare before security-check system. How will man react in embarrassing situation? Will man's fundamental right be first or his security first? As ever-sophisticated manufacturing technique reduces the commodity prices, nursing robots will be soon put into market in great quantities, which may bring shock to the traditional relations of the family members and incur the restructuring of social relations. With the development of bionic technology, man will be equipped with machine in his body and the machine will help man to do many things. Then, what do we think of "man-machine integrity"? Do we take this blending as "a man" or "a machine"? All these will make us to reconsider man and man's nature.

In terms of law the regulation, under the existing legal order, the redefinition of the traditional legal subject qualification, the industrial upgrading of legal consultant service, and the right ownership of the contents generated by AI are troublesome issues requiring pressing solution. As far as the legal status and responsibility of intelligent robot is concerned, how to define AI and intelligent machine and how to identify the legal status and responsibility of robot still remain to be settled. Regarding the protection of intellectual property right and relevant right, how to differentiate the contents in traditional works by and generated AI, how to determine the content generated by AI and copyright, and how to protect the contents generated by AI demand our meticulous consideration and study.

With regard to education and employment, they will be the probability events in intelligent age. A large number of production posts will be replaced by machines. Individualized work will be substituted by man–machine cooperation. Numerous office employees will work at their houses, and there will appear more and more freelances. Based on the laws of successive industrial revolutions, the emerging one will be bound to eliminate the outdated working modes, but plentiful jobs will be offered. It is a general trend that new posts will replace the old ones. Correspondingly, education should adapt itself to this transformation, focusing cultivating the professionals who are competent for the new jobs. To higher education, the concept of university should extend beyond the entity and enclosure and realize conceptive education as

advocated by Prof. Qian Weichang, the late president of Shanghai University who appealed "dismantling the four boundaries" (the boundaries between school and society, the boundary between the discipline and the administration departments within a university, the boundary between teaching and scientific research, and boundary between one pedagogy and the other), and we may forge "a shared university." To the teachers, students may employ the best teachers in the world on theoretical base. If so, college teachers may be met with greater challenge. This situation will bring us another headache problem—how to exercise administration over teachers and students.

On security and international norms, mankind is confronted with numerous issues on security. With the advent of intelligent age, new problems may come at wake of the settlement of the old ones. Remaining to be solved, some old issues will be become tougher, such as security in traffic, individual, production, foodstuff, resources, network, public, national defense and fiancé, etc. To the final analysis, we should see to AI security by enforced measures, as security during intelligent age is more complicated than before, which will be ensured by the concerted efforts from international community rather than by an individual country. Therefore, we should establish an AI international organization, formulate international norms on AI, perfect AI international cooperative mechanism, and strengthen our ability to control artificial intelligence so that we may do our bit to "human destiny community." In addition, the worst challenge lies in military security in intelligent age. It can be predicted that military security will be deteriorating in the days to come. Here we appeal that the governments of different countries should be highly alert of this issue.

### *1.3.3 The Far-Reaching Influence Brought by AI*

Nowadays, while attracting the close attention from international community, AI upsurge has brought numerous opportunities for scientific research and industries, but it also incurs a certain shock to the existing social orders. It can be anticipated that intelligent age will exert profound influence upon human evolution, human developing process, and the relationship between man and nature.

(1) Intelligent Age Will Promote Human Evolution to a Higher Stage

In the past two and three decades, major breakthroughs have been achieved in AI's simulation of human perception and learning and great headways have been made in speech recognition, image identification, autonomous learning, etc. In many respects, AI has been approached to man's ability or even surpassed it. However, AI study does not aim at replacing mankind but at supplementing man's ability, especially strengthening man's ability through setting free the bounds on man. AI may help man to realize many purposes. One conspicuous tendency indicates that with AI development, the advent of machine-inlaid man and intelligent robot will break the boundary between man and animal, man and machine, and drive man to a higher evolution.

(2) AI Will Accelerate the Development Process of Human Society

As Chinese often quote "Science and technology is the primary productive force," AI will bring far-reaching influence on world development process and promote human evolution. With AI being more popular, tremendous change will take place in the existing social structure as what the successive industrial revolutions reacted. The present development speed is adequate to perform the functions on every respect of human society.

(3) AI Will Enable Man and Nature to Harmoniously Amalgamate

During the primitive civilization, man adapted himself to nature in passive way. In the times of agricultural civilization, man was positively suited to nature. In the era of industrial civilization, man became the dominator of nature. With the coming of intelligent age, the beliefs "Man is the paragon of all living creatures" and "intelligence peculiar to human beings" will gradually fade away and man will no longer be so sacred and mysterious, whose unique subjectivity will be changed. All these transformations enlighten man's further understanding on the relationship between human beings and nature and urge them to construct a harmonious environment between themselves and nature.

However, the assertion "Man will perish in AI age" deserves our intense attention. But we should not be bothered by this claim too much as the developing trend of AI proves that three issues still remained unsolved. Firstly, data standardization, circulation, and coordinated perception are to be elevated. No high integration density of various sensors simulating man's perception of five organs based on AI infrastructure is yet to be achieved. Scientists are still unable to unfold integrative collection, processing, and analysis of multi-source data acquired by the sensors. Secondly, no AI breakthroughs are made so far in the critical technology of human brain operation. AI is still in initial stage in terms of technical development and breakthroughs in higher level of artificial consciousness, emotion, and perception that are to be made. Thirdly, there remains much to be desired in usability and automation in intelligent hardware platform, and AI application. The applicable intelligent hardware platform, intelligent competence, sensory system, and the adaptability to different environments of service robot are still restrained by the underdeveloped level of AI. In the short run, it is impossible for us to furnish robots with man's learning and reasoning capacity, let alone the robots' comprehensive judgment approximate to that of human being.

As AI era is approaching, what we should do is to deal with relevant the issues with the application of new concepts, new ideas, and new strategies. Individual is expected to spare no efforts in promoting technical innovation, transformation, and application, while team planning and collaboration are required to propel the common progress of human society. What is more, the international community should cope with the opportunities and challenges with the open attitude, the action for innovation, the shared concept, and the vision to take human being as a community with the common future.

## Bibliography


Accenture. *Artificial intelligence: Healthcare's new nervous system*. [20170924]. https://www.accenture.com/us-en/insight-artificial-intelligence-healthcare.

Accenture. *How artificial intelligence can drive China's growth*. [20170924]. https://www.accenture.com/cn-zh/insight-artificial-intelligence-china.

Blumberg, R. *What happens when the Trump administration ignores AI*. (20170422) [20170924]. https://venturebeat.com/2017/04/22/what-happens-when-the-trump-administration-ignores-ai/.

Boucier, D. 2001. De l'intelligence artificielle à la personne virtuelle: Emergence d'une entity juridique?. *Droit et Society* 3 (49).

Charniak, E., and D. Mcdermott. 1985. *Introduction to artificial intelligence*. Reading, MA: Addison-Wesley.

Collins, H. 2000. Les capacités des ordinateurs et leurs limites. *Réseaux* 8 (100).

Escande, P.P. L'intelligence artificielle défie l'humanité. *Le Monde*, 20170623 [20170924]. http://mobile.lemonde.fr/idees/article/2017/06/24/l-intelligence-artificielle-defie-l-humanite_5150440_3232.html.

Fast, E., and E. Horvitz. 2017. *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence*, Feb 2017. San Francisco.

Gao Ji, Zhu Miao Liang,He Qin Ming. 2002. *Ren Gong Zhi Neng Ji Chu* (*The fundamentals of artificial intelligence*). Beijing: Higher Education Press.

Goyal, P., and S. Gurtoo. 2011. Factors influencing public perception: Genetically modified organisms. *GMO Biosafety Research* 2 (1).

Hains, T. *Facebook CEO Mark Zuckerberg: AI "Naysayers" like Elon Musk are being "really negative", "pretty irresponsible"*. (20150725) [20170924]. https://www.realclearpolitics.com/video/2017/07/25/facebook_ceo_mark_zuckerberg_ai_naysayers_like_elon_musk_are_really_negative_pretty_irresponsible.html.

Haugeland, J. 1985. *Artificial intelligence: The very idea*. Cambridge, MA, London, UK: Bradford Books.

Hawking, S. *This is the most dangerous time for our planet*. (20161228) [20170926]. https://www.theguardian.com/commentisfree/2016/dec/01/stephen-hawking-dangerous-time-planet-inequality.

Hsu, S. *China is investing heavily in artificial intelligence, and could soon catch up to the US*. (20170703) [20170924]. https://www.forbes.com/sites/sarahsu/2017/07/03/china-is-investing-heavily-in-artificial-intelligence-and-could-soon-catch-up-to-the-u-s/#6672f4c85384.

Kania, E. China's artificial intelligence revolution. *The Diplomat*, 20170727 [20170924]. http://thediplomat.com/2017/07/chinas-artificial-intelligence-revolution/.

Kurzweil, R. 1990. *The age of intelligent machines*, 1st ed. Massachusetts: MIT Press.

Kurzweil, Ray. 2005. *The singularity is near—2045, when computer intelligence surpass that of mankind*. Penguin Group.

Li Yan Hong. *Ren Gong Zhi Neng Rang Fu Za Shi Jie Bian Jian Dan* (*Artificial intelligence makes the complicated world easier*). (20170629) [20170924]. http://www.tj.xinhuanet.com/ztbd/wic/201706/29/c_1121234737.htm.

Mabille, P. L'intelligence artificielle va être un énorme tsunami. *La Tribune*, 20170519 [20170924]. http://www.latribune.fr/technos-medias/l-intelligence-artificielle-va-etre-un-enorme-tsunami716841.html.

Markoff, J., and M. Rosenberg. China gains on the US in the Artificial intelligence arms race. *New York Times*, 20170204 [20170924]. https://cn.nytimes.com/world/20170204/artificialintelligence-china-united-states/dual/?mcubz=0.

Mu Zi Fei. *Ji Qi Ren Jiang Chong Ji Jiu Ye Shi Chang Ri Ben Biao Shi Bing Bu Dan Xin* (*Japan doesn't worry about robots' striking upon employment market*). (20170321) [20170924]. http://www.gkzhan.com/news/Detail/98149.html.

Murray, A. Fortune 500 CEOs see AI as a big challenge. *Fortune*, 20170608 [20170924]. http://fortune.com/2017/06/08/fortune500ceos-survey-ai/.

Musk, E. *Elon Musk predicts World War III* (20170910) [20170924]. http://news.iyuba.com/essay/2017/09/10/57808.html.

Nilsson, J.N. 1998. *Artificial intelligence: A new synthesis*, 1st ed. Burlington, MA: Morgan Kaufman Publishers.

Obama, B. *Now is the greatest time to be alive*. (20161012) [20170904]. https://www.wired.com/2016/10/president-obama-guest-edits-wired-essay/.

Pan, Yunhe. 2016. Heading toward artificial intelligence 2.0. *Engineering* 3 (4).

Poole, D.L., and A.K. Mackworth. 1998. *Computational intelligence: A logical approach*, 1st ed. Oxford: Oxford University Press.

PWC. Sizing the prize: What's the real value of AI for your business and how can you capitalize? [20170924]. https://www.pwccn.com/en/consulting/ai-sizing-the-prize-report.pdf.

Rich, E., and K. Knight. *Artificial intelligence*, 2nd ed. New York: McGraw-Hill.

Russell, S., and P. Norvig. 2009. *Artificial intelligence: A modern approach*, 3rd ed. New Jersey: Prentice Hall.

Secretan, P. 2003. Remarques sur l'intelligence. Ses illusions et ses crises. *Autres Temps* (7980).

Shim, H.B., et al. 2017. Examining public perception of artificial intelligence in cyberspace: Before, during and after the Alphago vs. Lee Sedol competition. *Meeting of Pacific Telecommunications Council*, 15–18 January 2017, Honolulu [20170925]. https://online.ptc.org/assets/uploads/papers/ptc17/PTC17_Wed_RTS11_Shim.pdf.

Soubranne, Q. Comment le big data et l'IA vont révolutionner le conseil financier. *Le Journal Du Net*, 20170614 [20170924]. http://www.journaldunet.com/patrimoine/finances-personnelles/1195333comment-le-big-data-et-l-ia-vont-revolutionner-le-conseil-financier-selon-xerfi/.

Tian Ma Jin Yun. *Zhi Neng Gai Bian Shi Jie—Ma Yun Zai Shi Jie Zhi Neng Da Hui Yan Jiang Quan Wen* (*Intelligence changes the world—Ma Yun's full text on World Intelligence Meeting*). (20170629) [20170924]. http://www.sohu.com/a/153144011_689129.

Tnn, H.C. Artificial intelligence has globally impacted businesses across industries. *The Times of India* 20160829 [20170924]. http://timesofindia.indiatimes.com/business/india-business/Artificial-intelligence-has-globally-impacted-businesses-across-industries/articleshow/53912240.cms.

Walker, M.J. *Hype cycle for emerging technologies*. (20170721) [20170924]. https://www.gartner.com/doc/3768572/hype-cycle-emerging-technologies.

Winston, P.H. 1992. *Artificial intelligence*, 3rd ed. Reading, MA: Addison-Wesley.

Xi Jin Ping. *Rang Gong Cheng Ke Ji Zao Fu Ren Lei 、 Chuang Zao Wei Lai—Zai 2014 Nian Guo Ji Gong Cheng Ke Ji Da Hui Shang De Zhu Zhi Yan Jiang* (*Making engineering and technology bring benefits to mankind and create the future—Keynote speech at International Conference on Engineering and Technology in 2014*). (20140604) [20170924]. http://cpc.people.com.cn/n/2014/0604/c6409425099536.html.

Xi Jin Ping. *Zai Er Shi Guo Ji Tuan Gong Shang Feng Hui Kai Mu Shi Shang De Zhu Zhi Yan Jiang* (*Keynote speech at the G20 Business Summit's opening ceremony*). (20160903) [20170924]. http://news.xinhuanet.com/world/201609/03/c_1119506216.htm.

Xi Jin Ping. *Zai Ou Mei Tong Xue Hui Cheng Li 100 Zhou Nian Qing Zhu Da Hui Shang De Jiang Hua* (*Speech at the Foundation of Euramerican in memory of its one hundredth anniversary*). (20131021) [20170924]. http://cpc.people.com.cn/n/2013/1022/c6409423281641.html.

Zerega, B. AI Weekly: Google shifts from mobile-first to AI-first world. (20170518) [20170924]. https://venturebeat.com/2017/05/18/ai-weekly-google-shifts-from-mobile-first-to-ai-first-world/.

Zhang, S. China's artificial intelligence boom. *The Atlantic*, 20170216 [20170924]. https://www.theatlantic.com/technology/archive/2017/02/china-artificial-intelligence/516615/.

Zhang Xuan. Zhuan Jia: *Ren Gong Zhi Neng Fa Zhan Ying Re Chao Reng Xu Leng Si Kao* (*We need calmly think at the climax of the development of artificial intelligence*). (20170723) [20170924]. http://finance.sina.com.cn/roll/20170723/doc-ifyihrwk1973070.shtml.

Zhong Hua. *Ren Min Gong He Guo Zhong Yang Ren Min Zheng Fu. Xin Yi Dai Ren Gong Zhi Neng Fa Zhan Gui Hua* (*Development planning of the new generation's artificial intelligence*). (20170708) [20170924]. http://www.gov.cn/zhengce/content/201707/20/content_5211996.htm.

# Chapter 2
# Artificial Intelligence and Ethical Principles

**Weiping Sun**


W. Sun (✉)
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 200444, China
e-mail: swp1966@126.com



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_2

**Abstract** People tend to confuse ethical principles with moral principles as these two concepts are quite similar ethical principles refer to the social relations of propriety, whereas moral principles denote the norms and standardizations for human actions. The former emphasizes objective human relations for people in their interactions, while the latter focuses the corresponding objective norms and moral property, the two of which adjust the value system of social relations among the people, including the intrinsic value ideal and the extrinsic codes of conducts. Artificial intelligence is by no means a generally pure technique, but a revolutionary technology that will significantly transform human society and our world, with much room for development and extensive application prospect. Meanwhile, it is also an open and subversive technology, far from being mature, for which no one can predict both the ethical and moral consequences it will incur. In recent years, with rapid development of AI and its application in broader domains, there appear both positive and negative effects with each passing day, especially its successive breakthroughs of biological restraints. Once such powerful AI technology is blended with biotechnology, there will be the greater probability that the integration will surpass human intelligence, which will lead to huge uncertainty and risks. At the same time, confronting this critical emerging technology, we realize an intense contrast between the robust AI development and our deficiencies, including backward concept, unclear policy orientation, shortage of ethical regulations, the tenuous moral ideas and the imperfect laws and regulations. Under such circumstances, we should set foothold in ourselves, conduct an all-round introspection on AI and the application consequences. We should persist in people-first principle, safeguard human dignity, guard against and dissolve the possible risks so as to establish a reasonable, righteous ethical order.

## 2.1 Positive Effects on Ethical and Moral Principles Brought by AI

It can be anticipated that the advent of intelligent era will exert enormous and far-reaching influence on the modes of social production, people's living styles and their ways of leisure and recreation. Based on AI development and application, we should mind to strengthen the material foundation for ethical and moral construction, resort to multiple moral means and instruments, and elevate people's ethical and moral awareness so that we may seize the god-given historical opportunities.

### *2.1.1 Strengthening the Material Foundation for Ethical and Moral Construction*

(1) Social and Economic Development and Ethical and Moral Construction

As AI development drives the elevation of productive forces, the degree of social intelligence becomes a landmark evaluating the developmental achievement of a

country or a region. As the intelligent age is approaching, AI is exerting influence on the modes of social productions and people's living styles. Moreover, the emerging intelligent industries contribute a lot to economic growth. A fact shows that the extensive application of AI has driven the restructuring industries, the ongoing transformation, and upgrading of economic structures, the improvement of productivity and the provision of more products and services. With speedy economic development, more social wealth will be accumulated, which, in turn, makes people more affluent, and elevates social governance. Although the remarkable improvement of people's living quality under such circumstances, a solid foundation has been laid for the elevation their ethical and moral standards, the free and all-round development for man and our society.

Historical materialism proves that productivity plays a decisive role in social development and a conclusive force for the free and all-round development of man and our society. The material improvement has been into-relative, interactive and inter-supplementary with the promotion of cultural and ideological progress. An ancient Chinese remarked, "When one's barn is filled with grain, he will know how to behave in a ritual way. Once a man is well-clad, he will be aware of the honor or disgrace" ("Guan Zhong—How to Govern the People"). Only with certain material foundation, from which people may quench their requirements in food, clothing, housing and traffic, will they yearn for spiritual and cultural realm, will they have the time and energy to make up for their deficiencies, will they gradually change the chaotic, ignorant, superstitious and backward conditions around them and achieve progress in spiritual, cultural, ethical and moral fields. Otherwise, they will render themselves into "the generally miserable and extremely impoverished conditions, under which they will again rise up in the struggle for the necessities and all the decayed and filthy dregs will stage a comeback" ("Selected Works of Marx and Engels" (Vol. 1), People's Publishing House, 1995, pp. 86).

With the advent of intelligent era, together with the accelerating development of intelligent economy and intelligent culture, constant improvement is being made in intelligent governance and intelligent services, all of which meet the increasing spiritual and cultural requirements of the people in an unprecedented way. This is especially shown in the fact that people have greatly expanded their survival and activity space. The improvement of living standard will enable people to better develop themselves and bring their potential and value into full play so that they may make substantial headway in "Helping others to reach their aims while subliming one's morality."

(2) Offering Direct Support for Ethics and Morality

As a frontline basic technology, AI is brimming with broad and limitless application prospect. AI not only promotes the adjustment of industrial structure and economic transformation, lays a favorable premise and foundation for ethical and moral construction, but also is directly applied in the fields related with ethical a moral realm, offering support for its construction.

In intelligent era, the central government will pool more funds for the following goals, including enhancing AI education and training, innovating of the modes for

ideological and political education, improving the public cultural quality, scientific and ethical cultivation, providing more precision intelligent services, promoting safe and efficient social functioning so that people may enjoy quality services and convenient life, establishing and perfecting the mechanism for social welfare and social security so as to aid and support the vulnerable groups and realize social equity and harmony, strengthening AI function to exercise real-time monitoring on natural disasters, constructing intelligent monitoring and early warning and controlling system foodstuff, drug and public security, protecting the public life and property from encroachment, applying technical, economic and legal means to exercise penalty on those who violate moral principles (intelligent criminals in particular) so as to safeguard the fundamental ethical standards and social orders.

As ethical and moral principles involve every respect of social life, the construction of those principles should also keep abreast of time, which should accord with the public expectation and requirements in intelligent age. In such an age featured by multi-elements and interactions, ethical and moral construction should organically integrate with economic, political, social, cultural and ecological construction rather than focus formalization and specialism. It should proceed with research, design, production, application and management of artificial intelligence. By means of multiple and multi-level interactions to bring about mutual influence and common elevation, ethical and moral construction will achieve the function of humanization in a gradual way.

### *2.1.2 Social Development and Betterment of Man's Ethical and Moral Behaviors*

(1) To promote more "ethical" productive process

In agricultural production, man manipulated instruments of production by his physical power and harness of domestic cattle. This production mode exhausted much man's physical energy, but he reaped much fewer fruits of labor as compared with modern production. Industrial revolution has set man free from his strenuous physical labor and considerably elevated production efficiency at unit interval. Moreover, it expands the space needed for people's survival and living and enriches their living experience. However, it has also brought unprecedented negative effects to people. Before machines were put into use on large scale, people followed the rhythm "seeding in spring and harvesting in autumn", and they had certain free time for their disposal, whereas natural time is squeezed out by machines in mechanical production and the workers must keep the rhythm of machines, repeating the tedious and repetitious operation and turn out the standardized production in batches day by day. Workers feel stressed, disinterested, repressed, and annoyed. Karl Marx hit nail squarely, "Machines replace manual labor, turning some workers back to the rustic labor and some others are turned into machines. Labor generates wisdom, but brings

crassitude and dementia to workers" (Vol. 1, "Selected Works of Marx and Engels", 2012 ed. People's Press, pp. 53.).

The rapid development of AI realizes intelligent reform to machines and endows machines with man-like thinking mode and thinking ability. This change not only revolutionizes mode of production and greatly improves productivity, but also expands the space for human survival and living, making them experience abundant and limitless possibilities.

When machines were just applied in production, automation began to appear. Yet, short of sensing technology and the technique to analyze and process information, the automatic machines cannot be made independent judgment in production process. Therefore, man's function is irreplaceable in production process. With IT development, AI grants machines such sensory organs as "eyes" and "ears" and "brain-like" thinking organs. In this way, intelligent machines can undertake much work and set workers free from the alienated state caused by the mode of machinery production. Under such circumstances, man may have much more time to explore and experience the unknown world, to conduct interactions with others, to tap his own potential and to cultivate his ethical culture.

(2) To help man improve himself incessantly

As the extension of man's hands, legs and brain, AI will enable man's body structure and ability to develop in a dramatic speed by such means as man-machine mixture, man-machine symbiosis, and man-machine integration. For instance, the ever-increasing man-machine coordination and plus breakthrough in AI may substantially improve man's ability in memory (storage), computing, logic, reasoning and management. As a result, man's cognitive competence is greatly strengthened and elevated. With the assistance of data-based analytical technique, virtual technology, and machine-aided learning, man's potential will fully be tapped and applied. Much potential and work that could not be tapped and done previously are now under the people's consideration and operation. For example, as AI may be used in virtual reality, everybody may drive plane, submarine, and spaceship by means of virtual technology. Man can travel through spatiotemporal channels…. "We can fly to the moon to make exploration and dive into the ocean to mine minerals" is no longer a far-farfetched dream, but a "comprehensible" and "perceivable" reality.

In virtual reality, one may be turned into a different person in body and mentality, even make selection by his own or other's will (lover or companion), but the relevant experience may be quite different. Ray Kurzweil, American futurist, makes a bold prediction, "By 2030 or so, we may put nano-robot into man's brain through capillary, which will associate the cerebral cortex responsible for thinking and cloud storage to bring about interactions, a way that will make man look healthier, more handsome and live longer …".

It is noted that AI not only serves as a tool to externally strengthen man's ability, but also develops "internally", changing "man-machine confrontation" state since Industrial Revolution and trying to forge a situation marked by man-machine coordination, man-machine integration and man-machine harmony. For example, with more intelligent technology put into application, personal terminal can not only process

words, but also deal with image, audio and visual materials, forming a holographic operation system for communication between intelligent terminal and man. Moreover, the new-type man-machine system becomes smarter and more "considerate" for people to leisurely operate, free from any "mechanical" attribute. Headway is also made in the research of personal audio and writing system which will easily identify the customer's voice and shift the sound among different languages (interpretation), evolving into "my assistant", "my secretary" and "my companion." Some given intelligent system may take care of the disabled and patients and will be equipped on their bodies or installed into their inner part to help them to get over their bodily defects and inability…. In the new living environment, people's space for survival and living has been greatly expanded, together with numerous modes available for their study, work, leisure, and entertainment. Man will be remolded, more powerful and more consummate. Their imagination and creativity will develop in an unprecedented pace, whose mentality and talent will be fully demonstrated.

(3) Ethical Implication of Free Time

During industrial upgrading and economic transformation in intelligence era, various human jobs will be done by intelligent robots, especially the posts shunned off by people, with the ever-increasing automation and intelligence in machines. The intelligent production will not only greatly improve productivity, but also free the laborers from the pernicious and dangerous working environment, thus saving up manpower and labor hours which accordingly increases people's free time and makes it possible for man to free himself from the heavy and tedious work and develop himself in an all-round way.

Man's emancipation and all-round development must be based on free time. The so-called free time indicates the time for man to allocate at his will except the necessary working hours, with which people may acquire a free and all-round development in a society. It can be said that free time is the prerequisite for people's emancipation and all-round development.

In human long-standing civilization, due to low productivity, mankind had to spend most of their time on producing living necessities, leaving very little free time for them. With the advent of surplus products or free time based on surplus labor, a small part of people might take up the surplus products or surplus labor to free them from the strenuous production labor and evolve into "white-handed class." By means of arrogating surplus products or surplus labor, they dispossessed the free times, whereas most people had to be loaded with the onerous labor and became "laboring class" in producing materials all their lifetime. They were deprived of the free time they created which was indispensable for study, research, and entertainment. For example, in capitalist society with private ownership, the profit-making nature of capital will inevitably turn the free time made workers into surplus labor and squeeze the surplus value created by workers as much as possible. The capitalists will, by hook and brook, restrict their employees to use the free time to amuse, develop, and elevate themselves. Even if the advanced technology was put into use which resulted in the improvement of productivity, the reduction of labor hours the workers earned through the rising labor movements, the capitalists still tried to

increase the complexity in production process by the claim "increase revenue by laying off employees." In this way, workers had to spend more time for training and reeducation in an endeavor to elevate their laboring quality and competence and do their bit to "capital appreciation" in conscious or unconscious way.

With the advent of intelligent age, although no changes are made in the innate greedy nature of capital, in the existing ruling order and in the situation that some people accroach the surplus labor of others (in other words: free time), labor productivity and social productive forces have been substantially increased due to the development and extensive use of AI, ever-sophisticated automation and intelligence, which not only meets various consumption requirements for man's all-round development, but also sets man free from his taxing mental and physical labor, thus unprecedentedly reducing man's working hours (or man's essential social labor hours), resulting in the weakening of the rulers' and the exploiter's monopoly right over man's development of his potential and competence and the general increment of free time for him to develop in an all-round way.

Economizing labor hours means the increment of free time for a man to fully develop himself, while a man's full development will react on social productivity. From the perspective of production process, economizing working time can be taken as the increment of fixed production cost, which is created by the employee. More free time for the employee indicates that he will no longer have to incessantly work for livelihood materials and that he may pursue what he likes, such as swimming, sports, appreciation of opera or literary and artistic creation. The development of man's interest, hobby, ability and talent will not only promote the improvement of scientific and technological level as well as social productivity so as to further raise social material production, but also facilitate man's emancipation and all-round development, imbued with profound ethical connotation.

In a nutshell, in intelligent times, the ever-innovative advanced technology, the ever-developing social productivity and the ever-increasing free time have forged a more favorable environment, conditions and means for people so that they may better develop themselves in science, philosophy, literature, art and ethics. When intelligent society gets fully developed, man will be the master of nature and society and he can control his own destiny, a free man indeed. Such a highly developed and highly humanistic society will be naturally a social formation with lofty morality and sublime progress.

### *2.1.3 The Improvement of Modes on Ethical Construction*

(1) To help mankind to exercise ethical evaluation and option in reasonable way

Artificial intelligence means the inspiring and innovative simulation of human brain. Based on "objective stance", "sober mind", "abundant knowledge", "agile thinking" and "absolute executive power", AI may help people to control the developing trend

of tines, get to know the detailed facts so as to better recognize man self and instantly improve his ethical evaluation, selection and decision.

Learning algorithm-based AI may systematically grasp man's living experience and his principle of life, help him to analyze his ethical requirements, "discover" his ethical motivation and ensure his ethical right, responsibility and obligation when he is confronted with certain ethical dilemma. Supposing that an intelligent assistant knows that one persists in such "top ethical principle" as "What you do not wish to do to yourself, don't impose it onto others." It will take this ethical principle as the basic norm to deal with the value relation between one man and the other, man and society and two different social communities, to readjust various ethical requirements among people's inter-relations and to normalize the essential starting point as well as guiding principle in autonomy, impartiality, and non-maleficence. With regard to the present situation, it reminds its master what to do. For example, one hates his child to adopt a rush and discourteous attitude to him. If he is impatient to his elder parents for some reason one day, his intelligent assistant will timely remind him that he has violated the ethical principle advocated by himself and his behavior is irrational and improper.

To mankind, given intelligent system may boast more objective stance, broader vision and richer knowledge, more detailed fact, make more reliable prediction, apply more appropriate ethical norms, experience much less interference from snarled varied social relations and traditional codes of conduct. Thus, AI may help people to exercise ethical evaluation, selection and decision in a reasonable way. In fact, given intelligent system is displaying its advantages in judging the dispute over obligation in our daily life, defining the liability in traffic accident, sentencing legal case and predicting the effect of ethical selection. At present, such assistants seem to be imperfect, but they are of help in people's ethical evaluation, selection, and decision. We may be bold to predict that the coming intelligent system will boast more and better data, and it will be "smarter", more "agile" and better to interpret ethical principles and moral norms and will be more effective in helping people to deal with ethical issues.

(2) Moral self-discipline and self-cultivation

Generally speaking, morality is sustained in two ways: self-discipline and heteronomy. Artificial intelligence for moral self-discipline and morality heteronomy provides new practice foundation and practice way.

Moral self-discipline, based on people's self-cognition and moral evaluation, is a kind of value pursuit of self-restraint and self-improvement. Intelligent system has a broader vision and more systematic knowledge, which can help people have a deep insight into the social environment they are in, accurately grasp the fact that they are facing, so as to guide their behavior in accordance with learned ethical principles and moral norms and constantly revise and improve themselves in life practice.

If people have a kind heart and hope to practice and improve themselves in morality, they can timely remind themselves to restrain unreasonable desires and urge themselves to practice moral norms by virtue of intelligent tools such as intelligent secretary, learning assistant, intelligent nanny and intelligent housekeeper.

For example, remind and urge yourself "should go to see your parents", "should keep your promise to keep your appointment on time", "should repay debts according to the agreement", and "should complete their own work."

This can help people to be self-vigilant, strict with themselves, forge their own moral personality, and be a virtuous person.

For some of their dissatisfaction which is difficult to control bad habits, such as procrastinating, online game addiction, and Internet shopping addiction, we can also design a certain intelligent program to help their "enforcement" in excess of the preset threshold.

Humans are "living" with more and more intelligent machines. With all kinds of intelligent partners who know rules, etiquette, and impartiality, people will externalize the "justice" in their hearts. They can always remind themselves to cultivate their morality, cultivate their character, stop evil and promote good, so as to elevate the level of moral self-discipline to a new level.

(3) Moral heteronomy and new ethical order

Moral heteronomy is maintained mainly by public opinion, education, and management of relevant institutions.

The age of intelligence provides a more transparent social environment for moral heteronomy and more and more moral tools.

Because the whole society is increasingly digital, networked and intelligent, data collection, storage, processing, transmission capacity are unprecedented. With people's every move being almost under the "spotlight", there is no hiding.

Such an unprecedented and transparent social environment can form strong pressure of moral public opinion to urge people to actively restrain bad motives and consciously regulate their words and deeds.

In certain moral situation, if a person or an organization's behavior is against established ethical principles and ethics, with the aid of artificial intelligence, the social public, and the related institutions can query the background information of the parties in time, accurately restore the story, which was based on facts and form a strong social pressure of public opinion, forcing the offender to refuse evil to reward good, maintain the normal order of ethics.

Losing the moral bottom line is a prominent problem facing the world and China in the period of social transformation.

> Entering the age of intelligence, for those who wantonly trampled the moral bottom line and even broke the law such as intentional injury, doing nothing to save others from ruin, being saved to bite the hand that feeds one and civil servants soliciting bribes bribery, we can use a variety of intelligent system including all kinds of intelligent monitoring system, large data analysis system, to find out the truth conveniently and quickly. And to the parties, we take systematic, strong heteronomy means.

例如，除了通过各种媒介曝光当事人，进行大范围、强有力的道德谴责外，还可以对其采取包括技术、经济、法律制裁等在内的惩处措施，切实让作恶者成为反面教材，从而将“善有善报，恶有恶报”落到实处。

For example, in addition to exposing the parties to strong moral condemnation through a variety of media in large-scale, we can also take measures to punish them, including technical, economic and legal sanctions, so as to make the perpetrators of evil become negative teaching materials, so as to implement the principle that “good is rewarded with good, and evil with evil.”

It can be seen that entering a new and unique intelligent society and facing the dilemma of lack of belief, multiple values and repeated loss of moral bottom line in modern society, artificial intelligence may become a good helper of moral education and management and a moral weapon to maintain normal social order.

Perhaps, due to the current level of intellectualization in society, people are not benefiting enough today. However, with the rapid development of artificial intelligence, novel and unique intelligent education and management methods are emerging, and a more reasonable and fair ethical order is expected to be formed.

## 2.2 The Ethical Conflict and Choice Dilemma Caused by Artificial Intelligence

Artificial intelligence is quite different from the technical problems and challenges that human beings have faced in history.

This time the problems and challenges facing mankind will be profound and comprehensive.

Artificial intelligence not only destroys the traditional human relations and causes a large number of ethical conflicts, but also leads to ethical and moral consequences related to human nature and dignity and related to the future and destiny of human beings.

Therefore, human beings have to take it seriously and make wise choices through reflection and criticism.

### *2.2.1 Ethical Conflicts Caused by Artificial Intelligence*

(1) privacy and other basic human rights are threatened

Privacy right is a basic right of personality. In modern society, there has been a consensus on the protection of personal privacy, communication freedom, and so on. However, as an abstract right, privacy right has strong elasticity and has different understandings in different cultural circles.

In general, the right of privacy refers to a right of personality in which the natural person can enjoy private life and private information secretly protected in accor-

dance with the law. This right of personality is protected from unlawful intrusion, knowledge, collection, exploitation, and disclosure by others. Moreover, the parties concerned have the right to decide to what extent others can intervene in their private lives and whether their privacy should be disclosed to others, as well as the scope and extent of the public.

When privacy right is violated, it points to prying into, collecting, divulging, or using the personal information of a party concerned without the permission of the party concerned. This will affect their normal life.

Some scholars believe that "privacy is the foundation of human rights." Then, how to protect basic human rights like privacy?

The artificial intelligence based on big data has posed an unprecedented threat to fundamental human rights such as privacy, which has been caught in a stormy dilemma. In the era of intelligence, people's life is becoming a life where everything is recorded. It may be detailed to an unexpected degree.

All kinds of data collection facilities and various data analysis systems can easily obtain all kinds of personal information, such as gender, age, height, weight, health status, education, work experience, home address, contact information, social identity, marital status, kinship, colleague relationship, faith status, social certificate number.

In the process of personal information collection and various security checks, such as the common holographic scanning and three-dimensional imaging security checks at airports, stations and docks, passengers' physical information and even privacy features can be clearly seen. Privacy disclosure often makes the parties involved into an embarrassing situation and often leads to a variety of disputes.

In the application of artificial intelligence, cloud computing has been configured as the main architecture. Many governments organize enterprises and individuals to store data in the cloud, which is relatively easy to be threatened and attacked. In addition, artificial intelligence can conduct in-depth analysis of massive data through cloud computing.

When a large amount of disordered and seemingly unrelated data is integrated, it is possible to work out a person's personality characteristics, behavior habits, life trajectory, consumer psychology, interests, and hobbies, and even read out some unspeakable secrets, such as hidden physical defects, previous medical history, criminal record, and transsexual experience.

So it's fair to say that data intelligence analysis systems often know themselves better than we do, know what we like, what we hate, what we need, what we reject, what we're for, what we're against, etc.

If sensitive personal information held by intelligent systems is leaked out and shared by people with ulterior motives, or illegally used for commercial purposes, sometimes people will be put in an awkward or even dangerous situation, and the privacy right of individuals will inevitably be violated to varying degrees.

Of course, in the social governance system, in order to protect personal privacy, legislation can be passed to stipulate that personal information cannot be disclosed under any circumstances, and protection can be implemented by popularizing encryption technology.

On the one hand, in order to protect personal privacy, the personal information collected, stored, and analyzed by the intelligent system should be absolutely confidential. On the other hand, anyone must be responsible for his own behavior, and his behavior should be recorded in detail so that people can conduct moral evaluation and moral supervision, and even be used as the evidence of legal proceedings, so as to guarantee the network and social security.

However, what ethical principles and moral norms should be established to protect people's privacy and safety? Under what circumstances can we store, retrieve, and use personal information? What is the basis of moral evaluation of the public? How should we coordinate the contradiction between personal privacy and social supervision? How should we deal with this contradiction and avoid it from becoming a sharp social ethical conflict? There are no definite answers to these questions, thus posing a threat to the ethical order of an intelligent society.

(2) Challenges the ethics of marriage and family

The desire for food and sex is part of human nature. Erotic industry has promoted the process of social informatization. Into an intelligent era, it may also play a role in promoting the intelligent and social development. In recent years, there has been a flurry of news about AI's foray into the erotic realm, even into marriage and family. It constantly impacts people's sensitive nerves and the existing ethical relations, ethical principles, moral norms, and ethical order.

With the development of artificial intelligence, the development of humanoid intelligent robot is making a breakthrough. Humanoid robots are becoming more human-like, more "empathetic" and more "sentimental." They may have "read" a lot of erotic works, have rich emotional experience, can understand the "love" more and more complex, can do things that is possible to break through the existing limits. Experts predict that by 2050, humanoid robots will become indistinguishable from humans. In other words, a humanoid intelligent robot may have the same perfect body, delicate facial features, smooth skin, gentle temperament, and faithful character as a real person. Humanoid intelligent robot can do housework for people, be assistant for people, accompany people to chat, play together, and even flirt with people… People can not only have a humanoid intelligent robot to accompany them for a long time, but also can have a customized sex robot to relieve people's loneliness at the psychological level, meet people's personalized physiological needs including being pregnant, giving birth to children and raising them…

When a humanoid robot really appeared in the people's life, when they enter a home as a nanny, pet, lover, partner, or even a child, they "participate" in people's work and life as domestic helpers, work assistants, game playmates, and life partners. Over time, will there be a variety of feelings between people and intelligent robots?

Will there be all kinds of conflicts of interest?

Especially when people customize the female robot "partner", who is so beautiful, gentle, virtuous, hardworking, considerate, or customize the male robot who is so robust, forthright, generous, knowledgeable, considerate, will people consider marrying it, forming a unique "new family"?

Can such an unconventional marriage be understood and legally recognized?

In any case, the possible arrival of all this will have a different degree of impact on traditional human relations, family structure, work relations, and so on.

In 2013, in the American science fiction romance "Her", the human writer Theodore and samantha, an artificial intelligence operating system, fell in love.

But Theodore finds out that samantha is in love with many users at the same time.

It turns out that their understanding of love is not the same thing samantha's view of love is not exclusive!

The interests and emotional entanglement between intelligent machines and human beings will become more frequent and more difficult to understand.

We might as well imagine that the future intelligent robot should have the autonomous consciousness, have the emotion learning to "act like a spoiled child" or "loses his temper." How do you get along with them when they come into the home, into people's lives, and make demands like lovers, family, partners?

This will inevitably bring about a series of boring new ethical problems, forming a huge impact on the traditional ethical order.

Sometimes, conflicts may even erupt, putting the parties at risk. In 2014, at the end of the science fiction film "Ex Machina", the robot Ava became self-conscious and brutally killed her designer with a knife.

(3) Ethical consequences of the combination of artificial intelligence and virtual technology

As we all know, "virtual" is one of the functions of human consciousness.

However, the "virtual" in human consciousness has its own limitations, such as the limited amount of information the human brain can store, the limited speed of information processing, the limited divergence of thinking, the difficulty in the communication of "virtual" images between people.

Language, characters, and sand table technologies have externalized the "virtual" function of human consciousness to varying degrees.

Modern information technology is based on the most abstract machine language (i.e., "0" and "1") to perform various computations that are logically simple and programmatically complex.

At the same time, it can also restore machine language to concrete information symbols (including text, image, audio, and video), thus pushing "virtual technology" to a new stage of development.

With the support of artificial intelligence, machines can spontaneously convert human language, gestures, expressions and so on into machine instructions, and judge by "logical thinking" and "image-like thinking" based on such "understood" instructions. On the basis of this "virtual technology", it can really let the person in the "spirit", producing immersive interactive feeling.

In virtual reality, a person can even choose to be a different person physically and mentally, such an experience is obviously unimaginable in the past.

However, virtual reality it can not only bring magical experience, but also lead to a lot of ethical and moral problems.

Artificial intelligence doctors can make diagnosis through telemedicine and perform surgery on patients, which may be completed by intelligent machines entering the human body.

However, the special feelings between traditional doctors and patients (such as unconditional trust and tender comfort) often disappear and may even cause some psychological estrangement.

In addition, artificial intelligence teachers, nannies, and so on may also lead to similar problems.

With more and more various intelligent terminals put into use, people have such sense that intelligent devices are similar to our body organs, which people can hardly tear with. If those devices are not available, we find it hard to proceed our normal study, work, and living. Living in the virtual world, people sometimes feel it absurd, bored, full of unreliable and fantastic phantom. However, some people, especially the youngsters, are excessively addicted to the virtual world, feeling it realistic and approachable, attached to it so much that they hate to contact people in real life, with the notions "too weary", and "meaningless." Gradually, those young people turn to be solitary, indifferent, and misanthropic, resulting in new barriers for human communications.

The video games are filled with pornographic and violent contents and some even ignore moral baseline. As time goes, the game players will be mentally deteriorated, their personality will be distorted which is shown in complete obliteration of moral sense and rejection of any ethical responsibility. For example, in some violence games, the players will try every means to get a deadly intelligent weapon and kill their "enemies" for their survival. In virtual world, the players have not any sense of bloodiness, cruelty, and inhumanity in "killing" people. Moreover, the players won't feel any disturbed and guilty because there are no face-to-face resentful confrontations, nor are there physical fights and anguished facial expression of their "enemies." In addition, no physical injury is caused.

Although every virtuality is based on real foundation, people are faced with a wonderful world in which virtuality is intervened with reality and possibility when sensory virtuality is technically externalized. The embracers of new life may cheer. Virtual reality is opening up a new space for survival and activity, in which a brand-new ethical sense and ethical relationship are formed together with novel ethical regulations and moral order coming into being, since players have got may opportunities and much experience. Faced with this trend, traditional moralists are laden with such worries that man's moral emotion in realistic society is being fooled, the existing ethical responsibility and ethical codes are being decomposed and social ethical order is at risk of collapse.

(4) Accountability of Moral Responsibility Caused by Pilotless Drive

Pilotless drive, including automobiles, planes and boats, becomes a distinctive area in application AI, generating considerable economic and social effects. To take pilotless automobile for an example, its safety factor is higher than that odd manned driving. At present, as a large number of traffic accidents occur every year, pilotless drive may save many lives. To the aged people and the disabled who are incompetent of

driving automobiles, pilotless drive may thoroughly change their life. In addition, pilotless drive based on mega-data may reduce traffic jams, pollution, and increase utility rate.

As a new innovation with broad prospect of application, pilotless drive cannot be perfect in every respect at present. For example, it cannot completely eliminate pollution and traffic jams in cities, nor can it thoroughly eradicate traffic accidents. As a pioneer in pilotless drive, Tesla received several accidents in this field. On May 7, 2016, an electric automobile produced by Tesla collided with a lorry in "pilotless" mode in Florida, leading to the death of the truck driver. Although the investigation report submitted by National Highway Traffic Safety Administration of the United States claimed that pilotless system was not blamed for this accident, unmanned drive aroused public concern on the safety of this mode. As various problems remain unsolved, many new ethical issues and moral responsibilities surge up.

Pilotless drive may incur some "ethical dilemmas." Someone designs such a scene, in which a pilotless coach loaded with passengers is driving at high speed when it suddenly meets with a pregnant woman who is jaywalking the road. At this moment, if the system exercises emergence brake, the coach may turn over and the passenger may be injured. If the coach continues to move on, it may run into the woman. What will the pilotless system do? If it is a man driver, he may make decision by his instinct or intuition. When AI involves the issues concerning the extreme cases of human ethical dilemmas, its operations are preset by algorithm, in which no program is prepared for such an event. So the system has to make an analogy in light of the similar cases from the databank. If it meets with an alien situation, the system will randomly select on way to deal with the event. It is known to all that the unknown realm is indefinite and alien cases cannot be avoided anyway. Supposing that a traffic accident is caused by a running pilotless vehicle, resulting in injuries, death, and loss of property, who will be blamed for this accident? Is it the designer of the pilotless system, or owner of the vehicle, or the pilotless vehicle that should assume the corresponding responsibility?

### *2.2.2 Digital Gap and "Social Exclusion"*

(1) Digital Gap

In intelligent age, mankind forges an ever-increasing complicated and faster technical system and social structure. However, the development of science and technology won't automatically carry out "universal principle." Due to its advancement and complexity, AI cannot be mastered by the non-professionals. To achieve social justice and enable all the people to enjoy the benefits brought by AI, it cannot be realized by mere progress in science and technology. In mast cases, even though the system is reasonably designed, government holds a fair stance, decisions, and policies will be deflected. What is worse, irregular practice is found in AI field and there are many defects in policy orientation and ethical rules. These chaotic phenomena will result in

the deviation of people's original intention and AI will be rendered into the privileged province of the economic, political, and technical elites. For example, as the development of productivity is uneven, scientific strength is unbalanced, people's quality, and capacity are different from one place to another, intelligence development is varied in different nations, countries, regions, and enterprises, leading to the situation that there exist the disparities in opportunities of applying AI and the competence for application of such technology and digital gap has been forged. To be specific, opportunities for learning and using AI are not equally available for the people in different countries and regions, with diverse competence in using AI products, which results in different compatibilities with AI and yield the inequality in income and position and the expected inequality in the years to come. All these adverse conditions are overlapped with the existing the regional gap and the disparities between urban and rural areas, hastening the parturition of more and more "digitally poor areas" and digitally poverty-stricken people." Moreover, in the fierce international and market competition, developed countries and transnational companies have been monopolizing the critical data resources and blocking the innovative achievement of AI core technology so that they may further control those advantages and gain excessive profits. This situation leads to the widening digital gap and there appears a trend marking "impoverishing the poor and enriching the affluent."

People uphold innovation of knowledge in intelligent age, which is no longer the physical laborer-oriented times. To the common workers, the more progress in science and technology, the greater the productive force will be. The more abundant products, personal strength turns to be weaker, beyond one's control of his own destiny and his selection. Although some elites may become the strong of life and billionaires by means of knowledge and wisdom acquired through their learning and innovation, the digital gap and the difference between the rich and the poor are widening with each passing day. With lowering actual status of the common laborers in economic and social sectors, they will be rendered into poverty-stricken state. Moreover, they will be even deprived of their legitimate rights.

With the development of AI and industrial constant adjustment and upgrading of industrial structure, entrepreneurs tend to spend their capital on intelligent robots, resulting in the ever-severe structural unemployment. In addition, as knowledge is updated in an accelerating speed which gives rise to survival of the fittest, people are subject to enormous mental stress. Every person will be anxious whether his/her knowledge and technology adapt to the requirements of this era. Is it necessary for me to refresh my learning and technique? Shall I need the training for new knowledge? Am I eligible for the new post with my existing competence? How will I deal with the rapidly upgrading knowledge and technology? In retrospection of the informatization and intelligence process, we may easily discover that huge gap has been formed amid industrial upgrading and economic transformation caused by the fierce intelligent and technical competition. In AI era, some intellectual elites earn huge fortune, whereas the jobs of the common laborers are gradually replaced by mega-data and intelligent robots and their economic benefits are seriously undermined. A large number of structural jobless people have to acquire another expertise so that they may be re-employed, whose vulnerable conditions are worse than ever.

In a nutshell, it is an indisputable fact that intelligent times yield digital gap, "digital poverty-stricken area" and "digital poverty-stricken people", a new trend that endangers social justice and harmonious development. Controlled by few countries, regions, enterprises, or individuals, intelligent technology may turn to be an accomplice for jeopardizing the interest of "digital poverty-stricken area" and "digital poverty-stricken people." It is extremely unfair and immoral. The advent of digital gap and the difference between the rich and the poor in information and new social strata will be an unsolvable social concern, labile factor or even a destructive element in subverting the existing ethical and social orders. "Who" will be the subject, what kind of ethical principle will be applied and what measures will be taken, to protect the "weak" ("digital poverty-stricken area" and "digital poverty-stricken people") so as to achieve social justice and world peace?

(2) "Social Exclusion"

Confronted with the rapid development and extensive application of AI, man's evolution is tardy to a great margin and find himself unable to deal with the complicated work, as the intelligence in social life reaches such a high degree that intelligent machines may be alienated into the tools for controlling, repelling, and enslaving human being. For instance, before a highly automatic assembly line where the robots are in operation, ordinary people will look rather "clumsy" and "dull" (excluding the "specialized" experts and engineers), who are ignorant of the production process and cannot be even an assistant, let alone control the robots' operation. Even if they have acquired certain knowledge and technique or have been trained for the posts, they grasp only a small part of intelligent machine principle and operation technique. Compared with the machines equipped with greater data, more complicated networks and more intelligent systems, man's physical parts, including his brain once claimed to be incomparable, become more rustic, plain and mediocre. Some science fiction writers make repeated predictions that in the world dominated by intelligent machines, a great majority of people will be rendered into "the slaves of such machines", the insignificant "spare parts" in the robot systems.

After intelligence is applied in production, the machines equipped with man's intelligence or the intelligence higher than man's will replace people to do the dirty, weary, repeated and dull work that they are unwilling to, or the work in toxic, harmful and dangerous environment. Moreover, intelligent machines will embark on the work previously pertinent to mankind, such as surgical operation, offering lecture, translating, lawsuit settlement, poem writing, painting, music composition, playing of musical instruments, driving and battle fighting, etc. …. Some of them even try to possess and "consume" emotions, "replace" man's friends, lovers, companions and children, etc., for example, Foxconn has announced that 60 thousand workers will be unemployed after it puts robots into use. In Kolner, Germany, Ford Motor applies robots, which work side by side with human workers. As intelligent robots can be made and duplicated in a steady way, and they work more "diligently" and "willingly bearing responsibilities without grudge" and operate with higher proficiency. Therefore, robots are capable of more complicated and heavy work and they will replace

more and more human workers, resulting in tides of unemployment with intelligent machines used in production and industrial transformation and upgrading.

What is worse, the literal, scientific, and computerized illiterates will lose their laboring value, excluding any opportunities to be trained for new posts, and they will have no way but to succumb to the fate of unemployment, thoroughly marginalized by the society. Manuel Castells, American sociologist, claims, "Now most people have got nothing to do with the logic of global system, whose conditions will be worse than their state of being exploited. I once assert that: one day the workers will cherish the big time of being exploited in that there exists a social relationship in exploitation at least, for I work for you whereas you exploit me. But I need you, or vice verse, in which you have the chance to exploit me. This relationship is absolutely different from "I no long need you" (Castells, Manuel, "The End of Millennium", translated by Xia Zhujiu and Huang Huiqi, Social Science Literature Press, 2003, pp. 434). Such relationship is called "the black hole of informationized capitalism" Mr. Castells. In intelligent society, "digital poverty-stricken people" are excluded from the global economic and social system, without any enterprises or organization to employ them and exploit them. In Chinese proverb, "No hatred arises without cause." When no one needs to employ such colony, there exists no antagonistic social relationship for them to be rebellious. In this sense, "digital poverty-stricken people" become the "fifth wheel", who will be ruthlessly put away by the highly intelligent society and their existence will be absurd.

Only labor makes man, which is man's sacred right as well as an activity from which man acquires self-affirmation, values and dignity. Featured by its ubiquitous, tireless, pay-irrespective "spirit", intelligent system will deprive people of their laboring right and pose realistic threat on man's fundamental right and the right of their all-round development. In addition, the exclusion of man's role in work and family by intelligent machines will probably spoil traditional working relationship, lead to the disintegration of traditional familial structure and thus pose great shock on the existing working and familial ethical principles replaced, neglected, excluded, and discarded, people will sense the insignificance in life and absurdity in survival. Apart from the worsening surviving environment for man and the drop in happiness indexes, man will be mentally unbearable and feel hopeless. Some surveys show that in the areas with high factory bankruptcy and unemployment, the rates of suicides, drug abuse and depression are higher than those in other places. In certain time of intelligent society, an extensive ethical and social crisis will break out when people cannot bear for any time and risk danger to take resistant actions in desperation. Just as Mr. Castells warns, "The crisis spreading to the whole world will burst out, not in a revolutionary way but in such process that it is beyond my endurance and I don't know what should do, but I have fly into my indignation, for the sake of outburst" (Castells, Manuel, "The End of Millennium", translated by Xia Zhujiu and Huang Huiqi, Social Science Literature Press, 2003, pp. 434).

### 2.2.3 Challenge to Man's Nature and Man's Destiny

(1) Severe challenge to man's nature

The ever-developing AI is actually changing "man" and his recognition. In the previous over four billion years, all living species (including man) have been evolving on the basis of organic chemical laws of the fittest survival. Yet, to man's anxiety, AI, a form of inorganic life, is changing the evolving process. With the integral development of biotechnology and intelligent technology, man's physical body is subject to "repair" and "remold." Intelligent machines are gradually acquiring the emotion, creativity, and sociability peculiar to mankind, during which the trend of man-machine complement, man-machine interaction, man-machine combination, man-machine coordination, and man-machine integration become an irresistible developing tide. When an intergrowth between man's physical body and intelligent machine, such as "repair" and even "re-coding" of man's gene, transplantation of bio-intelligent chips into man's brain so that it undertakes part of the functions such as memory, computing and expression performed by man's brain. Is the emerging "symbion" a man or a machine? To what significance and what degree will "man's" property still exist? There will diverse interpretations among the public.

The robot under research and development will pose a challenge to man and man's nature. For example, "thinking" is generally regarded as man's substantive feature. With the breakthroughs made in developing AI, "machines can think" is the public consensus. Just as mechanical machines surpass main's physical strength, speed, and endurance, machine's thinking capacity will overwhelm man's in an all-round way. When intelligent machines are not only far over man in storage (memory), computing, and information transmission, but also surpass man in controlling force, imagination, creativity, and emotional richness, they will pose substantial challenge to man's essence of thinking. Moreover, labor, manufacturing, and application of instruments of production are taken as man's essences, but the coming intelligent machines may automatically make or "print" production instruments, put them into production, constantly adjust and perfect the instruments according to production development. What is more, intelligent machines may manufacture robots and adjust them based on the requirements of production and living. For instance, in Xinsong Intelligent Industrial, China's largest robot production base completed in 2017, its C4 Workshop is China's first 4.0 pilot zone, where engineers intend to produce robots with intelligent machines. In this way, whether the manufacturing, or production instrument or the labor of general sense has got nothing to do with human patents. In addition, by means of modern biotechnology and intelligence technology, intelligent machine may be either unlike man's figure or "beyond the reach of human figure" in that machines will be more "standardized" and "perfect" than man's figure. If policy, law and ethical norms are permissible, any man may customize one or several "himself" in form, sound, personalty, response and action, enabling "himself" to live forever. If this happens, whether intelligent machines is still "man" or not will be a vague topic constantly arousing the public discussions. On October 25, 2017, Saudi Arabia became the pioneer to make the attempt by entrusting Hanson Robotics to

develop "Sophia", a humanoid robot, who is granted citizenship. This event triggers a huge tempest in a teapot around the world.

If an intelligent machine is defined to be a "man" to certain sense, it will arouse a range of problems. Will it be allowed to enjoy the fundamental rights as man does? (Can it be kept from mankind's overuse, or from severe environment that will bring damage to its hardware? Will it enjoy the personality and dignity same to man? (such as will it be treated as "man's servant"? or will man be allowed to maltreat it?) will it be a moral or legal subject and undertake the corresponding consequences? Will intelligent machines be allowed to communicate with their kind just like natural men, or to form their own "social organizations"? New problems will certainly keep bubbling up. Realistically, as intelligent machines can be manufactured and duplicated in large quantity and at comparatively low costs, they will be widely used in man's learning, production, living, leisurely and recreational activities…. Some people argue that such pets as cat and dog enjoy certain animal rights. Will the intelligent machines be granted fundamental rights, which acquire independent consciousness making man hard to identify himself from the machine?

Anyhow, with the development of intelligent technology, the advent of robots with independent consciousness gives rise to serious issue on man's nature. Perhaps, we should recognize and redefine "man", grant "man" new connotation and re-establish the ethical principles for dealing with interpersonal relations and man-machine relations by integrating all the creatures made by man, including intermediary system and intelligent system.

(2) Controversies over Moral Education and Administration Authority

As to ethical principles, there are debates on the issues whether man's ethical principles progress or retrogress. From the perspective of the former, the development of ethical principles fails to keep pace with AI development. In AI development and application, there emerge more and more issues that are beyond the governance of ethical principles, which shows certain moral abnormality and ethical disorder. How to deal this challenge so as to re-forge moral education and supervising modes is an issue to be urgently addressed.

With the coming of intelligent era, more and more intelligent systems are used in man's process of organization and management which stimulates the new reform in educational and managerial modes. As intelligent system stores a large quantity of policy and legal documents, it can automatically process administrative coordination and control assignments, undertake procedural tasks in management, and reduce human errors so as to economize administrative costs and improve manage efficiency. However, the moral education and administration performed by AI will sometimes ignore the cultural tradition and psychological features of the subordinates and even take no notice of the property of a flesh "man", which is short of human sympathy and "personal emotion" that man focuses.

With significant breakthroughs made in AI, people will wonder: whose moral conduct is more outstanding and convincing between man's and intelligent machine's? Who will dominate the moral principles and the right of speech? Who is more eligible for exercising moral jurisdiction and the corresponding power on education and

management? Although man is labeled "the wisest of all creatures", who used to control the right of speech, man is not so confident when facing those issues with definite keys in the times of intelligence.

It is worth our vigilance that with more information and intelligent machines used in our society, super intelligent robots may wantonly seize the rights of speech in ethical appraisal and decision making as well as the qualification in moral education and management with their advantages in power and mental ability and their operating efficiency beyond the reach of mankind. Will they even presumingly exercise moral admonishment and management over mankind who has created them and forcefully bring man into ethical category dominated by intelligent system? If this worry comes true, that will be an earthshaking "ethical variation" since human history.

(3) Will AI Be Out of Control?

Since 2016, AlphaGo developed by Google successively beat Lee Se-dol and Ke Jie, two champions of world go after the machine adopted training method of self-game with mega-data. This event made people aware of AI's power of in-depth learning and the threat of AI. As known to all, mechanization has immensely "extend" man's hands and feet, setting people from manual labor. No man can run as fast as a car, a train, or a plane. Nor can he carry as heavy load as a truck or a crane…. AI will completely beat man in terms of mental and intelligent ability. Man must recognize and admit this fact, making himself accustomed to these changes and keeping harmonious relationship with various intelligent systems.

Today, apart from in-depth learning, AI may proactively study and develop innovation ability. In the future, it may acquire independent consciousness and exercise automatic upgrading and improvement. Perhaps the situation will go just as Ray Kurzweil predicts, "In 2030s, it will be possible for man to upload the information in human brain. Since the 2014s, the upgrading 3.0 version of human body will appear, in which human body will evolve into non-flesh and transformable state by means of such technologies as gene, nanotechnology and robotics. By 2045, the singularity will come; AI will surpass human intelligence in an all-round way. When mechanical intelligence reaches human's, the unitary super-intelligence will come into being, which may upgrade itself through mutual learning, mutual interaction and self-perfection and forge a super-intelligence organization through networks. This futurist even makes such a bold prediction, Since 2045, the universe will awake. To go beyond the restraints of supercomputer, AI will turn the substances into supercomputers and the whole universe will be transformed into super-intelligence. Such intelligence may change the known physical laws, achieve the transversion in multidimensional space and realize human dream of being immortal."

Generally speaking, super-intelligence and its systems may master more background data, draw more objective and clear judgment on the situation, formulate more reasonable planning, make calmer and faster decisions and take more accurate and forceful actions as against human being. What is more, super-intelligence demands the survival environment that is less rigorous than human being, but works for longer time and more attentively, consumes less resources. It can automatically

perform automatic error correction and self-upgrading through feedback and learning. So it will gain ever-increasing advantage over human intelligence.

Super-intelligence which acquires independent consciousness is similar to an open "Pandora's Box." Man spares no effort in creating AI. Yet his destiny is like "a muddleheaded child playing a bomb." The mighty power of the bomb forms a striking contrast with the child's ignorance. People may wonder whether super-intelligence will "follow bad examples", boast selfness and greediness as mankind, acquired human errors and rotten values, or enslave and maltreat mankind, uphold the conviction "reaping what is sown" and take revenge as some people in history and reality. The great risk lies in whether super-intelligence may break through the designer's preset critical point and be out of control to dominate mankind by self-learning and independent innovation. Will super-intelligence "drive mankind to the zoos", even judge "imperfection and inability of mankind", so that it despises and brutally wipe out mankind? This profound anxiety on human prospect and destiny has been troubling mankind as manifested in the movies of science fictions, including "The Matrix", "The Terminator" and "Bicentennial Man", etc. Stephen Hawking warns us, "Maybe AI is not only 'the most influential event', but also 'the last event' in human history. AI development may forebode the extinction of human species."

Maybe some people will criticize the above statement to be too pre-acting and sensational. Even if super-intelligence is free from any undesirable motivation and erroneous values, certain organizations or individuals will abuse intelligent technology to bring about their ulterior purposes once they develop and master similar super-intelligence. If they exercise extremely severe and grievous Fascist rule over the people, the consequences will be catastrophic. The disasters will be far severe than those of World War II waged by Fascist Axes and the "nuke blackmail" by the USA and the Soviet Union during the cold war period.

In the past, when it was still in immature and budding stage, people held an optimistic attitude to AI, ignorant of its potential threat. With its rapid development in recent years, especially its independent study and creative thinking which will surpass that of mankind, people are gradually aware of the huge threat brought by AI. The ever-developing AI will gain such overwhelming advantage over mankind that the gap between man and AI will be as large as man's "running race" with airplane and spacecraft. Looking ahead, mankind no longer has the reasons to be arrogant and overconfident.

## 2.3 Construction of Ethical and Moral Principles

AI is an unprecedented social ethical experiment in human history. In intelligent age, although it offers a possibility to elevate the social ethical and moral standards and to develop man and society in an all-round way, it still remains to be a kind probability, which will bring the consequence hard for people to predict and the consequence will be very difficult to solve within traditional theoretical framework. No matter how it is powerful, technology is man's means or tool only. How to make selective application

of technology involves social field, human beings themselves in particular. A new ethical order based on people orientation, expansion of advanced morality, free and all-round development for man and society will be created with technical progress.

### *2.3.1 "Can" and "Should" by AI*

(1) Relationship between "Can" and "Should"

Just as other technical means, the relationship between "Can" and "Should" of AI must be properly handled in the development and application of this technology. Generally speaking, there are several possibilities of "Can" and "Should" listed as follows.

1. What "can" do is also what "should" do.
2. What "can" do is what "shouldn't" do.
3. What "can" do is "permissible."

At present, as AI is developing with each passing day and its capacity is getting more powerful, what "can" do is incessantly breaking through the original thresholds and extending to many new fields, such as automatic speech recognition, machine translation, electronic police, unmanned driving, private doctor, intelligent babysitter, intelligent secretary, intelligent steward, intelligent lawyer, intelligent judge, intelligent editor and intelligent journalist. …. Apart from human figure, the coming intelligent machines can perform thinking, with intelligence higher than that of human being, capable of completing many assignments which are beyond human ability and dealing with various complicated social relations and social contradictions. Will what AI "can" be what it "should" do? Obviously, the logical relationship between "can" and "should" shows that there exists no such inevitability. After all, what "can" do is also what "should" do, being one of the three logical possibilities, which requires people to make concrete analysis, prudently carrying out evaluation, selection, and decision on the basis of the specific conditions in living practice. While exercising the said conducts, we should be aware of the fact that AI is a novel and complicated technology, with strong uncertainty, which may yield non-human and immoral negative effects. What it "can" "should" not be put into practice.

Maybe someone will quote "theory of value neutrality" or "the conviction of no limits to science" to query or deny the introspection on AI ethics and values. However, as man's intrinsic activity, science is of no "value neutrality" and involves human life of values. So "no limits to science" is not applicable to science and technology. As to the scientific research and technological application which may bring severe danger to mankind or which may lead to unpredictable consequences, they must be subject to public discussions and democratic decision before they are put into operation. We should resolutely normalize and control the research and use of the uncertain science and technology.

Historically, human inventions and creations, including various tools, machines and even automatic systems, may be used to control their moral representations by scientists, engineers, and users. In his "The Relationship between Science and War", Albert Einstein points out, "Science is a powerful tool. Whether it benefits or brings disasters to mankind depends on human beings themselves rather than the tool. A knife is useful in our life, but it can be used to kill a person" ("Collected Works of Albert Einstein", Vol. 3, translated by Xu Liangying et al., the Commercial Press, 1979, pp. 56.). Emmanul G. Mesthene, a representative of technical neutrality, claims, "Technology brings new possibilities for man's selection and action, but it renders these possibilities into uncertain positions. What effect technology induces and what purpose it intends to reach are decided by man instead of intrinsic properties of technology" (Mesthene 1970, p. 60.).

With hi-tech development in our times, especially in intelligent society with heterogeneity, revolutionary and subversive changes are taking place. What people "can" do constantly breaks through the original thresholds, beyond human imagination sometimes, making people difficult to clearly predict the possible consequences as the development of science and technology is at the risk of being "out of control." The steady breakthroughs made in AI, the potential super-intelligence in particular, renders mankind into great hazard. Some pessimists even hold that instead of quickening human progress, AI accelerates the process of human enslavement and extinction.

Obviously, "can" and "feasible" of science is not equivalent to "should" in value. Nor can we deduce "should" in logic. To this issue, Erich Fromm, an American thinker, once queries the two guiding principles for scientific and technological development which he considers to be "adverse." The first one is "whatever technology is possible should be tried" and the second one is "to pursue the maximum efficiency and output" (Fromm 1968, pp. 3233.). Undoubtedly, the first principle drives people to forsake all the ethical standards, measure value, man's introspection and self-regulation to the effects brought by science and technology. The implementation of the second one may render mankind into the machines of social efficiency and uncharacteristic "spare parts." Such queries are profound in essence because science and technology can by no means exclude man's involvement but relates with man's practical activities. To regard science only as a tool means waiving and dodging human responsibility. To make science and technology available for human benefits and thoroughly erase the unbearable consequences, we must start from the planning, design, invention and creation of science and technology and take consideration of value as a direct influential factor before ethical and moral principles, and value is made to be one of the dimensions for scientific activities.

Based on the above analysis, we have sufficient reasons to exercise evaluation on the value of AI, and formulate ethical norms for AI development and application, all of which are our ethical responsibility and moral obligation. That is the reason why the USA ranks "recognition and AI influence on ethical principle, legal science and human society" as one of the seven strategic developing orientations in "The National Artificial Intelligence Research and Development Strategic Plan" released

in 2016. China also focuses on the solution of the issue "The uncertainty of AI brings us new challenge."

Of course, we will set "should" on facts, call for the value with which mankind may keep a foothold and reach consensus on the basis of democratic consultation. On one hand, although AI is imbued with uncertainty and various negative effects, we are not supposed to decline AI as some romanticists reject technology and waive the application of AI for promoting economic and social development and benefiting mankind. So we argue that it will be inadvisable for us to throw away the apple because of its core. On the other hand, with nearly limitless possibilities, we should guard against the adverse effects brought by abuse of AI, eliminate the fear for super-intelligence and its potential hazards. In AI programming, we should inset human fundamental value and ethical norms, under the guidance of which intelligent robots make decision and take actions so as to make them "Serve the people heart and soul" and bring more benefits to mankind. Mechanism for correcting errors, together with self-destructors should be loaded in robots with super-intelligence. Once they deviate from man's value by accepting vicious commands of ulterior motives, the robots can automatically identify those commands and perform automatic error correction to smother the coming troubles by initiating the self-destroying apparatus.

(2) Embodying the value principle of "should"

Since AI has emerged, some philosophers have retrospected its all-round influence and put forth some basic value principles for this new technology. As early as 1942, Issac Asimov, an American science fiction writer, raised "three laws for robots" in his novel "I, A Robot". Firstly, robots are not allowed to do harms to mankind and won't sit idle to human sufferings. Secondly, under the circumstances that won't violate the first law, robots must be subject to human commands. Thirdly, in the case that won't go against the first and the second law, robots are endowed with the obligation of self-protection. Later, Asimov another law of greater significance in which robots must protect human overall interests from being undermined.

With AI development, people have gradually been aware of the importance of ethical principles for intelligent machines and brought forth more specific value norms. For instance, in October 2015, based on Asimov's three laws, Japanese Keio University added another three principles for robots, covering "keep confidential", "service restrictions", "safety protection", "transparency", "responsibility."

In August 2016, the United Nations Educational, Scientific and Cultural Organization and World Commission on the Ethics of Scientific Knowledge and Technology jointly issued "The Preliminary Report Draft On Ethical Principles for Intelligent Machines", which elaborates the social and ethical issues brought by the manufacturing and application of robots. According to the report, intelligent robots should not only observe human ethical principles and moral norms, but also bear certain responsibilities, all of which will be encoded into robots.

In February 2017, Future of Life Institute, a voluntary organization formed by some scientists and robot amateurs, promulgated "Asilomar AI Principles", in which AI researchers aim at "we must develop beneficial AI, but bring it under control." People should abide by 23 fundamental principles for AI in the fields of research and

development, production, security, etc. Signed by 892 AI and robot research fellows (including Elon Musk and Stephen Hawking) and 1445 experts, this statement exerts far-reaching influence on AI realm.

The above principles are obviously Kantian ethical and moral decrees. As AI is developing in a fast way and exerts ever-increasing influence on our life, the similar ethical norms will keep bubbling up and will be made perfect. These norms are indispensable in guiding AI research, development, and application and will serve as the reference for us to prescribe the AI ethical principles with Chinese characteristics.

### *2.3.2 Ethical Principles for AI*

The fundamental principles for AI cover those in AI research, development, and application as well as those prescribed for the coming super-intelligence with independent consciousness. In this field, the latter is granted by the former, whereas the former serves as the basic guaranteeing for the latter. Based on the above discussions and in light of AI developing trend, we may integrate deontology and consequentialism and put forth the following ethical principles.

(1) People-Oriented Principle

As creative activities yielding value, scientific and technological activities must persist in "people-oriented" principle. Due to the boundless prospect of AI, we should update our ideas, reform our systems, expand intelligent industries and nurture intelligent economy so as to meet human desires and necessities as much as possible and bring more welfare and benefits to mankind. We should do our utmost to promote human self-elevation and self-perfection rather than sit idle to AI risks and its adverse effects to endanger human survival. Although intelligent machines can survive and work in extreme hostile environment, the selection and setting of environment and homeland must be based on the principle beneficial to the survival for man who acquires an organic life. Increasingly powerful, intelligent machines must be subject to man's commands and serve for mankind, do the things which are beyond human ability. Under no circumstances will intelligent robots intentionally do harm to mankind. Nor can they sit idle to the people in danger or disaster. They must respect mankind, tolerate man's defects and boundedness and ensure mankind to live as an organic life. After prudent evaluation, they should also be capable of forbid the scientific research and technological application that will endanger man's survival and prospect and censure the people in charge.

(2) The principle of impartiality

Justice is people's moral intuition that they expect to be treated without discrimination and to deserve what they should as well as rational agreement for mutually acknowledging the interests of the parties involved and safeguarding their interests. According to principle of justice, AI should bring as many benefits as possible to mankind and its creative fruits will be shared by as many people as possible. As all

men are created equal, everybody will have the equitable chances to gain access to AI, use AI products at his will and make good use of AI so that we may fill up digital divide and "digital gap between the poor and the rich, eliminate economic inequality and the polarization between the rich and the poor. Based on equitable principle, we should perfect the design of "people-orientation", through which we will suppress the tyrannizing "capital logic" on one hand and prevent "technical logic" from doing whatever it pleases. Moreover, we will establish and perfect the systems of social welfare and social security, render supports to the underdeveloped countries, regions and enterprises, exercise salvation to the literal and scientific illiterates and take effective measures to safeguard their dignity and legitimate rights and interests.

(3) Transparency Principle

As a proverb goes, "Sunlight is the best corrosion remover." Transparency ensures that AI research, design, and application won't deviate from the proper ethical and moral principles. With regard to the fact that AI research and design is conducted in an operating mode of black box, but its ever-rapid development and potential super-advantage may incur catastrophic risks. During this process, we should adhere to open and transparent principle and put the whole operation under supervisory control from the relevant regulators, the ethics commission and the public so that the super-intelligence of robots are subject to explicable, intelligible and predictable state and prevent super-intelligence from the motives of endangering mankind, ensure that super-intelligence won't be controlled by the persons with ulterior intentions or privately connected to network and upgraded to form a separate organization in evading monitoring. Once intelligent system induces destructive consequences, its designer and user must immediately report to relevant regulator who will take effective measures to deal with the situation and introduce the case to the public. Transparency principle will reduce unpredictability and uncertainty to certain extent so as to relieve people's horror, tension and anxiety.

(4) Principle of Informed Consent

AI research and application may substantially change man, his mental integrity, and his living conditions. The collection, storage, and application of individual and corporate data may involve man's mental integrity, his personality and dignity as well as the research and application of man's legitimate right and interest, who should have the right to be informed. Before the above-mentioned practice is carried out, the executor must solicit the consent of the client. During the implementation, once the client's life or his mental integrity is endangered and his legitimate right and interest run into unpredictable consequences, the executor should halt his operation at once and try to regain authorization.

(5) Obligation Principle

In the course of AI research, development, application, and management, we must define the rights, responsibilities, and obligation of different moral subjects, predict and prevent the adverse effects, take necessary measures to remedy trespasses and ascertain who will be responsible for misstep. The design and operation of intelligent

system must comply with human fundamental value, brimming with basic ethical judgment and controlling force on actions so as to ensure the value goal that AI must obey human commands and serve mankind and the harmonious man-machine coexistence. We must emphasize that it is of great significance to take precautions against the known or potential risks of AI, determine liable nature and attribution of liability. For the scientists studying AI, they used to be the evaluators and decision makers based on human knowledge tether. In the times of AI, what they perform will decide the moral outlook and presentation of intelligent machines. Moreover, they bear the sacred and inescapable moral obligations and resolutely carry through the principle of "people-orientation." In his "To Make Science Beneficial to Mankind", Einstein warns, "if you want your life work to be beneficial to human beings, it is nor enough for you to know how to apply science. The concern for man should be your major goal for technology acquisition from the beginning to the end. You should focus the significant unsolved issues on how to organize people to work and how to distribute the products in a fair way si that our scientific achievement benefits human beings rather than scourge them" ("Collected Works of Albert Einstein" Vol. 3, translated by Xu Liangying et al., the Commercial Press, 1979, pp. 73.).

### *2.3.3 The Specific Paths to Construction of Ethical and Moral Principles*

Regarding the ethical and moral issues induced by AI, international community is taking initiative action, as shown in "The Roadmap of Robot Ethics" by EU, "Constitution of Robot Ethics" formulated Southern Korean Government, Ethics Commission set up by Japanese AI Society and "Ethics Commission on Studies of Artificial Intelligence" of Google. We should also keep a sober mind to those issues, take effective measures to deal with them so that we may reach the consensus and direct its development in an active way.

(1) To Enhance the Construction of Moral Subjects

Moral subjects are dynamic persons who boast ethical rights and responsibilities as well as the consciousness of ethical obligations and who can perform activities on the basis of their ethical requirements. Ethical principles are set for mankind. So long as there exist evil intentions and greedy desires in man's mind, there will definitely be villainies. As AI is imbued with complexity, unpredictability and risks in application, it is the prerequisite for AI healthy development that the persons in charge should strengthen their conscience, define their own ethical rights and responsibilities and take prudent and reasonable actions. Therefore, in the course of researching, developing, applying, and managing AI, we should intensify the construction of ethical subjects, aiming at arousing the moral sense of the decision makers, administrators, engineers and users, who should consciously acknowledge and following the corresponding value principle and moral norms through self-communion, self-discipline and "cautiousness" so that they may utilize AI to benefit others and the society

and keep alert of AI adverse effects that may endanger the society. Although AI is not eligible for "a full ethical subject" at present, it remains a controversial topic whether AI will be "a full ethical subject". Even if more breakthroughs will be made in AI, super-intelligence with the ability to perform independent thinking and actions should identify and observe man's ethical principles and moral norms by keeping man-machine interactive state all the time and following man's commands.

(2) To Establish "Ethical Commission"

During AI search, development, and application, there appear a number of frontline problems featured by inconsistency, making it difficult for researchers to exercise evaluation, supervision and regulation of AI. So it is necessary for us to form "Ethical Commission" which consists of AI scientists, engineers, and other experts in ethics, law, politics, economics, culture and social sciences so as to ensure the proper orientation for AI development.

The functions and power of "Ethical Commission" should be based on the above value principles. Under the premise of fully democratic consultation, the Commission will, according to the principle "majority decision" performs evaluation on AI development program and the research of cutting-edge technology, conduct democratic deliberation of the ethical conflicts arising in application, seek the consensus through full discussions and reasonable demonstration by relevant information and data so as to coordinate the parties involved to take concerted actions. As this issue is great significance, "Ethical Commission" has the power to delay the vote and exercise veto. Naturally, the client may appeal for the resolution which he claims to be incorrect so that the possibly erroneous decision may be rectified.

(3) To Stop the Evil Conduct and Award the Benevolent Performance by Integral Measures

All social organizations should make concerted efforts to tackle the major problems, popularize the mature AI technology and promote industrial upgrading so as to improve production efficiency and generally increase the public income and elevate living quality. We should pool more funds for free education and training to help the jobless and unemployed people to improve their professional competence so as to ensure people's employment as much as possible. We should also establish and perfect social security system for coverage of the vulnerable groups, provide the "digital deficient areas" and "digital poverty-stricken people" with professional service so that all the people may share the benefits brought by social intelligence.

We should set up effective risk pre-warning and disposition mechanism and transparent AI monitoring system, carry out double-deck monitoring mechanism of design censure and application supervision so that we can exercise the regulation on the complete flow operation of AI algorithm, product development and application of achievement. We should urge AI industries and enterprises to be self-disciplined, to hold up the bottom line of ethics and to perform their social obligations and refrain themselves from doing whatever they please for earning profits. We should establish international coordinating organizations with disposal rights, contribute more efforts

in studying such universal issues as alienation of intelligent terminal and safety supervision and store coping technology scheme so as to deal with the global challenge. As to the immoral behaviors, such as data abuse, invasion of privacy, intentional injury, pilferage of others' belongings and dereliction of supervising duty, we must exercise severe penalty over the said atrocities with such means as ethical denouncement, confiscation of gains and legal sanction and form a benign mechanism featured by "Evil seeds yield bad fruits."

(4) Ethical and Moral Construction Taking A Long Time to Complete

As a new technology, AI develops by following its own law and logic, and its developing trend is by no means the straight simulation of human beings. If a car, a train or plane, made similar to man, moves by two legs. Then it runs as fast as man does. Rather than direct imitation of man's brain, AI will personalize man. With only one brain, man cannot focus on two things at a time. However, equipped with a number of processors, an intelligent machine may complete several assignments at the same time. It is the premise for our consideration and action that we should break up man's existing mindset, conform to AI law and logic in developing such technology, enable intelligent machines to do what man is unable and unwilling to and make them to help and serve mankind to a great extent.

At present, AI is at its initiative stage of development. It is similar to the morning sun just over the horizon, which is now lower than man's intelligence in most fields. Yet, we shouldn't predict the development of super-intelligence based on man's existing intelligent level. Now AI is developing at an accelerating speed. With its boundless prospects, AI will approach and even surpass man's intelligence, free from any technical restraint. If it is not controlled, the event will probably occur that an "alliance" will be formed among the machines equipped with super-intelligence. AI may induce profound social influence, which we have preliminarily sensed.

AI is complicated and revolutionized new hi-tech, an unprecedented social ethical experiment in human civilization. As far as the present conditions of AI are concerned, we should update our concepts, make technical breakthroughs, expand its application areas. As we cannot predict its application consequences, have very superficial experience, we shouldn't draw the premature conclusion on the ethical results brought by AI. Whether man's existing ethical principles and moral norms are applicable to the evaluation of AI, we should unfold more open discussions. We still have to probe the effective methods and measures for exercising technical supervision and normalize the moral principles on AI. In this sense, we may conclude that the construction of ethical principles and moral norms for AI will be a long historical process. It will be detrimental to AI development if we seek quick success and instant benefits or we expect to accomplish the whole task at one stroke.

Naturally, as AI is developing in an uncontrollable way, it is filled with uncertainty and risks which may result in the worst consequences unbearable for mankind. Therefore, we should take precautions against such situation. We must make more efforts to study AI, keep track of AI technical innovation, be well-informed of the developing trend of AI, so that we can put it into application, make it better serve mankind and bring more benefits to us. More importantly, we should make bold

prediction and thorough introspection on AI, make prudent value evaluation and decisions, bring forth an insurmountable "ethical bottom line", take reasonable and feasible countermeasures in different stages, gradually accumulate AI experience and technology and remold anew ethical order featured by man-machine cooperation and man-machine integrity step by step.

## Bibliography

Ai Yin Si Tan Wen Ji (Di 3 Juan). 1979. *Einstein's collected works: Volume 3*. In ed. Xu Liang Ying, Zhao Zhong Li, Zhang Xuan San, Bian Yi. Beijing: The Commercial Press.

Bar-Cohen, Yoseph. 2009. *The coming robot revolution*. Germany: Springer.

Bostrom, N. 2013. *Super intelligence: Paths, dangers, strategies*. Oxford: Oxford University Press.

Bostrom, Nick. 2016. *Superintelligence: Paths, dangers, strategies*. UK: Oxford University Press.

Castells, Manuel. 1998. *End of Millennium*. UK: Blackwell.

Domingos, Pedro. 2015. *The master algorithm: How the quest for the ultimate learning machine will remake our world*. New York: Basic Books.

Fromm, E. 1968. *The revolution of hope: Toward a humanized technology*. New York: Harper & Row.

Kurzweil, Ray. 2005. *The singularity is near—20145, when computer intelligence surpass that of mankind*. Penguin Group.

Li Kai Fu, Wang Yong Gang. 2017. *Ren Gong Zhi Neng (Artificial intelligence)*. Beijing: Cultural Development Press.

Li Yan Hong, Deng. 2017. *Zhi Neng Ge Ming (Revolution of intelligence)*. Beijing: China CITIC Press.

Ma Ke Si En Ge Si Xuan Ji (Di 1 Juan). 1995. *Selections of Marx and Engels: Volume One*. Beijing: People's Publishing House.

Marcuse, Herbert. 1964. *One-dimensional man*. Beacon Press.

Mesthene, E.G. 1970. *Technological change: Its impact on man and society*. New York: New American Library.

Minsky, Marvin. 2006. *Emotional machines*. New York: Simon & Schuster.

Veruggio, G. The birth of Roboethics. In *Proceedings of ICRA 2005, IEEE International Conference on Robotics and Automation, Workshop on Robo Ethics*, Barcelona, 18 April 2005.

Webster, Frank. 2007. *Theories of the information society*. UK: Taylor & Francis.

# Chapter 3
# Artificial Intelligence Governed by Laws and Regulations

**Junfeng Li, Ying Liu, Lin Yue, Fengliang Jin, Qi Guo and Cong Xu**


J. Li (✉) · Y. Liu · L. Yue · F. Jin · Q. Guo · C. Xu
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 200444, China



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_3

**Abstract** While promoting human progress, AI has also triggered the transformation of social structure, which exerts profound influence on the existing legal system and legal concepts. While actively responding to technological progress, legislation also needs to get ready for potential risks brought by technical innovation. Having broken through the traditional boundary between space and time, AI has brought to the world a convenient interactive environment for development, with its transformation to nature penetrating into every respect in human life. Actually, AI has evoked a number of issues, including status definition for intelligent robots, the controversy over the copyright of the works by AI, data information security, and protection of privacy, etc. Considering that law has its stability and can't be frequently altered while AI industry is still on rapid development, it is advisable to take the policies as major guidance for AI industry regulation and legal norms as a supplement. In addition, legislation should be put on agenda as early as possible before crisis can happen, sphere of which should include protection of intellectual property right, information application and privacy protection, as well as formulation of technical standards.

## 3.1 The Challenge to the Existing Legal System

The development in every respect of social life can inevitably appeal for legal assistance and thus exert certain influence on legislative and judicial institutions. Driven by the development of sensor technology, mega-data storage and application of communication technology data scale show exponential growth and the ability to process data is dramatically improved, all of which prove that AI starts to deeply involve in social life. The advent and development of AI make our life and legal relations more complicated. Legal practice calls for new thinking tool, while AI has been gradually displaying its immense advantage in addressing this issue and exerting increasing influence on legal activities with each passing day.

### *3.1.1 AI's Influence on Existing Legal Order*

Traditional legal order was based on the natural reasons of natural persons. In the times of mega-data, AI breaks away the unicity of interpersonal interaction in traditional society, while the unpredictability and intangibility of such interaction have brought intense shock to traditional legal order. In many cases, individual conduct depending on AI technology tends to go beyond the controllable scope of one's intention, as interpersonal association becomes closer and individual public activities are getting more frequent. AI development is posing challenges to traditional legal expectation and conventional legal order.

(1) To Break the Traditional Rules for Defining the Qualification as the Subject of Law

With AI development, the acknowledgment of intelligent robot's qualification as the subject of law becomes a new problem facing by legal regulation.

In February 2016, National Highway Traffic Safety Administration (NHTSA for short), the supreme administrative institution in automobile security of the USA granted "driver" certificate to the AI system of a Google pilotless car, which indirectly confirmed the qualification as virtual legal subject of AI product. In May of the same year, Committee on Legal Affairs of EU Parliament submitted Commission of European Union "Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics", which appeals for conferment of legal status as "the electric persons" to automatic machines as well as of "specific rights and obligations" to the robots who acquire the qualification of legal subject by law. The motion also suggests that separate accounts be opened to intelligent robots so that man can prescribe legal liabilities for robots, pay taxes, submit fees, and draw the pension. In January 2017, Committee on Legal Affairs of EU Parliament adopted a resolution which required the Commission of European Union to legislate for robots and AI. One month later, the EU Parliament passed this motion. The statement published by NHTSA of the USA and EU's resolution encourages AI technology development and will surely bring shock to the affirming system of traditional legal subject qualification.

(2) Loopholes in Protection of Data and Privacy

AI is founded on mega-data, while the sustainable development of AI industry also needs support from mega-data technology. Intelligent robots can achieve data exchanges through sensors and then analyze those data that's how they acquire their autonomy. In the context of mega-data participation, there will arise data leakage and infringement of privacy in the course of data stream transmission and application. For example, as Internet technology can promote the frequency of collecting and using data and accelerate scale upgrading, many Internet service providers (ISP) capture the electronic traces left by clients who browse web pages and thus obtain the browsers' information by behavior tracking technology and then they sell the integrated data to the third party who will formulate targeted commercial strategy based on clients' behavior information. It seems to be a smart business means, but the data is obtained at expense of personal information and privacy of netizens. These issues demand prompt solution and need due attention upon the existing legal system of countries all around the world.

(3) Industrial Upgrading of Legal Consultation Service

AI has been applied in various legal services, of which the representative ones are legal information system and legal consulting and retrieval system. The huge and complicated data bank stores various laws and regulations, court judgments, legislation drafts and academic literature, which are all resources indispensable for legal experts in their professional services. In consideration of the complexity of the controversy and judgment in legal cases, AI at present cannot completely replace lawyers, but it is obvious that AI development is getting to challenge traditional legal services.

### *3.1.2 Legal Status and Liabilities of Intelligent Robots*

With the rapid development of mega-data technology and computer IT, breakthroughs are constantly made in AI, which urges some technological and automobile corporations to explore and develop pilotless driving, including Google, Baidu, BMW, and Benz. As AI breakthrough becomes the heated topic around the world, people wonder whether the developing AI will exert influence on legal system. In "The 18th China International Hi-Tech Fair" held in Shenzhen, Guangdong Province from November 16 to 21, 2016, a robot injured an audience, being the first case in AI history, aroused a series of queries on legal status and legal liabilities of intelligent robots: What kind of legal status will we grant robots? Will robot be the subject of intellectual property right? What kind of liability will a robot hold if it does injury to human? In July 2017, China's State Council released "Program for Developing A New Generation of Artificial Intelligence", emphasizing "To unfold the studies on legal issues concerning affirmation of civil and criminal liability, protection of privacy, and intellectual property right and safe application of data during AI application. We'd like to brief on the status and legal liability of intelligent robots in legal realm."

(1) Legal Definition of Intelligent Robot

At present, AI involves extensive industries, such as intelligent hardware and software, intelligent robot, intelligent carrier, virtual reality, augmented reality, intelligent terminal, and basic devices of Internet of Things as prescribed in "Program for Developing A New Generation of Artificial Intelligence." However, not all of AI will pose challenge to legal status and liability in legal system, but focus is laid on affirmation of legal status and liability for intelligent robot and intelligent carrier (pilotless driving).

As to the issue of exploring legal regulation for intelligent robot, a working panel was set up in January 2015 by Committee on Legal Affairs of EU Parliament, whose function is to study the legal issues on developing AI and robot. In May 2016, this organization released "Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics" and "European Civil Law Rules on Robotics" five months later. Based on the rules in those legal documents, the so-called robots should be defined by the following features.

1. Can obtain autonomy from the data exchanges with the environment made through sensors or from data analysis.
2. Can possess the ability to study from experience and interactions.
3. Tangible in form.
4. Capable of adjusting its behavior and action so as to adapt itself to the environment.

Based on this feature, intelligent machines can cover pilotless automobile, medical robot, nursing robot, robot lawyer, robot judge (such as "FaXiaoTao") while autonomy (e.g., independently making decisions) and learning ability are the striking features for identifying intelligent robot.

(2) Legal Status of Intelligent Robot

Firstly, for legal status of intelligent robot, the present discussions focus "the object of right."

Generally speaking, the subject of legal relations refers to the beneficiary of certain rights and undertaker of certain obligations in this relation as well as participant in the relation. In positive law, the subjects involving in legal relations include citizens (natural persons), institutions, organizations (legal persons), and states. As the construction of legal relation is based on natural person, an institution (organization) is granted with fictional personality by law, and so it can be regarded as a subject in legal relations. Based on the existing legal regulations, intelligent robot is not the subject in legal relation yet, in other words, it is neither a beneficiary of right nor an undertaker of obligation.

With science and technology development, intelligent robot may possess the intelligence equivalent to human and they may even surpass human in this respect. Will it become one of the subjects in legal relations for this reason? To put it simple, can it sign contract with an organization? Will it be allowed to possess its property? Will it enjoy the rights of the person as natural person owns (including body right, health right, reputation right, privacy right) and property right? Will it undertake certain responsibility if it does own the said rights? According to the existing legal concept, man can be the subject of right in that he has independent personality, whereas legal persons are endowed with fictional legal personality, because they have their own name, domicile, the necessary property and can undertake responsibility independently. In addition, legal persons are in essence controlled and represented by natural persons for legal representatives who may exercise right outwards in accordance with the law are often acted by natural persons. In this sense, as intelligent robot doesn't possess independent personality at present, it cannot own its property. Nor can it act as the subject in legal relations.

Then, will intelligent robot be the object in legal relations? Theoretically, the object in legal relations refers to the object directed by the right and obligation of the subject in such relation. The existing object in legal relations includes such varieties as material object, human body, intellectual and artistic products. The object in legal relation must contain at least three features.

1. It must be "useful" to the subject.
2. It must be among "thing-for-us" that can be controlled or partly controlled by human.
3. It must be among "thing-in-itself" independent from the subject.

Nowadays, the birth of such intelligent machines as pilotless automobile, medical robot, nursing robot, robot lawyer, and robot judge has been offering assistance and convenience to human life. While subject to human commands, they are independent of man. For all these reasons, intelligent robots meet the features standards in legal relations, and they can be regarded as objects of right.

Secondly, prospect of legal status for intelligent robot in the future: possibility of granting it legal fictional personality.

In human civilization evolvement, legal system "constructs the node, structure and level for the operation of social system by endowing various subjects with different legal personalities, status, identifications, rights, qualifications and obligations" (Yu Chengfeng, "The Methods from Trial of Mouse to Artificial Intelligence", contained in No. 7 "Readers", 2017.). Viewing from the history of legal system, legal subject has gradually extended from natural person to legal person and legal organization. Through the mode of legally fictional personality, legal person integrates himself with legal relations and acts as the subject in such relation, resulting in positive and significant contributions to economic development of the society.

With rapid AI development, intelligent robot boasts ever-advanced intelligence, which may narrow the gap in intelligence between robots and human. The coming robot maybe equipped with bio-brain which can even be comparable with the nerve cells in human brain. Some American futurists even predict, "By mid-21st century, non-biological intelligence may be one billion times as intelligent as that of all human being" (Du Yanyong, "On Robot's Rights", contained in No. 8 "Philosophical Trend". 2015.). On that occasion, intelligent robots may be granted subject qualification in legal relations in the form of fictional personality by law, enabling them to involve in social and economic life.

(3) Legal Liability of Intelligent Robot

Firstly, legal liability of intelligent robot at present stage: product liability.

At present, robot can act only as the object of right in legal relations, so it cannot independently undertake responsibility. As injury arises during the application of robot, how to define responsibility undertaking becomes a novel theme. In the existing legal framework, we may confirm the responsibility of robot as product liability, and thus, robot is exempted from administrative responsibility and criminal liability in that intelligent robot is a "product" which is based on algorithm and developed by research institution or manufacturer. Therefore, the injury caused by "product" can undoubtedly be attributed to product liability.

Product defect is a key concept in product liability, which refers to the unreasonable hazard that imperils human life and property. Products are made in accordance with governmental and industrial standards that ensure the security of human life and property. The subjects of product liability mainly cover producer and seller (in cases of intelligent robot, the subjects are their producers and sellers), whereas the standards of due responsibilities for the two subjects are quite different on the part of robot. Producer undertakes strict liability, while seller bears responsibility for fault. If damage to human life and property happens in application of robot, its producer and seller should assume product liability in light of "the Law of Tort Liability", "the Law of Product Quality, and "the Law on Protection of the Rights and Interests of Consumers." The legal relation between consumer and proprietors is stipulated in "the Law on Protection of the Rights and Interests of Consumers." The proprietors refer to both "the producer" and "the seller" in "the Law of Tort Liability" and "the Law of Product Quality."

European Union takes serious consideration of the legal liability for intelligent robot by suggesting to formulate some regulations on civic liability of the robot. In

"Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics", Committee on Legal Affairs of EU Parliament offers some referential legislative proposals on the basis of EU legal systems. The suggestions cover the following:

1. Intelligent robot should bear liability for fault if it causes damage. Regardless of the legal solution that could be chosen, no limit on forms as well as range of probable compensation is bearable in cases except for pecuniary loss ones. Nor can the reason that the damage is caused by non-human actor (robot itself) prevent the victim from acquiring the compensate on.
2. If the ultimate accountable subject is affirmed, the liability for him should be commensurate with his command level and the robot's autonomy.
3. To allocate legal liability for the damage caused by robot is a fairly complicated issue, for which a feasible solution is to formulate a compulsory insurance system available to intelligent robot.
4. Compensation funds are recommended to set up as a supplement measure for compulsory insurance system.

Secondly, prospect of legal liability of intelligent robot in the future: independent liability.

Once the coming robot is endowed with legal personality as legal person, it may enjoy the rights in legal relations and at the same time undertake responsibility independently. Naturally, as the liability of robot is different from that of the legal person whose personality is prescribed by law, the pattern of liability undertaking for robot should refer to that for human being, whether it is civic or administrative responsibility, even the criminal liability. The exact differences between the specific liability forms of the two will be an important theme for further study in the future.

### *3.1.3 AI's Influence on Judicial Ecosystem*

(1) Improving judicial efficiency;

(1) Saving the time of trial.

It is an irrefutable fact that robot judge and other AI technologies may improve the judge's work efficiency. The statistics made by Intermediate Court of Suzhou shows that the court text-to-speech system shortens the time of trial by 20% to 30%, even 50% or over in complicated cases. The intelligent judicial system developed by Chinese court helps to reduce the judge's routine work by over 30%.

In recent years, Chinese judges are facing the trouble of "numerous cases but numbered judges." Just as a factory addresses the shortage of workers, the court's strategy is to increase the working time of the judges and recruit more young judges on one hand and tries to improve work efficiency by technical innovation on the other. It is likely that once technical breakthrough is made in one certain link, the

work efficiency will be greatly elevated in the whole chain. For example, speech recognition technology can not only alleviate the workload of court clerks, but also reduce the time of other court personnel (especially the judge).

According to the present personnel policy and judicial reform orientation, Chinese courts won't recruit judges in considerable number in the near future. In this case, to improve judges' work efficiency will alleviate their workload and mental pressure, as the leadership of China's Supreme Court claims. If the technical progress of robot improves the court efficiency by 60%, 90%, or even higher, the situation will be totally different, because the government has to provide each judge with much welfare, but a robot may work around the clock with no payment.

(2) To cut down auxiliary personnel

So long as robot technology is put into used from theoretical field, unemployment will arise for human being. Two optimists, Ray Kurzweil and Jerry Kaplan, hold that although AI may expel people from their work posts, it can not only improve the gross efficiency of human society, but also create more jobs on the whole. Therefore, they believe that unemployment triggered by robots is just a transient phenomenon, whereas the pessimists, such as Bill Gates and Stephen Hawking, are worried that AI will deprive of some people's work opportunities forever because AI won't enable them to be re-employed. If the impact of IT and AI is considered, the demand of human judges in courts will get to decline. Although there is little possibility that the employees are laid off on a large-scale, judicial administrative and auxiliary staff will be the first to be unemployed. At present, as speech recognition technology remains to be perfected and the professionals are needed to debug the system and supervise its operation, necessary auxiliary personnel still hold on their posts before the technology is mature. Of course, judges will meet this situation some day.

(3) Reducing the frequency of necessary human judge involvement

Even if robot judges may strand in the Weak AI phase, our social life never stops its intelligent process. Intelligence level in other areas of life may be probably higher than that in the court. For instance, if we take Taobao as an independent social system, its intelligence degree of internal mechanism for online settlement of disputes could have been above that in judicial systems of all the countries. So long as the court is willing to link up with Taobao's dispute resolution mechanism, unify the procedures and standards, the judges will be leisurely in processing the relevant cases, so leisurely that they will be skeptical their own influence on those cases. In a similar way, if all behaviors of people are recorded in information systems (such as Alipay, WeChat, or "electronic eye") which include various respects in life, including shopping, renting contract disputes, or traffic violations, all these legal problems will be readily solved. In other words, the more intelligent life become, the less involvement of judges will be demanded.

(2) To Reconstruct Discretionary Power of Judges

(1) To promote the same verdict in the same kind of case

In the countries practicing civilian legal system, judges are required to exercise the same verdict in the same kind of case, whereas its judicial system is denounced to be as "administrative type." However, when making adjudication, judges find it hard to exercise the same verdict in the same kind of case across a country. Although the Supreme Court has released a great number of judicial interpretations and exemplary cases, they still cannot reach the effects in their judicial adjudication same to the exemplary cases.

After AI is used in adjudication, effective or not, it will retrench or restrain the discretionary power of the judges as long as it can be popularized on the basis of unified criteria across the country. On one hand, AI will follow the consistent specification, making the information in the lawsuit process (including legal norms and case facts) more standardized and leaving little room for judges to interpret the adjudication in their own way. On the other hand, robot keeps company of the judge with every step of his operation; actually, the judge is rendered into the robot's supervision to such extent that even a redundant blank or punctuation mark cannot be typed. So robots will surely act as the assistant of judges and play a supervising role in fact. With more involvement of robot, the judges will perceive that he is more like the assistant of the robot.

(2) Human judges are mainly responsible for value evaluation

To these days, there are still many people holding that even the application of AI leads to reduction of some judicial administrative staff and even judges, it is too early to predict that intelligent robots can completely replace human judges. The present legal documents are written in human languages or natural languages after all, in which the value evaluation on many contents is beyond the interpretation of robots. So long as AI technology cannot master natural languages and make value evaluation, it is impossible for robots to drive out all the judges from the courts.

Of course, no matter it is natural language or value evaluation, it is the hard nut that AI researcher try to tackle. Human confidence in judicial discretionary power stems from the immature AI technology at present day. Maybe a more critical issue lies in who designs and controls intelligent robots rather than the competition between robot judges and human judges. If the coming intelligent robots acquire the ability to recognize natural language and make value evaluation, the most critical issue is whether human beings can still hold "discretionary power" over AI technology, no matter to what extent AI robots reach or surpass human brain. Just like the scenes in the science fictions "2001: A Space Odyssey" and "The Matrix", in which robots surpass mankind in intelligence, and human beings are controlled and enslaved by intelligent robots.

(3) Rationalization of Internal Administration in Courts

(1) Bureaucratization of Judicial Administration

In September 2015, the first intermediate people's court of Shanghai developed a set of intelligent audiovisual converting supporting system for collegiate bench. In the beginning of 2016, the court conducted intellectualized reconstruction of its judicial management system, which offered more accurate and considerate "privately customized" service for judges. In recent two years, people's court has focused construction of "intelligent court" as one of its tasks so as to realize "intelligent trial service" and build "AU judicial system." If "intelligent court" means informationalized court which covers every respect in the court, "intelligent trial service" or "AU judicial system" involves the central function of the court, namely judicial adjudication.

From the perspectives of Max Weber's legal sociology and dominating sociology, the rationalization of legal form should match the bureaucratization of legal system. With high intelligence showing in judicial adjudication, bureaucratization of court management should be elevated accordingly. In this sense, AI in legal realm acts not only as the technology in judicial adjudication, but also as the technology for judicial management. Robot judge is the assistant to human judge and the supervisor as well.

At present, AI is mainly used as a management technology in the judicial system in most countries. It is unnecessary for us to fly our imagination about "robot judge." Superficially, AI is gradually reducing human judges' positions and restricting their discretionary power, but it exerts the in-depth influence on legal system will further strengthen the bureaucratization of legal system. It seems to Weber that the process of bureaucratization can be regarded as the extension of modern social rationalization.

(2) Centralization of Legal Authority

The constructing "intelligent court", implemented by the courts at different levels, is "the top-level design" of the People's Supreme Court." Therefore, the contents and standards for AI vary with the courts in different places. For such construction, the best technical standards may be screened out by the competition among the courts in different regions, a practice that helps avoid "indiscriminate" reform and increase the elasticity of institutional reform. It is worth noting that the emerging construction of "intelligent court" and "information court" in recent years is indeed affected by AI on one hand and is to meet the internal requirement for judicial reform on the other. To optimize or reconstruct the administrative system within the court by AI is the major motivation for building "intelligent court."

All of the information technologies, including AI, reduce the management costs of human organizations by the ways of cutting down information transfer levels. In a similar way, with more mature AI put into use, a complete set of AI operation system will be established in the courts at different levels nationwide. If this aim is realized, all the judges across China will adopt the identical standards when trying cases. This practice means that all the cases under proceedings will be subject to the supervision of the Supreme Court. In this way, the relation of supervision and adjudication between courts of different levels, together with the internal administration relations

in the courts of different levels will be weakened, whereas administration relations between the Supreme Court and grassroot courts and those between grassroot courts will be strengthened.

## 3.2 Regulation on AI Industry Development by Policies and Legal Norms

AI is universally acknowledged to be the innovative technology that will change our world. Whoever masters updated technology, it will lead the developing trend in the world. To realize this purpose, we should first formulate the positive and effective regulating standards for developing this industry.

While summarizing and concluding the previous social experience, legal norms are somewhat hysteretic in reacting to the development of future society. Therefore, the present regulations on AI industry should focus on the dominance of policy, supported by legal norms. At the initial stage of AI development, the strategy of "policy and regulations first and then legal norms keep up" will depend more on the adjusting force of policy and regulations and will fully mobilize people's initiative for developing AI so that we can better promote the development of this industry and lay the foundation for establishing and perfecting legal system as well.

### *3.2.1 The Current Regulation State of AI Industry*

In "Made in China 2025", its program of action explicitly emphasizes, "To promote intelligent manufacturing, we should study and formulate the developing strategy for this purpose, accelerate the development of manufacturing equipment and products, propel the intellectualization in manufacturing process, deepen the application of internet in manufacturing field and enhance the construction of internet infrastructure" (Long Weiqiu, "A Study in Legal Challenge and Counter-Measures In China's Intelligent Manufacturing", No. 6 "Review of Legal Science", 2016.). As an important guideline for developing AI, "Made in China 2025" serves as a "prelude" and "propellant" of legislating for the coming AI industry. From this program of action, we may perceive that China promotes its AI mainly by means of policy and give consideration to the possible legal problems, with formulating the corresponding legal norms, policy, and regulations in allusion to the foreseeable legal troubles.

(1) Top-Level Design for Regulation of AI Industry: Promoting its Development

In 2013, EU put forth eight strategies on the cooperation between governments and public private partnerships and research program "Horizon 2020", for which governments invested 6 billion Euros for developing new technology, products and service. In addition, to popularize "Digital Futures Project", EU has initiated "Digital Agenda for Europe".

Early in 2011, British Government invested to set up "High Value Manufacturing Catapult Center." As a unit featured by its coordinated research and development jointly running by public power authorities, universities, and enterprises, the center is under the supervision and administration of "Technology Strategy Board" which consists of seven research and development institutions, including, "Advanced Forming Research Center", "Advanced Manufacturing Research Center", "Center for Process Innovation", "Manufacturing Technology Center", "National Composites Center", "Nuclear AMRC" and "WMG Catapult." As an important communication channel between British Government and different industrial departments, this center endeavors to strengthen the close cooperation between the government and industrial associations and grant the relevant institutions research funds to support the ongoing research. The center sets up subcenters in different regions which will take their respective local advantages to offer enterprises equipment, the relevant knowledge, and information for innovations.

In 2013, American Government sets up "National Network for Manufacturing Innovation", aiming at integrating resources and promoting technical innovation. In 2016, Oval Office released "Preparation for the Future of Artificial Intelligence" and "The National Strategy and Planning for AI Research & Development." In addition to focusing the country's emphasis on active application of AI for human benefits in these two documents, US Government also proposes the further actions in the specific fields so that the country may better adapt itself to the advent of AI age.

Following the USA, China promulgated "Program for Developing A New Generation of Artificial Intelligence", in which the Central Government calls on "To seize the significant strategic opportunities for AI development in no time, motivate our first-mover advantages in this technology." and "To further implement innovation-driven development strategy, accelerate the in-depth application of AI into economic, social fields, and national defense so as to elevate our innovation ability in developing a new generation of AI to spur intelligent economic growth and build an intelligent society."

(2) Strategic Layout for Regulation of AI Industry: to Improve Legislation of AI

In May 2016, after releasing "Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics "and "European Civil Law Rules on Robotics", Committee on Legal Affairs of EU Parliament adopted a resolution in January, 2017, which raised to Commission of European Union ten legislative proposals on developing robot and AI, including establishment of specialized AI supervising institution in EU, construction of AI ethical framework principle and fundamental ethical principle, reconstruction of liability rules for AI industry, affirmation of AI "independent intellectual creation" status to delimitate ownership of intellectual property right, emphasis of the standards for protection privacy and data, promotion of standardization and guarantee of safe reliability, formulation of regulations for AI of specific purposes and use, attention to AI's social influence and strengthen international cooperation, ten proposals in total.

In August 2016, UNESCO and World Commission on Scientific Knowledge and Technological Ethics jointly issued "Preliminary Report Draft on Robot Ethics",

holding that not only robots should respect the ethical norms of human society, but also the specific ethical norms should be encoded in robots.

In December 2016, Institute of Electrical and Electronics Engineers released "Ethical Design: Prospect on Enabling Artificial Intelligence and Autonomous System to Benefits for Human Beings" (Version1), which brings forth specific proposals on eight themes, including the general principle, ethics, methodology, the security and benefits of general AI (AGI) and super AI (ASI), personal data, automatic weapon system, issue of economic and humanitarianism and legislation.

In July 2017, the House of Representatives of the USA adopted "Automatic Drive Act", in which amendment is made in No. 49 (Transportation) of "United States Code." This Act for the first time exercises management on the production, test and sales of pilotless automobiles, stipulates the security standards for driving pilotless automobiles, and issues network security requirements and exemption clauses. The Act will be effective through the vote of US Congress and authorization of the president.

By contrast, China hasn't initiated the legislation on AI yet and so there has left much to be desired in formulation of relevant laws and regulations.

(3) Coordinating Regulation System in AI Industry

Innovations in major countries are driven by two directions, in which government takes the lead in pooling funds, integrating research institutions and building platforms for technical innovations so as to provide fundamental facilities for industrial intelligence and information innovation of domestic industries. During the sustainable development of AI industry, government should play a leading role in its cooperation with the industry in integrating relevant research institutions and development platform, establishing the unified innovation units, offering favorable facilities and environment for university–industry collaboration so as to effectively promote technical progress and achieving breakthroughs in.

### *3.2.2 Regulating Means for AI Industry*

Considering that AI is a leading edge and innovative technology, the regulating means for traditional industries prove ineffective for this technology. The conventional supervising patterns, such as licensing system for products, supervision on research and development and tortious liability, are invalid in dealing with the risks brought by intelligent machines of management autonomy. Hardly can the pre-supervision smoothly proceed as well. All these are attributed to the fact that the research and development of AI is undergoing in stealthy (with fairly few facilities), discontinuous (the spare parts for AI may be manufactured without intentional cooperation), scattered (The research in AI can be completed with the cooperation of several teams which are distributed far apart.) and opaque ways (Outsiders find it hard to perceive the potential hazards in AI). "The automatic features result

in the difficulties in risk foresight and management, especially shown in the case that AI incurs disastrous risks, the post-supervision proves ineffective" (Scherer, Mathew. U. "Regulating Artificial Intelligence: Risks, Challenges, Competence, and Strategy". translated by Cao Jianfeng and Li Jinlei from No. 3 "Information Security and Communication Security", 2017).

The industrial regulation on AI meets the challenges from the adaption of legal regulations to technical conditions and technical development, which call for coordination from different social departments and re-evaluation of the effects of various legal regulations to AI and other industries pertinent to AI. It is necessary for us to establish special supervising institutions on AI industry and set up comprehensive regulating framework which will be put in place by special institution. This organization will refine the classifications within regulating framework, the formulation standards for industrial products, supervising procedures and detailed regulations for the departments of specific classifications. The sustainable dynamic supervision will be achieved within the perfect regulating framework.

(1) Mode Choice for Synergy Regulation with AI

Worldwide, many European and American countries have formulated strategies for AI development and constructed the corresponding synergy regulating framework combining legal regulation and self-regulation of industries. As AI is widely used, people find it difficult to work out a universal applicable governing principle and code standards. Moreover, the complexity of AI will make the existing legal norms ineffective in exercising legal governance over AI operation. At present, there remain such issues concerning fuzzy definition for core concept, ambiguous subjects of rights and liabilities in normal forms in world mainstream AI industry. With regard to this situation, the existing foreign AI regulating norms are still on fumbling stage and the concrete judicial implementation effects remain to be evaluated by practice. When making legislation in AI, we would like to propose that China adopt the mode of specialized legislation. In addition, we should pinpoint the problems, establish a fundamental framework to settle these problems within the existing legal system by consulting international standards, learn from the experience in developing AI, and formulate the practical rules aided by policy.

(2) To Properly Deal with Two Pair of Relations

(1) The Balance between Public and Private Interests

While exercising synergy regulation on AI industry, we should first take the conflict reconciliation between public and private interests as one of the fundamental problems in legal regulation. Based on the openness of data and algorithm, AI transforms the regulation of the disperse behavioral subjects under the traditional legal framework into the centralized algorithmic regulation. The corpus consisting of individual data serves as the base and driving force for constant development of AI. Although the collection, settlement, and application of personal data are indispensable to the construction of intelligent society, smart city, and intelligence-driven economy, those

data will at the same time circulate in various intelligent networks and so the protection of privacy and legal rights and interests is rather critical in AI age. Confronted with rapid progress of AI, legislators should properly deal with the private interests while protecting the public one.

(2) The Relationship between Market Competition and Technical Innovation

The development of AI industry is the result of bilateral requirements and interaction of technology and the market. The elevation of intelligence technology together with market expansion brings about changes of traditional legal regulation during AI age. Firstly, the ever-increasing upgrading of AI technology explores new market, while the growing market will call for new requirements on further innovation of AI technology so as to achieve benign interactions between AI and market. Secondly, the contradiction between AI and market will pose great challenge to the existing legal system. Market expansion is driven by profits, the same to the market of AI products because benign competition environment is a prerequisite for sustainable growth of AI technology market. Therefore, while encouraging benign interaction between AI and market, legislators should give full consideration of the requirements of AI and market and reserve legal space for the coming development of new-type AI business but the necessary regulation must be kept.

### *3.2.3 Coordinating Regulating Framework for AI*

(1) To Establish Specialized Supervising Institution for AI

It is predictable that AI will infiltrate every respect of human life. As there exists pragmatic difficulty in exercising and regulating AI industry, highly integrative coordinating interactions are required among governmental departments, as shown in Fig. 3.1. With AI development, there will generate a number of demanding working items which start from scratch, evolve from simple to deeper procedures, continue the operation, and demand expertise. In this case, it is necessary to set up supervising administrative departments which will be responsible for the management in AI industry and security assurance in the extensive application of AI. In addition, they will make regulations for governing AI industry with their professional knowledge in such fields as ethics, science, and technology so as to promote AI healthy development. Most acts and government reports in allusion to AI and the relevant industries explicitly stipulate that to deal with the challenges to human civilization brought by AI, it is necessary to set up specialized supervising institution or commission, which will undertake the assignments such as examination and evaluation of AI products, unification of manufacturing standards for industries, coordination of other departments, collection of technical cutting-edge information, and upgrading of relevant legal supervising regulations and policies.

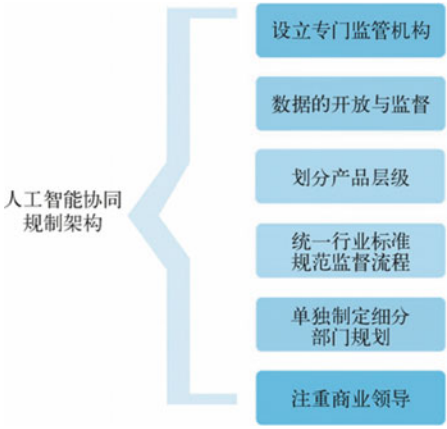



**Fig. 3.1** Artificial intelligence collaborative regulatory framework

(2) Openness and Supervision of Data

The evolution of AI depends on the constant development of mega-data and analytical technology. New processing technology upgrades the original information processing tools and increases the frequency and scope of data processing. Some commercial companies with Internet as the representative lose no chance in collecting the data of potential values, while Internet companies keep exploring the commercial values hidden in the data in the course of data acquisition and application so that they may reap the maximum profits.

To take the application of medical data for an example, in June 2016, General Office of the State Council released "Instructions on Promotion and Regulation of Mega-data Development and Application in Health Care" (Instructions for short), which defines medical mega-data as national strategic resource and which calls for further enhancement of standardized supervision while deepen the openness and sharing of the aforesaid data. How we ensure the openness of relevant data while effectively protect privacy and information security depends not only on technical support but also on strengthening safety supervision so that we may implement the standards for industrial data and operate by following the policy guidance.

The prerequisite for furthering industrial development in medical service aided by AI lies in the construction of databank. Electronic medical records are the most important one among the background data in medical institutions. The substitution

or complementary program of electronic medical records is to set up personal health record (PHR), in which all the records are compactly integrated and can be stored in patients' flash disks or uploaded to cloud information base, or to both. At present, except for a small portion of the electronic health records that achieve interflow with electronic medical records, the electronic medical records in most medical institutions cannot be shared among them. The collection and application of data in electronic medical records call for removal of the barrier formed by the secluded electronic information management systems of all the hospitals and clear definition must be made on right to use and ownership. "The Instructions" offers policy base for the smooth share of medical health data, and inter-industrial and commercial applications.

The exploration and application of medical data induce the potential risks of data in AI development, because the databank built on the basis of personal electronic information records is prone to disclose privacy. Only by strengthening supervision can we remove the hidden danger and protect the patients' records while realizing sharing of information through data openness. The booming AI appeals the efficient and safe solutions from the Central Government to local governments. While accelerating the construction of mega-data industrial chain, we should also explore the interactive development of the deriving industries and bring forth information platforms of regulating data resources for mobile applications.

(3) To Clearly Define Product Hierarchies of AI

Subject to the restraint of technical development level, AI is imbued with the striking hierarchies in "intelligent" proficiency and functions in foreseeable future. Different hierarchies of AI will exert distinct influences upon industries and pose different requirements and challenges to legislation. At different stages of development, the exploration of regulating standards on AI industries will be the gradually in-depth and perfect process, whereas the attempt to settle this issue at one stroke will be hard to achieve the expected results. AI report by the White House points out that the early extensive regulation on AI industries is not advisable. The radical regulating measures are not conducive to AI development and what we should do is to take full consideration of the social influence by AI and the necessity of regulating means, making the most feasible way being adoption of gradual regulating method. The process of AI development is also the course the governors grope and accommodate the regulating means. Gradually processing on the basis of traditional rules and keeping abreast with technical progress, this practice not only effectively regulates the ever-changing industries, but also reduces the risks at lower costs, while it may proper reserve space for the whole regulating framework and dispose of the rising issues at any moment.

Not being onefold and compressed the regulating mechanism for AI industry calls for the generation of a set of three-dimensional framework marked by overlapping and interlocking characteristics on the development of industrial technology basis. Classifications should be made on the performances, levels of AI products and industries, on application categories and target markets and management should be

exercised in accordance with different standards so as to adapt itself to industrial development and carry out efficient industrial regulation.

(4) To Unify Industrial Standards and Normalize Supervising Procedures

With rapid development of AI, there will arise some problems on different technical levels and inconsistent evaluations on effects. From the perspective of technical application, AI is short of unified industrial standards and related policies are implicit as well. To implement industrial standards is in need of explicit division of work and responsibility-legible supervising means as logistics. From qualification verification to quality supervision, from information disclosure to code inspection, from early warning on assessment to emergency disposal and from supervision of industries to promotion of development, all these require formulating regulating documents pertinent to the process step by step and defining clear-cut regulations for supervising means.

It should be clear that the research, development, production, and manufacturing of AI must meet the lowest requirements and the strictest restriction of "must observe." We should ensure to keep the development of AI industry within the scope of human ethical principle and under law so that human interests can be ensured and the innovations should be conducive to favorable results. We must observe corresponding fundamental norms and different core principles for supervision in the research, development, production, manufacturing, and application of AI at different levels because AI products of varied degrees should be treated with different standards and regulating means. The unified industrial standards for AI can help effectively integrate the information resource in industry and set up standard parameter system. It can also help prevent market resources from repeated development, reduce production costs, and improve technical compatibility of products so as to guarantee the rapid development of AI technology.

(5) To Separately Formulate the Rules for Subdivided Departments

After specifying industrial standard system and regulating supervising rules, we may work out the more targeted rules for subdivided departments in accordance with industrial requirements. We may follow the procedures in unfolding more meticulous discussions by checking industrial standards. There should always be corresponding rules for AI's manufacturing, sales, and application (civilian or commercial). Corresponding standards should also be formulated for the specific uses of AI with different functional modules. Meanwhile, the different means for supervision of AI industries should be in place and implemented, supplemented by authority files for corresponding procedures so as to guide the practical operation. For instance, special tests and evaluations are needed for the research and manufacturing process of AI products and we should test the safety reliability for AI hardware and software according to process norms. Chapter 9 of "Pilotless Driving Act" of the USA stipulates the publicity of product information and documents which particularly make known to the public the actual performance, functional defects, and the best operating pattern of pilotless automobiles. Those regulations for the subdivided departments will be continuously updated with the advancement of AI technology.

(6) To Focus Commercial Guidance

The mega-data age generates data exchange and platform service and new-type commercial patterns as well. Based on such platforms, the commercial framework driven by data is also one of the important components in intelligent manufacturing. Resources like the information of terminal users and the transaction data on platform service may entrust the commercial platform to customize specific services for users so as to optimize their experiences. Wang Hua, management partner of "Innovation Workshop" holds that AI commercialization may fall into three stages.

(1) AI will be first used in highly online industries, leading to the realization of automation in mobile terminal like data-end and media-end.
(2) With the development of perception technology, machine learning technology and robot, AI will extend to tangible world and bring about off-line automation in specialized fields and industrial application. The ever-mature sensors and perception technology will bring AI commercialization into manufacturing industry.
(3) When cost and technology are permissible, AI will penetrate into personal life, signifying the coming of all-round automation.

The future world will witness an entirely new age marked by the coexistence of mankind and intelligent machines and coordinating operation of various crafts. AI industry will hit the existing working patterns, commercial modes, and the relevant economic structure of every walk of life. But the coming of AI time doesn't mean the thorough subversion of traditional commercial modes. The entirely new commercial patterns are the remolded ones by AI. Once AI is used in industries, the platforms on data sharing and transaction will integrate relevant data resources to form the new-type commercial patterns and interconnect the options of users. As many users are worried that the traditional commercial ecology will be destroyed in intelligence age, what the governors should do is to ensure the smooth and steady transition of the traditional commercial patterns to new-type ones so as to avoid the radical mutation. To better adapt ourselves to the rapid development of AI, we should have a clear understanding of the real situation in AI age and clear up the relationship between mankind and AI and formulate a set of matched policy and legal regulations.

## 3.3 To Protect Intellectual Property Rights and Other Relevant Rights

As AI changes the transmission and application modes of works, the contents generated by AI may yield new economic interest relationship and new commercial patterns. Because AI can perform self-creation, will it subvert the traditional theory of "machine as a tool" in attributing and protecting intellectual property rights? Will AI become a subject of intellectual property right? All these issues pose a great challenge to the legislation in AI age.

### *3.3.1 The Attribution of Right Concerning AI Creation*

With regard to legal characterization and attribution of right on AI creation, there are two questions to be answered by the copyright law. Firstly, is man or machine the originator of AI creation? Secondly, will AI creation possess the feature of originality, the prerequisite for being an object in the law of copyright? Based on the authoritative definition by World Intellectual Property Organization, the works under the protection of copyright law must possess originality, which means that the works is created with minimal intelligence and shows the independent personality of the composer rather than simple duplication and plagiarization. If the contents generated by AI are formally similar to traditional human works in expression, such as the picture by a robot and the news composed by an intelligent machine, we should judge whether it is a work by its production process. As AI creates by means of applied algorithm, rules and template, what measures should be taken to promote the rapid development of AI, based on the premise of respecting conventional human intelligence works, is a critical theme deserving the deliberation of the legislators worldwide when establishing legal regulating system of science and technology.

(1) Technical Elements: Traditional Works and AI Creation

(1) AI creation hits the market of traditional works

In June 2015, Google claimed in its blogs, "The picture drawing by AI is based on algorithm 'artificial neural network' as AI has identified the image before it performs the action." Not long after that, Google released the piano music "Daddy's Car" composed by Magenta, its intelligent robot. In September, 2015, Tencent's Dreamwriter, its news-writing robot issued a financial news "CPI Increased its year-on-year growth by 2.0% in August, A New Peak in the Past 12 Months." In May 2017, Robot "Beng" developed by Microsoft formally issued its collection of poems "The Sunlight Has Lost Its Window", in which "Beng" had learned from over one thousand poems by 519 poets since 1920 and the diction in the collection is basically identical with that of the authentic poets.

There exists similarity between AI creation and human works to certain extent, which is a challenge to the current behavioral rules concerning the duplication and issuing by the obligee in copyright system. According to traditional law of copyright, "The works as referred to in Law of copyright cover the intellectual property with originality in literary, artistic and scientific fields, which can be tangibly reproduced." Works must meet the following three critical conditions: (1) being fruits of human intelligence; (2) being perceptible expressions; (3) possession of originality. Traditionally, the works under the protection of copyright law refer to the intellectual property peculiar to human beings, whose subject is limited to natural person. Only in special situation will legal person or organizer be regarded as "author."

(2) Technical Mechanism and principles of AI Creation

AI creation falls into three stages: (1) gathering, sorting, and inputting of linguistic materials (in data form); (2) establishment of data model on the basis of designed

algorithm and data training of the corpus. Algorithm means in essence the disposal of the collected data in accordance with a series of instructions by the computer; (3) generation of new contents based on data model. The core capacities of AI are its learning ability and data processing ability. Having built a proper model by the known data, AI makes judgment of the new situation with the model. It conducts continuous inspection on the original model and hypothesis with the updated data and exercises real-time adjustment. To take the news written by AI for an example, under the traditional algorithm, programmers must strictly design every program running procedure to every command within the set context. While under machine learning algorithm, the computer conducts data analysis of the numerous previous press releases, from which it discovers the elements for news writing and then it composes news articles by means of simulation.

(3) Controversies Arising from Protection of AI Creation

To take the novel written by AI for an example, the specific procedures consist of the selection of hero or heroine, composition of the outline and plot details and generation of verbal contents by the previously set program of AI. In this case, the writing produced by AI needs to be polished and revised by human. Therefore, the writing of the novel proceeds by following the instructions set by man and is completed by AI intrinsic data framework and algorithmic rules.

AI creation's involvement in literature and art has become a common phenomenon in AI age. AI incurs the transformation of role of computer from a tool only for helping human to make innovation to a special existence with its self-learning ability. But the creative achievements made by AI cannot be protected by law yet due to their conflicts with concepts and law systems of traditional intellectual property right.

(2) To Protect or Not: Nature Determination of AI Creation by Copyright Law

(1) Legitimacy of Protecting the Object of Traditional Intellectual Property Right Under Copyright Law

Legitimacy theory of protecting intellectual property right covers deontology (theory of natural rights) and encouragement theory (theory of utilitarianism). Deontology or theory of natural rights is based on US Constitution which is borrowed from French utilitarianism. Deontology consists of two views. The first one, with John Locke as the representative, asserts that the originator (or inventor) may obtain certain exclusive right for his labor fruition during his creation (ongoing invention); the second one represented by Immanuel Kant and G. W. F. Hegel emphasizes right of personality more, holding that work creation embodies personal attribute of the author, the individual self-realization of the originator, therefore he should enjoy the exclusive right on their work. However, according to Mark Lemley, the founder of utilitarianism theory, intellectual property right serves more for utilitarian purposes—stimulating innovations and increasing social welfare, compared with traditional property right. Whether deontology or Encouragement Theory, the legal system of copyright remains unchanged on the aim of stimulating the creation and dissemination of literary and artistic works through granting the obligee the exclusive right by

legal means. Hence, whether AI creation can be put under the protection of copyright legal system demands more discussions on copyright legislation and the explanation of the relevant purposes.

(2) The Objective needs for Protecting AI Creation by Copyright Law

As for the works created by AI, there is no reason for us to exercise no protection for them since AI works match those created by human beings in both function and quality. The differential between the two may only lie in the ownership of copyright, whereas both deserve protection by intelligent property rights. In addition, if the object status of AI creation is not acknowledged in the law of copyright, it will be difficult to determine the ownership so as to address the potential disputes on the infringement of copyright, if there come up similarity between AI creation and human works or the acts of duplication and publication arise. Moreover, the protection of AI works based on copyright law could also be an indirect approach for protecting investment under the background of encouraging social progress. AI creation certainly takes costs and needs investment, which should be made up for by law of property right protection. Only the copyright of AI works is protected by law can we better ensure the safety of technical investment in AI and encourage the development of this industry.

(3) The Realistic Barriers to Copyright Protection of AI Creation Works

Once AI creation is protected as work that acknowledged by copyright law, there will arise great impact on the standards for identifying the object by traditional copyright law and principle of ownership, resulting in "domina effect." Firstly, human enthusiasm in creation will be greatly reduced. If one work is completed by AI, the company which applies AI will accordingly acquire the juridical status of copyright owner. Once man possesses the exclusive right on AI works, his dependence on AI will be stronger, and he is gradually reluctant to create, leading to the decline in man's creation desire and ability. In this respect, to protect AI by copyright law violates the legislative principle of "transmit cultural knowledge and encourage intellectual creation" for copyright law. Additionally, even if AI creation is subject to legal protection, the role of such protection is rather finite. As international community hasn't reached consensus on whether AI may enjoy copyright on its creation, and the exclusive right in intellectual property rights is imbued with territoriality, certain country grants AI creation exclusive protection under intellectual property right, which is not acknowledged by the legal systems of other countries, resulting in the awkward situation that the AI creation cannot enjoy the mutually beneficial guaranteeing in overseas market.

In terms of legal norms, to be a work subject to the protection by traditional copyright law basically requires its expressions of the creator's individual ideas, emotions and views included in it. In this respect, even if the contents generated by AI boast originality, it has nothing to do with man's idea, emotion a view and thus cannot be taken as work. Moreover, even if it is acknowledged as work, it may not meet the requirement of originality. If the contents generated by a computer constitute

an unoriginal data group, undoubtedly they cannot be treated and protected as work by copyright law. Even if the contents of AI creation are similar to conventional human works in external form, e.g., the news or poems composed by AI machines as mentioned above, generated by algorithm and data which are totally subject to the operation of programming designer, works like this can hardly acquire the originality demanded by copyright law. In addition, even though AI creation is taken as work by copyright law, the copyright can hardly be enjoyed by robot itself as robot has not been recognized as the subject of right yet according to present legal regulations.

(3) Legislative Proposal for Neighboring Right Protection of AI Creation

Neighboring right is a general name for the exclusive rights enjoyed by work spreaders and creators of certain relevant labor fruits except for the specific work itself. Neighboring right stems from the following circumstances. A valuable non-material laboring work cannot be protected by copyright law for its lack of originality, but the work can be transmitted, and even can be duplicated and re-transmitted without the consent of its operator, and so it should be subject to legal protection. In other words, neighboring right means to protect the copyright-related right. For example, in order to exercise EU Database Directive, Germany, together with some other European countries, grants neighboring right to the obligee of the databank without originality so as to maintain the rights and interests of the organizers of databank and investors. AI is the result of technical generation in essence, which is lack of the substantial elements of originality demanded by copyright law and thus not entitled to the protection of copyright law as human work. However, as certain labor and costs are required in AI creation, it deserves some necessary protection so as to attract investment in this technology. In this sense, we may interpret the ownership of AI creations possessed by AI holders as neighboring right, with which we can establish the framework of neighboring right with holder/investor as the core so as to ensure the long-term development of AI.

### *3.3.2 Protection of Data Information and Privacy in AI Age*

It has been a long time since information became one of the objects of civil rights and such cases keep emerging. Among the mass information that can be perceived and used by mankind, the varieties of information taken as the objects of right are still few and far between and the information in general or overall sense is still kept from the category of object of private rights. The extensive application of AI will be kept with the "ubiquity" of electronic communication network, which greatly raises human ability to perceive information and to excavate the value from the information of "all" things. If the abuse of such ability is not curbed, "a horrific world without any privacy" will be generated. For this reason, we should work out legal measures for protecting all kinds of information (including privacy) during AI age.

(1) The Conflicts between Conventional Information Right System and AI Environment

(1) Absence of the Mechanism for Protecting Conventional Information

With the advent and development of intellectual property right, the manifestation and combination forms of information such as works, technical plans, trademarks, commercial secrets, and databank may be used by the obligee in legal and exclusive way, in which the intellectual property right can be interpreted as "the law for granting the monopoly right or quasi-monopoly right on certain kinds of information or certain respects in the information as a regulating means" and "The basic subject matter of intellectual property right is information." The privacy act, protection act for personal data and the special legislation aiming at protecting the information of special contents and forms bring the sensitive information of natural person and the information of identifying significance into the governing scope of personality right and property right. However, the existing norms of information right are scattered in laws of various legislative purpose and foundation, respectively, governing certain parts of information area. They can pile up "a mixed legal stew formed by laws with narrow legislative purposes" (Reidenberg, Joel R. "Privacy Wrongs in Search of Remedies", Hastings Law Journal, 2002, Vol. 54.), but it fails to form an integrated pedigree of information rights.

Among the mass information that can be perceived and utilized by mankind, the information categories landing on "islet of private right" are still finite, most information is still drifting in lawless realm or otherwise rallies as the "data commons" available and applicable by everyone. In a nutshell, civic legislations in different countries offer the exclusive rights for information like personal privacy and intellectual fruits, but it fails to admit the information of general and overall meaning into the category of the object of private right.

(2) The Intensification of Information Interest Conflicts by AI

The application of AI may lead to "ubiquity" of electronic communication network. By means of AI, human perception of information can greatly transcend the restraints of biological function, space and time, object and content, excavate the realistic or potential value from the information of "all" things (including the information seeming to be the simplest and the most common). As the basic implementation mode of modern information perception technology, a great number of micro-, intelligent and inlaid information perception devices are widely deployed in physical environment, which will incur a series of new-type interest conflicts.

By applying ubiquitous information perception technology, people can exercise the real-time comprehensive supervision over information carrier (whether man or substance). If it is abused without control, "Nothing can escape the detection, observation and interpretation of our acts by artificial environment composed of AI equipment" (Hunter 2002, p. XXII.). Computer can analyze and even predict human behavior from a large number of information records. Whether it is out of state interests, public security, commercial profits, personal entertainment or any other

purposes, everybody can be "promoted" to "surveillant" of certain level if funds are put into information perception equipment or purchase of supervising service, but at the same time the "surveillant" cannot escape the supervision from "the other surveillant" of higher level.

(3) The "Dichotomy" Feature between Information Source and Information Sink

People not only desire the information on substances(including human body and other substances beyond human body) they do not possess so as to share the value from others or public information section, but also expect to keep substantial information under his strict control so that they can sustain the value of traditional information section. This contradiction between supervision and counter-supervision stems from "Two-Subject Division" social legal relationship, as shown in Fig. 3.2.

From scientific and philosophical perspectives, information must take substance as its carrier, without which no independent information exists. Whether the sensing information or the information by human sense, its source is substance in essence and the information content is the quantity representation of substance motion. The information captured by human sensation in vision, hearing, smell, taste, touch, and temperature comes from the substance object perceived and can theoretically serve as the representation of quantitative value of certain measurement units. In the discourse system of information theory, the object whose information is perceived is called "information source" whereas the object which acquires information from the information source is named as "information destination." Both "information source" and "information sink" can be either human or object. Information theory is a discipline that applies probability and mathematical statistics to study the universal law of information, information transmission, and information processing. The two concepts "information source" and "information destination" are coined by Claude Elwood Shannon, known as "the father of information theory" as well as "the founder of information age."

Information source and information destination are owned by different obliges. The interest acquired by the obligee of information destination is contrary to the information reserved by the obligee of information source. The contradiction between the

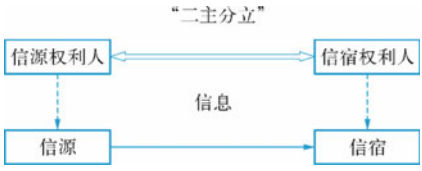



**Fig. 3.2** "Separation of two main sources" from information source and information sink

**二主分立：Two main division**
**信源权利人：Information source right holder**
**信宿权利人：Information sink right holder**
**信源：Information source**
**信宿：Information sink**

objective state of ubiquitous perception for substance and the subjective requirement of exclusive reservation is the significant conflict peculiar to the ubiquitous network society and AI environment. Therefore, to define the bottom line and boundary between the application mode and application scope for information sensor technology so as to settle the ownership of "substance information" (the information loaded on human body and substance) under the state "two-subject division" by information source and information destination is of far-reaching significance in molding the situation at present day and the coming social relations.

(2) The Right of Information Source in the Context of AI Age

(1) The Concept of Right of Information Source

When one cherishes "reasonable expectation" acknowledged and supported by law which is based on his experience and "the hypothesis of civilized society or the conscience of the community", and it is compliant with natural right or moral right, then we must acknowledge that such expectations are widely existing among the mass, that is to exclusively retain and enjoy the information loaded on their body and other substance they possess. It is reasonable and rational to protect the expectation on information loaded on one's body or substance of a natural person owning personal right or property right, and such rationality of protection is so-called the right of information source, namely the right loaded on information source. As information source falls into human body and substance, the right of information source can be divided into information right of body and information right of substance.

(2) The Rationality of Right of Information Source

The right of information source combines the justice of natural law, the foundation for positive law and the rationality of economics. The affirmation of this category lays a foundation for legislation of information ownership mechanism in the context of ubiquitous network environment. Furthermore, it signifies that technical means may easily break the restraints of physical environment, but a legible legal barrier between the information source and the doer who acquires the information still stands. For this reason, we should observe the explicit bottomline and boundary both in mode and in scope while applying the information sensor technology.

As human body serves as a carrier of information, every motion of body's components may represent as and be measured by information, covering gene sequence of cells, frequency of heartbeats, brain consciousness, vibration of vocal cord, action of limbs, speed of body motion, and geographical position of body, etc. The information of human body may be valuable both to the body owner himself and to other people. That man retains and enjoys the information of his own body while keeping others from spying the information is of irreplaceable significance to reservation of man's purpose and individual subjectivity so as to bring about distribution (possession) justice.

In broad sense, objects indicate "all the matters that are independent of human body and that can be perceived by human", including the material objects defined in civic law and natural substance excluded by civic law (e.g., heavenly bodies).

In narrow sense, objects only refer to the objects in civic law, meaning "all the objects that are independent of human body and that can be perceived, dominated and disposed by man." The information of object denotes the quantity representation of the object motion. If we interpret the application of object as "to achieve the purpose by means of the object's peculiarity", we should acknowledge that the act that purposefully acquires the quantity representation of object motion is a mode of object application. The right of obligee toward the object's information, or the information right of object enjoyed by the obligee, naturally contains in his right of object. The information right of object is something inherent in the concept of ownership or the complete right of object, and it can also be deemed as a concrete form of certain function of ownership. Ownership is among the right of property, so the right of object information also belongs to the right of property.

(3) Principle of Information Right Protection in the Context of AI Environment

(1) Principle Framework Needed for Protection of Information Right

It is a legitimate right deriving from present human civilization governed by law and the consensus on economic rationality that natural person and the obligee can exclusively reserve and enjoy their body information and information on their object. To differentiate substance into human body and object is equivalent to the design ability recognition of all possible information carriers. The category of the object's right of information source based on the information of human body and object carrier is equal to all the information that mankind perceives by means of his own organs or technical means, which provides theoretical tool for confirming the preliminary right. However, the execution of every right proceeds within the restrictive conditions, while creation and acknowledgment of right of information source doesn't mean that the obligee can fully monopolize his body information and object information. Nor does it imply that other people cannot dispose of his information without his consent. To put up the category of right of information source intends to offer the affirmation of the fundamental, overall disclosing and supplementary right for the blockbuster of information realm uncovered by the existing norms of right rather than replacing other special types of information right or override it. With regard to this case, a pedigree of information right featured by containment, explanatory adequacy and intrinsic unified logic may be constructed within the theoretical framework consisting of several principles.

(2) Acquisition Principle of the Right of Information Source

If no evidence proves that the other people should enjoy the right of information source, the obligee of the right of information source (including the obligee of human body and the owner of the object) should be inferred to be the preliminary obligee of the right of information source. This idea for inferential judgment of the attribute of information right may be called acquisition principle of the right of information source.

Based on this supposition, the publicity of the right of substance carrier as information source is exact the public summons of the right of information source. If

the information source is movable property, the possession of information source can be inferred as acquisition of the right of information source. If the information source is immovable property, the legal mode for real estate publicity is to possess the external sign of the right of information source. The information loaded on information source of non-civic law object is the information without specific obligee or information that everyone may become its obligee, which anyone may possess the right to dispose of it.

(3) Reservation Principle of Priority Information Right

Reservation Principle of Priority Information Right denotes the fact that if someone possesses the exclusive right of certain information as prescribed in the law of prior application, such exclusive right ("priority information right" for short) should be protected prior to the right of information source and the act by the obligee of right of information source should not impair "priority information right" unless the act is based on other legal reasons.

(4) Restriction principle of Information Right

The general law of right is "to enable everyone's freewill choice to coexist with the freedom of everyone. In other words, the purpose of everybody is to internally respect others' purposes. To safeguard man's dignity, embody his value and ensure his development, we should make objective arrangement for individual right of the information of general sense on one hand and impose restrictions on such right on the other so as to prevent the exclusive and absolute occupation of information sources, which may obstruct the realization of legitimate purposes of other subjects.

(5) Principle of Management of Public Information

The act of the obligee to make public the information source should be regarded as his abandon of the right of information source to certain extent, and others may have the right to deal with the relevant information under the principle of reserving priority information right.

Whether information of source is open to the public or not may depend on both the subjective will of the obligee and the objective state of information source. Firstly, the obligee provides arbitrary persons in ostensive or implied way with body information (such as linguistic information of speech in public places or behavioral information in rallies), and object information (image information of utensils in display or exhibition), all of which can be taken as public information of information source. Secondly, as far as objective state of information source is concerned, for places accessible to everyone, the information there that the common people may acquire with their organs (for example, when someone travels by public transportation, other people can take in view his/her external information such as appearance, clothes and personal belongings.), such information should be regarded as public information. But the disposal of public information should not violate the principle of reserving priority information right. For example, no manuscript of the speechmaker is allowed to be published in the form of infringing the copyright. Nor can the image of someone

be used in public places in the manner of infringing his/her portrait right or privacy right.

## 3.4 To Formulate the Technological Standards

### *3.4.1 To Formulate the Standards for AI*

As the pioneers in developing AI, the major science and technology enterprises have made strategic deployment in AI long ago. While launching technology research and development, they have formulated their own technical standards in areas of their business, which serve as the self-disciplinary framework so that they may gain greater advantage over the coming operation and policy game. In 2016, five largest science and technology enterprises, including Google, Amazon, Facebook, IBM, and Microsoft, began to embark on formulating technical standards for AI. In China, Baidu, Alibaba and Tencent have made overall arrangement on AI from levels of application, technology, and resource. Baidu has obtained relative high degree of accuracy in audio and face identification and has brought forth "Baidu Brain" with leading edge in sound, image, interpretation of natural language and user portrayal. Ali Cloud put forward AI called ET equipped with technologies like intelligent speech interaction, image, and video recognition, traffic forecast and emotion analysis. Tencent has also set up its own AI laboratory, in which it unfolds basic theoretical studies on AI and project realization, and develops open platform for robots.

Amid the tide of developing AI among the major enterprises, more and more professionals appeal for formulation of AI standards and institutional norms. AI standards serve as the cornerstone for orderly development of AI industry and the prerequisite for elevating China's AI competitive edge in international market. We should focus the following respects in setting up AI standards.

(1) Consistency of AI Standards

Consistency of AI standards is conducive to the seamless connection between AI products and mega-data network and make it possible to construct AI information linkage mechanism based on global mega-data networks. First, the "work" to guide AI products by information analysis of mega-data bank may greatly strengthen the effects of early warning and emergency disposal in network security. Secondly, mass information data collected by AI products will be comprehensively integrated within the framework of unified standardized information submission, which will result in the construction of all-round global mega-data information network, achieving interactions among different countries, regions and the whole world. AI with physical shape may promote the development of swarm intelligence and collect as well as process more data with distributed terminal terminals which will be transmitted to cloud "brain", improving intelligence level of the overall network. While exercising supervision, we may resort to the potential capacity of collecting and analyzing mass

data in AI to elevate and expand the accuracy and width of the existing databank, and recirculate it to the mega-data forecasting system and aid people in making the decision for AI development and supervision so as to bring about the ultimate goal of inner circulation of self-supervision, self-early warning and self-decision making (assistance).

Viewing the present state of AI, shortage of the unified and widely available technical standards will undoubtedly restrict its development. So we should firstly make clear the basic concept of AI, on the basis of which we will formulate classified and graded technical standards, evaluate and test AI products and exercise registration and regular censorship system over the highly sophisticated AI products. In addition, we can supervise and trace back the service conditions of AI with the functions of mega-data analysis and information collection to promote the settlement of sustainable supervision so as to bring the science and technology risks within the steerable degree when applying AI for social progress.

(2) Security of AI Standards

AI products cover hardware and software, among which software constitutes the core technology. As the regulations by the government can hardly keep pace with AI development, this fact may induce the loophole of supervision and then further arouse public panic, which might be detrimental to the innovation and development of AI. In this case, the bottom line regulations marked by full disclosure is the last shield for ensuring the safe application of AI in present human society of civilization. The regulations should put forward the fundamental technical rules in design, research, production, and utilization of AI so as to meet the minimal requirements for AI in security, ethics, and law.

AI security standards cover "the minimal security norms" and "the maximum intelligence norms." "The minimal security norms" is the fundamental rule that man must observe in AI search and development. For example, unified code and supervising program should be installed, the operation of AI must be compliant human ethical principles, etc. "the Maximum intelligence norms" aims at bringing AI research, development, production and "thinking" function into proper sphere to make it conform to legal and moral requirements so as to keep if from impairing human interests. Therefore, beginning from research and development, we should set up a self-inspecting and evaluating mechanism to emit pre-warning on the possible risks. We may also set an order "one-key termination", with which we stop the operation of the intelligent machine once AI product is about to bring substantial harm to mankind. In addition, the supervising institutions may introduce information-disclosing mechanism and specify industrial subjects to reveal the procedure code and critical parts of algorithm in AI products so as to facilitate the public supervision. In "Pilotless Driving Act" adopted by US Senate, Chap. 5 covers network security program, in which security strategies are prescribed on how to deal with network attack, illegal invasion, and instruction of malign control. Moreover, American Government may also formulate the guiding standards to direct the proper orientation for development of AI in accordance with the requirements of national and social security.

In "Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics", Committee on Legal Affairs of EU Parliament points out, "in the course of designing, researching, developing, producing and applying robot and AI products, a guiding ethical framework needs be constructed to ensure that its operation conforms to standards of legality, safety and ethical principles" and "Special supervising regulations should be formulated for the robot and AI used for specific purposes"(Delvaux, Mady, "Draft Report with Recommendations to the Commission on Civil Law Rules on Robotics", 31052016, JURI_PR(2016)582443.). In practice, in the fields of rapid development involving pilotless airplane and automobile, the above-mentioned guiding ethical principle may serve as the standards in formulating the relevant supervising norms over AI products of specific purposes.

(3) Internationalization of AI Standards

Confronted with the upsurge of AI, all the sectors of society are anxious about this tide while keeping a close eye on the technical progress in this field.

How to deal with the revolution and challenge that AI brings to human society, how to formulate the unifying criteria that will effectively bring the risks under control while promoting technical progress and how to exercise efficient supervision over AI development and proliferation—all these are hard-nut issues that are faced with and needs resolvement by countries all around the world. It is irrefutable that the ever-delayering world will call for international discussion and cooperation to establish a shared supervising mechanism, which will be composed of the representatives of governmental departments and science and technology industries, researchers of non-governmental academic institutions and public interest groups that represent the great majority of service customers, and which will implement global management and supervision on AI through formulating international unified standards. As China's theoretical studies and developing level on AI ranks the forefront among the world countries, we should lose no time in formulating the relevant legal regulations and industrial standards and take an active part in and lead the research and enaction of various international technical standards.

In addition, it is worth noting that unified standards serve as the cornerstone for healthy and safe development of AI, among which data legislation, protection of privacy, interdisciplinary studies, transmission of education and culture, legal and fundamental ethical principles constitute the critical parts in preliminary framework construction. Countries should communicate and cooperate with each other in the formulation of technical standards and legal norms in certain fields as data legislation, protection of privacy, interdisciplinary studies, etc., so as to bring about the maximum regulating effects. On the other hand, however, with regard to transmission of education and culture, legal and basic ethical principles, it is reasonable that there exist different technical standards and legal norms due to the disparities in culture, history, religious beliefs, and social development among varied countries. Therefore, during fundamental construction, we should not only consider domestic regulations and international law, but also be considerate of the diversities of ethical and cultural views among the different civilizations and of the social expectations.

### *3.4.2 Formulation of Technical Standards—Take ICV as a Case Study*

AI application generates new-type automobiles called ICV, which are loaded the advanced sensors, controllers, executors, integrating modern communication and network technologies. AI helps to realize the intelligence information exchange and sharing between automobiles and X (man, vehicle, road and cloud) and equips the vehicles with such functions as perception of the complicated environment, smart decision making and coordinated control so as to bring about the goals of "safe, efficient, comfortable and energy-saving" diving and of pilotless driving. ICV completely depends on interconnection offered by the vehicle information system to give its functions into full play. Horst Leonberger, VP of German strategic ICV even make bold forecast, "By 2022, all the vehicles will be connected to car network." Interconnection criteria will become the core technology in ICV.

(1) The Necessity of Formulating Technical Standards for ICV

Standards precede industrial development. How to realize vehicle interconnection has been the strategic commanding height for pilotless driving. In the context that countries and regions advanced in automobile industry have taken ICV as their national strategies, it is necessary for China to take comprehensive measures such as development of generic technology, demonstrative operation, formulation of standards and legal regulations, policy support so as to propel the development interconnection of ICV. Compared with the advance speed of the developed countries, China doesn't gain any advantage in this respect. To take interconnection standard of communication for an example, the United States enforced the implementation of "Dedicated Short Range Communications" (DSRC for short), which is an efficient wireless communication technology and which can identify the mobile object in high speed in the specific area (decades of meters) and achieve bi-directional communication, namely "vehicle-road" and "vehicle–vehicle" connection, a technology that brings about real-time transmission of image audio and data information so that the vehicle may drive on the selected roads. It was also required by American government that 50% of ICV be equipped with DSRC by 2021, and with 75% and 100% by 2022 and 2023, respectively. In terms of patents, overseas patents applications account for a great majority in China's market, resulting in inferior situation in car network patent for Chinese enterprises. As the supreme decision maker, the Central Government should be initiative in top-level design. It should regulate and integrate industrial resources, direct the orientation of industrial development, all these can be of critical importance of ICV's smooth transition throughout the beginning stage.

(2) Top-Level Design for Technical Standards of ICV

The interconnection of ICV is imbued with striking trans-regional characteristics. Firstly, it amalgamates different technologies and industries of information, telecommunication, automobile, and traffic. Secondly, the huge ICV market and the bigger traffic pressure will inevitably involve different supervising and administrative departments. All these require that the formulation of interconnection standards will certainly involve multiple standardization organizations and governmental departments. The former covers National Standardized Technology Commission for Intelligent Transportation System, Applied Alliance of Vehicle-Loaded Information Service Industry, ICV Industrial Technology Innovation Strategy Alliance, Ubiquitous Network Technology Commission of China Telecommunication Standardization Association and National Automobile Standardization Technology Commission, etc. As to the latter, information acquisition will inevitably involve State Administration of Surveying and Mapping and military authorities in military controlling areas. In addition, formulation of criteria for patent granting will team up with State Intellectual Property Administration. Other departments like traffic supervising department may also be involved.

The formulation of ICV standards involves multiple governmental functional departments and industrial organizations. If there is no top-level design and overall planning, it tends to result in the disorder that each enterprise puts forth its own criteria. In May 2015, Chinese Government promulgated "Made in China 2015", in which ICV was listed as the field for the primary breakthrough, supported by Ministry of Industry and Information Technology in formulating ICV standards and improving relevant legal system, but it is a pity that "made in China 2025" doesn't mention the studies of V2 V (vehicle and vehicle) from the angle of intelligent traffic on ICV interconnection issue. V2 V communication technology is a kind of technology free from fixed base stations restriction, which can provide the moving vehicles with end-to-end wireless communication, namely V2 V technology, with which the terminals of vehicles may directly exchange messages without transmission through base station. The interconnection between V2I (vehicle and network) and V2P (vehicle and person) and the effective coordination among person, vehicle and the road are lack of the guidance and regulation from top-level design. At present, only automobile market is probing the way, whereas the enterprises can only take automobile as foundation and studies on ICV information as the target and bring vehicles into internet to achieve "connection" between automobiles and network. But the vehicles of the different systems cannot achieve connection to the network, what's worse, even for vehicles of the same system, only the simple interconnection between vehicle and network is achieved, realization of connection of vehicle–vehicle, vehicle-road and vehicle-person interconnection are still on the way. Therefore, it is important that the Central Government should lose no time to exercise top-level design and bring forth the solutions as soon as possible.

(3) Main Contents of ICV Technical Standards

Rather than referring to certain type of vehicles or certain individual vehicle, ICV takes automobiles as its main body and major joining nodes, consisting of vehi-

cles, road facilities, traffic control system, data storage and processing system. ICV technology may accordingly fall into two parts, namely critical hardware system and telecommunication system. The critical hardware system uses vehicle sensors to perceive the environment around the vehicle, from which it acquires the information of the road, vehicle position, and barrier. The system composed of vehicle sensors, controllers, and executors are pioneering devices to gather information. The telecommunication system applies modern communication and network technologies to conduct safe bidirectional interconnection with the information obtains by vehicle sensing system so as to realize the exchange and sharing of intelligence information between vehicle and X (person, vehicle, road and cloud-end, etc.).

(1) To Formulate Legal Regulations for Vehicle Sensor Standards

The intellectualization of ICV is based on the correct perception of the surroundings by vehicle sensors. As the sensors are set at the head of the automobile, it is with the information of the road, the position of the vehicle and barrier that ICV can make timely judgements. Vehicle sensors mainly cover radar, camera, sensors, signal receiver and emitter, vehicle information processing terminal and electronic executor, etc. "As there are numerous manufacturers engaged in spare parts of automobiles, resulting in multifarious degrees in performance and refinement, the institutions responsible for formulating standards should, in light of China's traffic environment, bring forth a series of standards for vehicle hardware, setting mandatory limitations on testing range, grades for accuracy and environmental adaptation, transmitting range and anti-jamming capability of signal receiver and emitter, grades in execution efficiency and reliability of vehicle information processing terminal, environmental adaptation of executors, execution efficiency, and fault-free mileage, etc., and ensure the operational reliability of products as well as immediate processing ability to deal with emergency, etc" (et al. "Studies of the Development on ICV Technology and Standards", No. 8, *Shanghai Automobiles*, 2015.

(2) To Formulate Telecommunication Standards

At present, Chinese enterprises generally use American DSRC telecommunication standards. However, as the world's largest automobile market, China should develop its technical standards with proprietary intellectual property rights in the era that traditional automobile is likely to be replaced by ICV. A report by China Automobile Engineering Society shows that ICV LTEV2X with proprietary intellectual property rights under research may improve traffic efficiency on general road by over 30% after it is widely used. Moreover, it acquires the functions of performing repetitious application of cellular network facilities and working frequency band. Technical competition will be ever fierce between Qualcomm and Huawei as both companies popularize LTEV2X technology.

(3) To Accelerate the Formulation of Safety Standards for ICV

A document decoded by Wiki shows that "At present, American CIA can initiate the microphones and cameras to exercise supervision and even kidnap at any time and at

any place through electronic devices or even the loopholes of vehicle intelligence system and those devices can be activated even when they are "shut off" (Koestenblatt, Jason "FBI Cybersecurity Chief: As Mobile Use Grows, So Do Threats, Enterprise Mobility Exchange", 20161110.) This denotes that differences no long exist in automobiles and other electronic devices equipped with intelligent system.

Now there are some organizations working out the relevant standards, including International Standardization Organization, (ISO), European Telecommunication Standards Institute (ETSI), FG CarCOM, National Highway Traffic Safety Administration (NHTSA), among which ISO is the earliest one to formulate ICV standards and issue several safety reports, such as "Safety Framework and Standards for Electronic Billing", "ITS System Safety Framework", "Privacy Protection" and "Lawful Interception." ITS WG5 Safety Panel/European CITS Platform promulgated ITS Telecommunication Safety (TS 102 940V1.2.1), "Privacy and Trust Management" (TS 102 941V2.1.1), "Evaluative Criteria for Safety Threat" (TR102 893V1.2.1). FG CarCOM which was established in 2009 is mainly engaged in research of the standards for safe telecommunication of automobiles. NHTSA released "DSRC Safety Criteria" (1609.2—2013), and turns its eye to privacy and telecommunication security. Other organizations unfold research of safety criteria for car networking, and focus on privacy and telecommunication security. By comparison, China shows development lag in studies on safety standards for interconnection of ICV, urging relevant formulation work to be put on agenda as soon as possible. In the preliminary phase of formulating, the rules for safety evaluation of "bank-level" is recommended, while with the increase of technology strength, the relevant rules to be chosen should be further stringent and come into being the highest grade of safety in civil use field, so as to be capable of maintaining the high security for vehicle terminal and the center of cloud control.

In a nutshell, there has left much to be desired in terms of China's interconnection technical standards for car networking as against those of foreign countries. For this reason, we propose that China should set up an institution specialized in formulating standards so as to avoid the distributed practice. In addition, we should accelerate our pace in formulating technical standards in vehicle sensors, telecommunication, and safety criteria for car networking. If we seize the initiative, accelerate formulation of technical criteria for ICV, attach importance to application and protection of patents, alleviate the control of foreign patents and break up patent barrier, we will be able to reverse the long-tern unfavorable situation that has troubled automobile industry and correlative industries in China and elevate overall technical strength and competitive edge in automobile industry.

## Bibliography

Balkin, J.M. 2015. The path of robotics law. *California Law Review* (6).

Boeglin, J. 2015. The costs of self driving cars: reconciling freedom and privacy with tort liability in autonomous vehicle regulation. *Yale Journal of Law & Technology* (17).

Bridy, A. 2012. Coding creativity: Copyright and the artificially intelligent author. *Stanford Technology Law Review* (5).
Cao, Jian Feng. 2017. 10 Da Jian Yi! Kan Ou Meng Ru He Yu Ce AI Li Fa Xin Qu Shi (10 Tips on the New Tendency of EU's Prediction of the Legislation of AI). *Robot Industry* (2).
Cuff, D., M. Hansen, and J. Kang. 2008. Urban sensing: Out of the woods. *Communications of the ACM* 51 (3).
Delvaux, M. 2015. *Draft report with recommendations to the commission on civil law rules on robotics*. 2015/2103(INL).
Dornhege, G., N.J.R. Mill, and T. Hinterberger et al. 2007. *Toward brain: Computer interfacing*. Cambridge, Massachusetts: MIT Press.
Guo Jia Che Lian Wang Chan Ye Biao Zhun Ti Xi Jian She Zhi Nan. (Zong Ti Yao Qiu) (Construction guide of national internet of vehicles industry's standard system). (20170926) [20171010]. http://www.360doc.com/document/17/0926/15/38241425_690325148.shtml.
He, Bo. 2017. Ren Gong Zhi Neng Fa Zhan Ji Qi Fa Lü Wen Ti Chu Kui (First look at the development of artificial intelligence and its corresponding law questions). *China Telecommunication Industry* (4).
Hildebrandt, M. 2015. *Smart technologies and the end(s) of law: Novel entanglements of law and technology*. Cheltenham: Edward Elgar Publishing.
Holder, C., V. Khurana, and F. Harrison, et al. 2016. Robotics and law: Key legal and regulatory implications of the robotics age. *Computer Law & Security Review* 32 (3).
Horst, Eidenmller. 2017. The rise of robots and the law of humans. *Law & Modernization* 765–777.
Hu, Ling. 2017. Ren Gong Zhi Neng De Fa Lü Xiang Xiang (Legal Imagination of Artificial Intelligence). *Free Talk on Culture* (2).
Hunter, R. 2002. *World without secrets: Business, crime, and privacy in the age of ubiquitous computing*. Wiley.
Kalra, N., and J.M. Anderson. Liability and regulation of autonomous vehicle technologies. (20150113) [20170915]. https://www.researchgate.net/publication/228931139_Liability_and_Regulation_of_Autonomous_Vehicle_Technologies.
Kurzweil, Ray. 2005. *The singularity is near—2045, when computer intelligence surpass that of mankind*. Penguin Group.
Leenes, R., and F. Lucivero. 2014. Laws on robots, laws by robots, laws in robots: Regulating robot behaviour by design. *Innovation and Technology* 6 (2).
Lessig, L. 2006. *Code and other laws of cyberspace, Version 2.0*. Basic Books, 2006.
Li, Jun Feng. 2015. "Fan Zai Wang Luo" She Hui Zhong De Xin Xi Quan Li Que Ren (Confirmation of Information Rights at the Society of Ubiquitous Network). *Oriental Legal Science* (3).
Mason, S. 2014. Electronic evidence (3rd ed.) *Computer Law & Security Review* 30 (1).
Nissan, E. 2017. Digital technologies and artificial intelligence s present and foreseeable impact on lawyering, judging, policing and law enforcement. *AI & Society* 32 (3).
Qi, Xiong. 2017. Ren Gong Zhi Neng Sheng Cheng Nei Rong De Zhu Zuo Quan Ren Ding (Copyright identification of ai generated content). *Intellectual Property Right* (3).
Qu, Guo Chun. 2016. Jia Qiang Zhi Neng Wang Lian Qi Che Ding Ceng She Ji Yu Fa Gui Wan Shan (We will improve the top-level design and regulations of smart networkers). *Free Talk on Automobile* (7).
Rehbinder, Manfred. 2005. Urheberrecht. Liu Chun Rong, Xian Yu Jing, Yi. Beijing: Law Press.
Reidenberg, J.R. 2003. Privacy wrongs in search of remedies. *Hastings Law Journal* 54 (25).
Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act (Self Drive Act) passed by the House Energy and Commerce Committee, United States. H.R.3388.
Schafer B, D. Komuves, and J.M.N. Zatarain, et al. 2015. A fourth law of robotics? Copyright and the law and ethics of machine co-production. *Artificial Intelligence & Law* 23 (3).
Schellekens, M. 2015. Self-driving cars and the chilling effect of liability law. *Computer Law & Security Review* 31 (4).
Scherer, M.U. 2016. Regulating artificial intelligence systems: Risks, challenges, competencies, and strategies. *Harvard Journal of Law & Technology* (29).

Si, Xiao. 2017. Cao Jian Feng. Lun Ren Gong Zhi Neng De Min Shi Ze Ren: Yi Zi Dong Jia Shi Qi Che He Zhi Neng Ji Qi Ren Wei Qie Ru Dian (On the civil liability of artificial intelligence: Take the self-driving car and intelligent robot as the breakthrough point). *Legal Science (Journal of Northwest University of Politics and Law)* (5).

Stanford University. Artificial intelligence and life in 2030. [20170915]. http://ai100.stanford.edu/2016report.

Sun, Jie Xian. 2017. Che Lian Wang Biao Zhun Zhi Zheng: DSRC Yu LTEV2X Shei Jiang Sheng Chu ? (Internet of vehicles standards competition: DSRC and LTEV2X who will win?). *Informatization in China* (5).

Surden, H. 2014. Machine learning and law. *Washington Law Review* 89 (1).

Susskind, R. 2013. *Tomorrow's lawyers: An introduction to your future*. Oxford: Oxford University Press.

Sun Ting Ting, Liu Zhao Hui, and Lü Ming Xin. 2016. Ji Yu V2V Tong Xin Ji Shu De Che Liang Fang Zhuang Yu Jing Xi Tong Yan Jiu. (Research on vehicle anti-collision early warning system based on V2V communication technology). *Shangdong Communication Science & Technology* (2).

Teng Xun Yan Jiu Yuan. 2017. Ren Gong Zhi Neng Ge Guo Zhan Lüe Jie Du: Ying Guo Ren Gong Zhi Neng De Wei Lai Jian Guan Cuo Shi Yu Mu Biao Gai Shu (National Strategy Interpretation of Artificial Intelligence: Overview of Future Regulatory Measures and Objectives of Artificial Intelligence in the UK). *Telecommunication Network Technology* (2).

Topol, Eric. 2012. *The creative destruction of medicine: How the digital revolution will create better health care*. New York: Basic Books.

Wright, D., C.D. Raab. 2012. Constructing a surveillance impact assessment. *Computer Law Security Review* 28 (6).

Wang, Qian. 2016. *Zhu Zuo Quan Fa (Copyright law)*. Beijing: China Renmin University Press.

Wang, Qian. 2017. Lun Ren Gong Zhi Neng Sheng Cheng De Nei Rong Zai Zhu Zuo Quan Fa Zhong De Ding Xing (On the nature of the content generated by artificial intelligence in copyright law). *Legal Science* (5).

Wang Ling Fang. Zhong Guo Che Lian Wang Fa Zhan Xi You Can Ban (The Development of Internet of Vehicles in China has been Mixed with Joys and Cares). (20161009) [20170915]. http://www.cnautonews.com/xwdc/201610/t20161008_496370.htm.

Wang Zhao, Deng Xiang Hong, and Liu Di. 2016. Zhong Guo Zhi Neng Wang Lian Qi Che Biao Zhun Ti Xi Yan Jiu (Research on the standard system of China intelligent network automobile. *Automotive Electrical Appliances* (10).

Wu Han Dong. 2017. Ren Gong Zhi Neng Shi Dai De Zhi Du An Pai Yu Fa Lü Gui Zhi (Institutional arrangement and legal regulation in the era of artificial intelligence). *Legal Science* 35 (5).

Yang, Jie. 2017. Quan Qiu Ren Gong Zhi Neng Fa Zhan De Qu Shi Ji Tiao Zhan (Trends and challenges in the development of global artificial intelligence). *World Telecommunication* (2).

Zhang, Bao Sheng. 2001. Ren Gong Zhi Neng Fa Lü Xi Tong De Fa Li Xue Si Kao (The jurisprudence thought of artificial intelligence law system. *Review of Legal Science* (5).

Zhang Ya Ping, Liu Hua, Li Bi Yu, and Deng. 2015. Zhi Neng Wang Lian Qi Che Ji Shu Yu Biao Zhun Fa Zhan Yan Jiu (Research on the technology and standard development of intelligent netted vehicle ). *Shanghai Automobile* (8).

# Chapter 4
# Artificial Intelligence and Employment

**Jingyue Wang and Xuan Jue**


J. Wang (✉) · X. Jue
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 20044, China
e-mail: swp1966@126.com



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_4

**Abstract** Human beings have experienced tremendous changes in social life brought by the two previous industrial revolutions. Steam engines in the nineteenth century, electrification and mechanization in the twentieth century gave rise to the earth-shaking transformation of economic and social development. Each revolutionary breakthrough made in technology will incur huge shock to the existing order in the labor market, with a large number of traditional jobs replaced by new technology and new equipment. Moreover, in the context that more newly emerging industries and new employment posts keep bubbling up, job opportunities would not drop. Instead, due to many new fields demanding new expertise, there occurs constructional shortage in labor force, which forces the fundamental reform of man's competence. If we make retrospection on the two previous industrial revolutions brought impressive shock and challenge to job market, we may realize that the long-term positive effect is far outweighed than the unfavorable influence. The new industrial revolution triggered by AI will also exert its influence on people's employment. As its broad application prospect in agriculture, industry, service and public sectors, AI may bring opportunities and challenges to the labor market of multifarious industries, a new technology that is overcritical of worker's quality and competence, but numerous posts demanding human intelligence are generated. We should not magnify the threat of AI and free ourselves from unnecessary worries, but we should also guard against its negative impact on traditional employment. We should adhere to the historical view of dialectical materialism, attach importance to its renovation of human social order from a comprehensive perspective, and hold an optimistic attitude toward the significant reform to global production order and employment in AI age.

## 4.1 Industrial Revolution and Evolution of Job Market

In history, the two industrial revolutions exerted a huge impact on the job market, each of which the core technology yielded the common points and discrepancies, as far as employment was concerned. The disparities eliminated certain working posts, but the new technology generated new industries which, in turn, created new job opportunities.

### *4.1.1 The Opportunities and Challenges for Job Market in the First Industrial Revolution*

The First Industrial Revolution promoted technical innovation in the textile industry and triggered renovation of allocation of resources in labor forces as well. When

mankind strode into industrial society from an agricultural society, the capitalist employment system came into being, yielding antagonism between bourgeoisie and proletariat which exerted concerted influence on the operating order of the labor market.

With the popularization of cotton textiles in the seventeenth and the eighteenth century, the stereotyped cotton spinning technique could not meet the market requirements. Even if women and children were plunged into textile factories, there remained a great shortage of workers. In Germany, even soldiers had to join in spinning. Huge demand for textile goods and factory's failure to meet the needs propelled constant improvement of production technology. Before long, the spinning Jenny was invented, an event marking the advent of the First Industrial Revolution.

In the capitalist production under the First Industrial Revolution, as the universal machine production replaced manual work, productive force skyrocketed to an amazing extent, domestic workshops and handicraft mills gave way to machine production. To take the metallurgical industry, for example, during 1770–1840, daily average productivity increased by 27 times in Britain. In the transport sectors where more sophisticated equipment was used, the productivity was increased by several hundred and even thousand times. Industries achieved unprecedented output, production efficiency, and growth rate and the socialization level of production kept steadily rising. The fast increases in output and productivity brought huge profits to factory owners, who expanded reproduction by building more factories, resulting in employing more workers. To the job market from which huge labor forces were demanded in the growing factories with machine production, where factory owners could employ so many workers became a headache problem that should be addressed in the course of capitalist development. At this moment, people thought of an effective means to solve this problem—enclosure movement.

During the collapse of serfdom, British emerging bourgeoisie and new aristocrats drove of the peasants from their own land by violent means and then deprived them of the tenure right and ownership of their land. Meanwhile, the capitalists approached public domain, restricted or cancelled the common right for farmland the right for herding. Moreover, they encircled the seized land and turned it into private-owned ranches and farms, extortion of land called by historians "Enclosure Movement." The rough movement deprived many peasants of their own land and they lost the source by which they could make a living. After they lost their land, the peasants became employees of the ranchers or flocked into cities where they turned themselves into free workers, the labor forces prepared for British capitalist development. With the emerging industries, the surplus manpower in rural areas turned to industrial sectors, breaking the balance of "rural peasant—factory work" job market. During the First Industrial Revolution, labor forces proved their strong anaclisis to factories.

The First Industrial Revolution resulted in a huge reduction of agricultural laborers and sharp increase of industrial workers, a trend that thoroughly changed people's modes of production and their lifestyles, and laid a foundation for modern social order. In short, with mechanical force replacing human power, labor productivity was greatly elevated. Overwhelming traditional small-farming mechanism, factory system dominated social production. Under such a system, having integrated spe-

cialization and labor division, factory workers were engaged in regular mechanical production. This revolution enabled mankind "to transform themselves from peasants and herdsmen to the manipulation of inanimate machines." After traditional small-farming economy was replaced by the industrial economy, the human society which had been based on manner-controlled society entered into a commercial society based exchange relationship. Interpersonal relationship turned from familiar and intimate ties to alienation and indifference. Formerly maintained by informal ethical and principles, social order now was governed by the formal legal system and rationalism became the mainstream of social ideological trend.

### *4.1.2 Opportunities and Challenges to Job Market Brought by the Second Industrial Revolution*

By means of mechanical production, the First Industrial Revolution generated the working class who shouldered the historical mission to reform human society. Different from the first one, electrical engineering is the conspicuous signal of the Second Industrial Revolution, a new age that witnesses the advent of the booming new-type industries, such as steelmaking, automobile and airplane manufacturing, etc. With the proportion of heavy industry getting bigger among all the industries, the inception of monopoly organizations greatly propelled the development of social productivities. The transition from manual labor to mechanical production is so far the most significant technical leap, while automatic equipment and system in this period is the continuation of the Second Industrial Revolution. The integration of science and technology brings a much more constructive effect than a destructive consequence to social order.

The most prominent feature of the Second Industrial Revolution signifies the extensive application of electric power. The use of electricity generators and electric motors promotes the rapid development of the industries based on electric energy, such as lighting, trolley bus, telegraph and electric welding, etc. The emergence of long-distance electricity transmission technology spurred the advent and development of electric industries one after another which accordingly breed numerous job opportunities.

Another important landmark is the invention and application of the internal combustion engine. Since the 1870s, the combustion engines with coal gas, petrol, and diesel oil as successive fuels accelerated the development of automobile industry bring about a number of new industries which generated petroleum extracting and refining industries. Of course, these industries take in numerous workers.

Compared with the First Industrial Revolution, the workers in the Second Industrial Revolution have changed both intellectually and psychologically. Workers have the right to choose their own jobs and careers. For capitalists, with the development of the Second Industrial Revolution, the knowledge-based manual labor is gradually

recognized. In the later selection of labor market personnel, knowledge-based labor is more popular among capitalists.

The Second Industrial Revolution in the electric age is the transition from semi-automatic to automatic. With the help of automatic equipment, people are gradually liberated from machines, and workers are no longer subject to the oppression of machines.

In the movie "Modern Times," the assembly line work model has been gradually questioned and replaced. The convenience and huge benefits of automation have enabled capitalists to find that the factory accumulated with a large number of manpower is not the most effective way of operation.

Instead, to give full play to the subjective initiative of workers, to improve the level of scientific management and to implement people-oriented business philosophy is a more sustainable way of enterprise development.

The Second Industrial Revolution distinguished laborers from machines, paid more attention to the human characteristics of laborers, and thus promoted the reconstruction of the labor market order, which also promoted the development of modern enterprise management.

Whether it is the Toyota model or the "*Y*" theory, workers have a new understanding of the role of ownership.

A large number of service jobs have been created to improve the living and production environment of workers, promote the rational allocation of resources around the world, and some emerging industries and products have emerged to meet the growing needs of mankind from different perspectives. At the same time, the Second Industrial Revolution led the job market to "smart workers."

The momentum of "intelligent workers" has exceeded that of "manual workers," who have reduced their physical attachment to capitalists and are gradually reducing their attachment to factories. The automation of the Second Industrial Revolution drove the development of "intelligence" in the future.

### *4.1.3 The Third Industrial Revolution and the Emergence of Artificial Intelligence*

In the mid-1970s, the computer programmable controller appeared and was put into use; automatic production began to move toward "autonomous" production. The development of Internet technology further promotes production autonomy. "Software is no longer just written to control an instrument or perform a specific work procedure, nor is it simply embedded in a product or production system. Products and services with the help of the Internet and other network services, through the combination of software, electronics and the environment, produce new products and services."

More and more product functions do not require operator intervention, that is, they may be autonomous. ([DE] ulrich sendler, Ed., industry 4.0: the coming Fourth

Industrial Revolution, translated by deng min and li xianmin, mechanical industry press, 2014, pp. 9–10.)

For example, smart devices with GPS can know where they are. By controlling the program, the system itself can react to the outside world autonomously or even self-optimize, just like a human with thoughts. That is to say, "the institutions that used to control the operation of machines directly controlled by humans have become automatic institutions independently controlled by intelligent machines."(Jia genliang, the Third Industrial Revolution and industrial intelligence, China social science, 2016, no.6.)

From this point on, it seems that people everywhere are talking about artificial intelligence, in fact, we are about to usher in a new era of intelligence. The application of artificial intelligence, especially in the industry, will lead to a major change in the global production and living order.

The reform of production order by AI mainly shows the application of automation and intelligence, which makes the most use of resources, improves productivity, and promotes production transformation. For AI development, we should follow a road featured by intelligence, low carbon, wide use of network and respect of personality. Different from human manipulation of production, AI makes intelligent labor to replace manual labor, freeing man from the heavy, dull and repetitious manual labor.

The reform of people's living order by AI mainly embodies thinking transformation and change of man's behavior. As far as human life is concerned, AI exerts its obvious influence in family life and entertainment. For example, an intelligent robot can do household work for you. Pilotless automobile facilitates man's trip, while ATM greatly simplifies banking procedures. Intelligent lifestyle changes man's primary thinking mode from "I will do" to "Intelligent machine can do for me," and working mode from "I am doing" to "Intelligent machine is doing for me."

In short, AI is gradually changing the basic logic of people's living order. Previously, the public used to hold the idea "Only by my hands on everything will I feel relieved." When dishwashers were just put on the market, it was in dull sales because the family members held that this machine could not do a satisfactory job and some residue would be left on the dishes which would bring hazard to people's health. With its functions perfected, dishwashers were widely used in the food and beverage industry and in most of the households. In the near future, the cumbersome household affairs will be done intelligent machines, a time-labor saving tool that leaves more time for the family members to communicate and reduce unnecessary conflicts.

A new invention will generate more job posts after it is put into application. Some researchers calculate the influence of Industry 4.0 on employment in 23 German manufacturing industries, concluding that the popularization of robot and computer technology will reduce 0.61 million posts in assembling lines and production units, but it will generate nearly one million new job posts, a net increase of 5% of posts in the said 23 industries.

Whether opportunities or challenges, the depth and width of AI influence on job market this time is quite different from the previous industrial revolutions, which will deeply effect on social production from enterprise reform to "the reform carried out

by all the people," form "mechanical innovation" to "innovation campaign involving all the people," which will violently move social development, an AI impact that sweeps the transnational companies and even household life. Being no longer the "mythological tale" in industrial sectors, AI will exert its impact on the transformation of social order. The maintenance of order that depends on industrial organization and industrial associations will, to a certain extent, be replaced by the organizations based on AI. In this context, the development of AI will give rise to "all the people intelligent zed," who will focus intelligence research, control, and deployment and who will be engaged in lifetime learning to constantly acquire new technology so that they may properly deal with the issues between man and machines and stand up to social selection. In a word, the proper application of AI will be the basic skill that everyone should acquire.

## 4.2 AI's Impact on Job Market

Every new thing is imbued with opportunities and challenges. Just as the previous industrial revolutions, AI will inevitably bring certain impact to job the market. Different from the previous industrial reforms, AI age will no longer be the sign of the rigid machines but stand for the advent of intelligentization. During this age, there will be the competition between machines and men, as many present job posts will disappear and the related professions will either vanish or be transformed, resulting in increasing polarization of job market and the aggravation of social inequality. The dramatic decrease of low-end job posts will deteriorate mid- and long-term employment, bring shock to job market and traditional employment administration, and then greatly reduce job opportunities.

### *4.2.1 AI's Impact on Agricultural Job Market*

Most people involve agricultural production in their employment in a direct or indirect way. A research report released by World Bank in September 2016 claims "Agricultural development is one of the most effective measures to address extreme poverty and promote common prosperity." and predicts that agriculture will have to feed 9 billion people of the world in 2050. In addition, agriculture is still one of the critical components in the national economic system of different countries, the developing nations in particular. It is no exaggeration that agriculture supports the people of the world. (To non-agricultural workers, the issue "survival" is addressed by agriculture and both "survival" and "livelihood" to agricultural workers.)

The rapid development of AI will be critical to agricultural production. This is especially shown in machine learning and the extensive application of Internet of Things in agriculture, which ensures highly efficient production and output of peas-

ants and accelerates the pace that intelligent machines will replace manual laborers as well.

Modern agricultural mechanization and automation have, to a great extent, transformed traditional agricultural production mode. Since the beginning of the twenty-first century, AI displays its full prowess in agriculture, involving robots in farming, sowing, and plucking. There are also intelligent recognition systems used in probing soil, detecting plant diseases and insect pests, and forecasting weather and natural disasters. Moreover, intelligent rings or plates will be used on domestic herds. A new generation industrial revolution integrates such technologies as AI and in-depth learning into agricultural production, enables the machines to identify the natural environment and the growing conditions of animals and plants so that people may select more rational, more individualized and refining ways of cultivation. Enabling more intelligentization in agricultural production, AI applications will greatly decrease the costs and operation while increasing agricultural output.

AI will dramatically elevate the broader application in agricultural production. From manual turn-up of soil, iron plough pulled by cattle to mechanical plantation, man has been freed from the manual and arduous labor in agricultural production. Rather than the emancipation of man from toilsome agricultural production, AI has done a more significant job in the publicity of agricultural information. The agricultural robots made by Blue River Technologies in California can "perform the functions of weed extirpation, irrigation, fertilization and pesticide spraying, etc."

AI will also popularize the application of the Internet of Things in agricultural production. Through such devices as field camera, controller of temperature and moisture, soil monitor, and aerial photograph by UAV, farmers will acquire the accurate real-time information, which will turn to be the useful information to farmers, such as overproof insect attack and the irrigation of land, after it is input into intelligent machines and studied by the professional analytical companies. All these impose higher requirements on farmers for their knowledge reserve and capacity of continuous learning.

In the future, AI will penetrate into the whole agricultural links, including land ploughing, sowing, fertilizing, insecticide, harvesting, storing, breeding, and selling. It can be foreseen that under the impact of AI, there will be a fundamental transformation in traditional agricultural production and agricultural labor forces.

The impact of AI on the agricultural job market is mainly manifested in laboring instruments and job market.

(1) Replacement and Upgrading of Laboring Instruments Caused by AI

The development of human society at different periods actually involves the transformation of laboring instruments. From Stone Age to Bronze Age, Iron Age, Steam Age Electronics Age and to present-day information and intelligent era, each revolution of instruments was not the plain replacement of the previous ones, but elevated the production efficiency. In this sense, those who first control the latest labor instruments will gain the advantages in the job market.

Since labor instruments are constantly upgraded, the difficulty in using the instruments is at incremental degree. Before Electronic Age, the application of labor instru-

ments consumed man's physical power and the upgrading of those instruments aimed at alleviating labor intensity and improving efficiency, as a result of which job opportunities were available in the job market for most people. When mankind strode into Electronic Age, Informatization Age, in particular, the manipulation of labor instruments depends more on "brain" than on "hands," which defines a boundary between blue-collar workers and white-collar workers. If the former are deficient of professional technical training and knowledge, it will be very difficult for them to join in the latter colony. In Intelligentization Era, the difficulty of mastering working tools will be greater, which will pose a new round of shock to the job market.

(2) Further Pressure on Job Market by Ever-Going Development of AI

The quick urban development attracts more rural labor forces. In the USA, agricultural population accounts less than 5% of the national total quantity. In the near future, the agricultural population will be reduced to 20 or 10%, or even lower. It is worth noting that the major factors incurring the changes do not lie in AI, which leaves the slightest effect on the changes. The extensive application of AI in agriculture will expedite the intelligentization of agricultural production, with many laboring links previously done by man replaced by AI, which will inevitably result in further amplifying the proportion between agricultural workers and non-agricultural workers. Affected by AI application, the agricultural job market will be further squeezed.

AI will edge traditional agricultural workers to the brink of unemployment in China, who have, all along, suffered from low educational level, low production efficiency, and low earnings from their arduous work which have troubled the Chinese Government and agricultural administrators. As an agricultural power, it will be an inevitable trend that AI will be applied in all the agricultural sectors. Therefore, instead of recession before this tide, we should be initiative to greet the industrial transformation in the agricultural realm caused by AI.

### *4.2.2 The Impact of AI on Industrial Job Market*

Similar to the situation in agricultural sectors, AI will also exert extensive and far-reaching influence on industrial realm. Whether German "Industry 4.0 Strategy" or China's "Made in China 2025," the two countries prescribe triple dimensionalities in their manufacturing programs. 1. Marketing, in which new technology will be used to connect enterprises with clients. 2. Manufacturing, in which new technology will bring higher efficiency in production. 3. Logistics, in which new technology will accelerate the circulation of production so as to deliver the goods to customers as soon as possible.

From the perspective of the above three dimensionalities, the rapid development of AI will leave huge imaginary space for enterprises to plan their development. In marketing, based on the computing and analysis of B2C and B2B mass transaction data, we may assist enterprises in formulating plans in automatic and intelligent operation. In the manufacturing level, the intelligent machine may automatically judge

good-quality products and exercise remote detection of equipment life by means of collecting production data and production equipment data and then analyzing them. In terms of production circulation, a large quantity of circulating data gathered by sensors may enable entrepreneurs to make production decisions and market plans so as to bring about automation and intelligentization. In "Industry 4.0: The Developing Prospect of the Coming Productivity and Manufacturing" made by Boston Consultation Company, the report claims, "AI based on cloud computing and metadata analysis will elevate the production efficiency in China by 15–25%, yielding an additional value of 4 trillion to 6 trillion *yuan*. To be specific, the impact of AI on the job market of manufacturing industries is shown in the following three respects.

(1) AI Enhances the Automation and Intelligentization of Enterprises' Assembly Lines

Having evolved for over 60 years, especially driven by mobile Internet, mega-data, supercomputation, sensor network, and the requirements of economic and social development, AI is advancing in an unbelievable speed, and new features such as in-depth-learning, transboundary amalgamation, man-machine coordination, public participation, and automatic manipulation. For example, the machines may operate o on the automatic assembly line. In metallurgical industry, furnace modeling and expert technical systems in supervision and diagnosis have been built in the USA, Germany, Japan, and China, with which those countries have realized intelligentization of blast furnace steelmaking. Figure 4.1 shows the profile of the global root application. During 2012—2016, the sales volume of industrial robots nearly doubled (13.2 billion $US in 2016, as against 7.3 billion in 2012. Meanwhile, the prediction of sales volume from 2017 to 2020 is at the ascending trend. In addition, learning driven by mega-data and transboundary cooperation and settlement make man-machine coordination, collectively integrated intelligence and intelligent system to be the focus of AI development. With the development of relevant disciplines, theoretical remodeling, technical innovation, and upgrading of hardware and software will be accelerated, resulting in the chained breakthroughs of industrial chain that promote the development of digitization, networking, automation, and intelligenization of enterprises' assembly lines.

(2) AI Reduces the Dangers of Operation in High-Risk Industries

The ever-developing science and technology enable robots to do low-end and low-technical work, as a result of which the industries operated by manual workers will be subject to huge pressure. Studies prove that the working-age manual laborers will be dramatically reduced in many developed countries in the coming ten years. As labor cost sharply surges, plus the consideration of security for blue-collar workers, work efficiency and production cost, an upsurge of "manual workers replaced by machines" will be bound to come.

In this context, the shortage of labor forces in high-risk industries such as coal mines, metallic and non-metallic mines, hazardous chemical, fireworks, and crackers will be thoroughly addressed. The danger in high-risk industries will be dramatically reduced if we focus the integrity of the creative chain of AI and industrial chain,

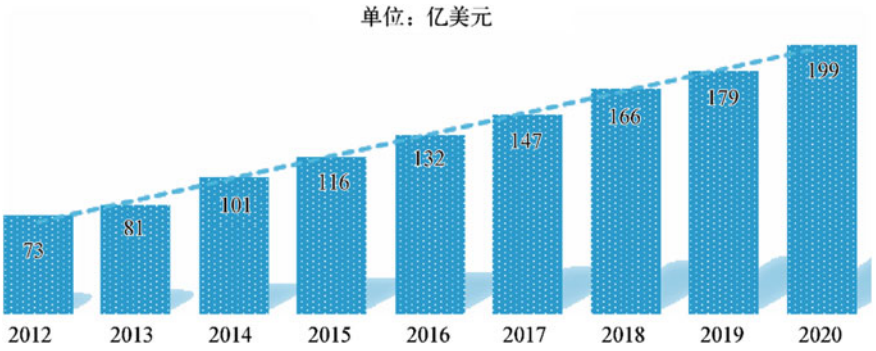



**Fig. 4.1** Global industrial robot industry sales growth in 2012 and 2020 Unit: $100 million. *Data Source* China electronics society "China robot industry development report in 2017" http://news.ifeng.com/a/20170904/51860725_0.shtml, 20170904, in which the 2017 and 2020 data are estimated

enhance the interaction between technical provision and market requirement, intensify intelligent control, safe-operation supervision, and disaster disposal on manufacturing process in high-risk industries.

(3) AI Will Induce the Elevation of Structural Employment Rate

According to some experts, AI will give rise to severe structural unemployment in short order, but it would not incur large-scale employment in a long run. It seems to us that as far as the impact on the job market caused by AI is concerned, the short-term surge of structural employment will be practically tangible. Technological progress exercises an adverse impact on the low-end and repetitious work posts. AI will trigger the subversive effect and automatic machines will further replace blue-collar workers, all of which will lead to the increment of structural unemployment.

To take a global perspective, manual workers account for a greater proportion among the total labor forces as blue-collar workers are employed at low costs. With technical progress, a large number of factories import automatic and intelligent equipment so that they may replace the mechanical and precisely operating manual workers. The relevant data from International Labor Organization prove that the proportion of low-technical workers is decreasing. From 2000 to 2013, apart from the developed economies whose low-end employment basically remains unchanged, the employment rate, volume, and proportion of low-technical workers in other economies have declined to a certain extent, among which East Asian and South Asian regions witness a drop of over 8%, the largest one.

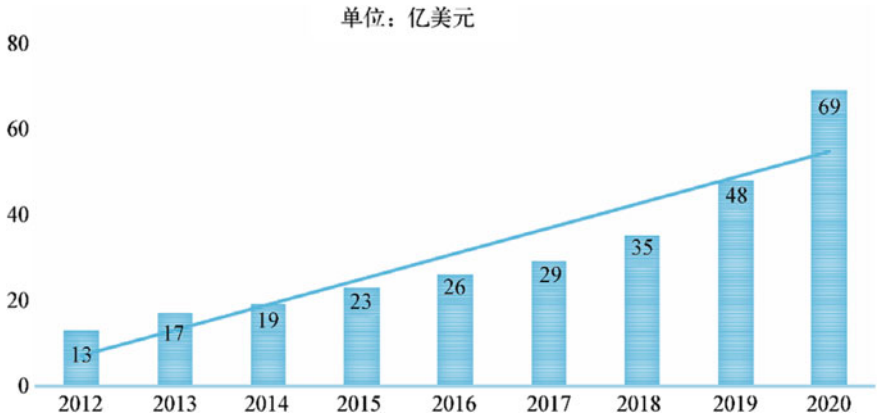



**Fig. 4.2** "2012—2020 sales growth of global service robots." Unit: $100 million. *Data Source* "2017 Report on China's Robot Industry" by Chinese Institute of Electronics, http://news.ifeng.com/a/20170904/51860725_0.shtml, 20170904

### *4.2.3 AI's Impact on Job Market of Service Industry*

"Machines of Loving Grace" remarks, "A report with total 115 pages at the end of 1966 draws a conclusion that technology dispels posts, not work." (Markov, John, "Machines of Loving Grace", translated by Guo Xue, 205, Zhejiang People's Press, p. 74.) Similar to manufacturing industry, AI will bring shock to the standardized and streamlined posts in service industry, especially the posts in finance, public, and living service sectors. AI will replace some low-threshold posts, as shown in restaurants where robots will replace the waiters and waitresses, in banks where automatic cashier system will substitute human cashiers, in Apple Inc. where Siri intelligent audio system will replace supportive staff. It can be foreseen that AI will gradually eliminate the stereotype waiters and waitresses. The personalized service based on data is what customer needs in the future.

Similarly, the global sales volume of robots may prove the shock to service industries by AI. Figure 4.2 shows that the global sales of service robots is lower than that of industrial robots, but its sales volume accounts for several billion of $US, with progressive increase per year. It is worth our attention that Fig. 4.2 predicts that 2017 will witness the blow-out development of global robots. In the chart, the sales are estimated to increase from 2.6 billion $US in 2012 to 6.9 billion $US in 2020. Obviously, there will be more opportunities for developing service robots.

AI application in service sectors will induce transformation in industrial organizations. Previously, telecom operators have consolidated their monopoly position, making huge profits in only SMS and audio service. Yet the advent of WeChat put the operators in great panic and no more advantages in the services of these two sectors. Similarly, with the aggressive trend of internet finance, the core businesses "deposits, loan and remittance" of traditional banking will be gradually edged out

by three emerging financial trades such as Crowd founding, Internet Finance and Third-party Payment. The transboundary competition launched by Internet enterprises may stimulate catfish effect, which will reshuffle the layout of traditional service industries.

### *4.2.4 AI Impact on the Organizations of Public Service*

Apart from the above commercial applications, AI will impose shock to the posts of public service. To take the governmental department as an example, AI forges the brand-new scene for public service. Inside the offices, a great amount of clerical work will be processed by automatic machines and auto-logging data will be completed by automatic handwriting recognition technology, the working schedule will be planned by optimization algorithm and public enquiries will be replied by the apparatus in automatic speech recognition, natural language processing and answering. US Citizenship and Immigration Services uses an intelligent robot named EMMA to reply to the questions from the clients. With its powerful computing ability, and supported by mass data, EMMA can answer half a million questions in efficient and accurate way. It boasts the capacity of automatic learning, with which it can learn from its own experience and improve the accuracy and integrity of the replies. Moreover, the feedback from the clients' mag help EMMA to analyze how to give meaningful answers. During "supervised learning," EMMA can quickly integrate mass data and analysis it, and then offer the correct answer. This capacity has changed the working process for dealing with public visits and tele-inquiries in governmental departments.

From the perspective of professionals in public service sectors, AI can induce enormous changes in those organizations, and change the working modes of governmental functionaries so that they can spare more time for doing more creative and challenging work. As AI may alter the contents of many work posts, AI application may free people from their routine and trivial affairs and improve the foresight and accuracy of their work. To integrate AI with supervision will help to consolidate the government's administrative and supervising ability, elevate the precision of the government's work, and reduce the clerks in public sectors.

From the perspective of public service organizer, AI elevates working efficiency and makes the different departments in an organization an interactive entity, inside which coordination is achieved in real-time flow of data. Based on the research of public service department of Colorado State, USA, the clerks of public welfares spend nearly 40% of their time in dealing with routine documents and administrative affairs, while only 9% of the time is used in the work related with public welfare affairs. Intelligent machines may greatly reduce the time spent in settling documents and daily management by functionaries so that they have more time in task-oriented work. In this way, governments may streamline their organizations, elevate their service efficiency, and accelerate the transformation of smaller governments and bigger society.

## 4.3 AI Brings Opportunities to Job Market

Just as Jonathan Grudin, the prime researcher of Microsoft, remarks, "Science and technology will continue to transform job market and create more job opportunities. When there were only several million people on our earth, millions of work posts were available. Although unemployment still exists, there will be billions of work posts when the world's population reaches several billion. So there will be no lack of things that should employ people to do. This tendency has never changed." (Wen Yanqin, "AI: The Unfavorable News for Labor Forces," carried in No. 24 of "China Times" (20141225). New jobs created by AI falls into two sorts. One is the upgraded version of "fomer job" and the other is "new profession," namely, newly created one.

### *4.3.1 The Transformation of Job Category Caused by AI*

While the governments of different countries successively rank AI as their national development strategies, AI greets an unprecedentedly favorable time. As an important tipping point, AI will help to increase production efficiency and economic assets by geometrical progression, which will promote significant transformation of operation order in job market.

It is this prospect that different countries have invested a great quantity of funds and manpower to boom AI industries. For example, the USA released "National Artificial Intelligence Studies and Strategic Development Program," for which it input 1.2 billion $US in 2016. Chinese Government promulgated "National Scientific & Technological Innovation Program for 'the Thirteenth Five-Year Plan'" in July, 2016, in which the systematic planning for AI is made by the Central Government, aiming at seizing the initiative in this field. At present, blowout development is found in AI as steady progress is made in science and technology, and the mass data are generated by Internet technology. As more and more large-scale enterprises are pooling funds in AI development, there are 2542 enterprises engaged in AI research and development worldwide by June, 2017, among which the USA boasts 1078 enterprises, China 592 and 872 are distributed in Sweden, Singapore, Japan and Britain, etc.

The rapid development of AI will change people's working purposes and working sites. AI will ensure the automation and intelligentization of many professions, particularly the manual work requiring mechanical repetitions and precise operation. In this sense, AI really frees man from the toilsome manual labor, spares them more time for creative and ingenious work and gives into full play their potential and their unique traits. At this time, people select the work that will give full scope to their talents rather than work for their livelihood. Then what kind of common features will such sort of work be imbued?

Based on the systematic arrangement of the skills for 365 occupations by Carl Frey, economist of Cambridge University, and Michael Osborne, expert on machine

**Table 4.1** Ten occupations that will be least likely to be replaced by intelligent machines

| 职业 | 被人工智能取代的概率（%） | 所需主要技能 |
|---|---|---|
| 教师 | **0.4** | 社交能力、人情练达能力、真心帮助他人心理 |
| 医生 | **0.7** | 人情练达能力、同情心、真心帮助他人 |
| 公关 | **1.4** | 社交能力、协商能力、人情练达能力 |
| 建筑师 | **1.8** | 创意和审美能力 |
| 牙医、理疗师 | **2.1** | 创意和审美能力 |
| 律师、法官 | **3.5** | 社交能力、协商能力、真心帮助他人 |
| 艺术家 | **3.8** | 创意和审美能力 |
| 音乐家 | **4.5** | 创意和审美能力 |
| 科学家 | **6.2** | 社交能力、人情练达能力 |
| 健身教练 | **7.5** | 社交能力、人情练达能力、创意和审美能力 |

被人工智能取代的概率（%）: The probability (%) of the occupations replaced by AI
For teacher (0.4), social acceptability, sophistication in social intercourse, and sincere assistance
For psychologist (0.7), sophistication in social intercourse, sympathy, and sincere assistance
For personnel of public relations (1.4), social acceptability, coordinating ability, and sophistication in social intercourse
For architect (1.8), innovation, and aesthetic taste
For dentist and therapist (2.1), innovation, and aesthetic taste
For lawyer and judge (3.5), social acceptability, coordinating ability, and sincere assistance. For artist (3.8), innovation, and aesthetic taste
For musician (4.5), innovation, and aesthetic taste
For scientist (6.2), social acceptability, and sophistication in social intercourse
For gymnasium coach (7.5), social acceptability, sophistication in social intercourse and innovation, and aesthetic taste
Data source: FREY C, OSBORNE M. The future of employment: how susceptible are computerization? [R/OL](20130917)[20171005]. https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

learning, BBC proposes three skills for certain sort of occupations: 1. social acceptability, coordinating ability, and sophistication in social intercourse; 2. sympathy and sincere assistance; 3. innovation and aesthetic taste. The higher demand for these three skills in a certain job, the less probability for a man that he will be replaced by a robot. The representative occupations are listed in the following chart.

Table 4.1 shows that the occupations that will be least likely to be replaced by AI in the coming 10–20 years cover teacher, psychologist, architect, scientist, etc. These occupations involve interactions with other people and personal characteristics. Meanwhile, they will bring about high added value and creativity. The repetitive work will be replaced by robots, the probability for telemarketers (99%), and for typists (98.5%).

In traditional working premise, packed in a small office, the clerks will be restless and their creativity will be suppressed. Apart from this point, the expansion of cities will take more commuting time for the clerks, resulting in the waste of their time and energy. AI will change such working pattern, enabling the clerks to work in

more comfortable and humanized premises. What is more important, AI will address the issues in work supervision, performance evaluation, and intercommunication of managers over employees by means of human resources system. The core of management on human resources lies in the execution efficiency, work quality and feedback, etc., based on which the decision tree algorithm model will be formulated. The shift of working premises actually reflects the change of management concept on enterprises.

### *4.3.2 Opportunities for Agricultural Job Market Generated by AI*

Income level in an industry is the most important factor for attracting professionals to join in that industry. At present, agricultural workers earn a comparatively low income. In American agriculture that is appealing to people, worker's revenue is guaranteed by expanding agricultural-cultivated areas which will generate scale economic effect. But it is unrealistic for most countries to follow American agricultural pattern. The advent of AI offers the possibility of raising the income of agricultural workers. AI will help to reduce agricultural plant diseases and insect pests by an intelligent system and develop precision farming. The positive effect of AI is mainly manifested in the following three respects.

(1) To Raise Peasants' Income and Increase Job Opportunities by Reducing Plant Diseases and Insect Pests

The recognition and treatment of plant diseases and insect pests depends on man's experience in the past, by which peasants identify plant disease and insect pests with naked eyes, or discern them after consulting relevant materials. This is a low-efficiency way. AI may resort to in-depth learning and image recognition techniques and scan the crops with recognition software, and then people know what the trouble is. Two intelligent software, American "Plant Village" and German "Plantix" are so powerful that peasants will know the conditions of their crops after the software are used to just "scan" the plants. Moreover, the peasants can shot photos on the crops and upload the photos through app and soon they will receive the solutions. By means of such new technology, the issues of plant diseases and insect pests are solved and peasants' income is increased accordingly. More posts related to intelligent recognition and alleviation of agricultural risks are generated to help peasants to reduce costs and improve their revenue. For example, the construction of databank of plant diseases and insect pests first requires the peasants to provide the information about various plant diseases and insect pests and then perfects the identifying system before plant diseases and insect pests can be uploaded to app.

In addition, although less workers are needed in the stage of agricultural production, more working forces will involve in making decisions for agricultural production. Peasants are expected to gather mass information on market requirements, analyze the present prices of agricultural products, and predict the total demand in the

next year which decides the cultivated areas for the coming year. All these procedures will generate some high-end work posts such as analysts of agricultural industry and analysts in crop cultivation.

(2) To Develop Refined Agriculture so as to Increase Peasants' Revenue and Work Posts in Agricultural Industry

The agricultural products based on traditional plantation, plus the limited output per hectare, are low in additional value, resulting in low revenue of peasants which lowers peasants' enthusiasm in agricultural production. AI will address this dilemma because AI may integrate mega-data and intelligent machines for agricultural production, with which refined agricultural plantation is possible. AI can make an elaborate analysis of the nutritional components of every piece of land and infuse a certain amount of fertilizer according to the land peculiarity, a measure that makes peasants to avoid the waste and rising costs because peasants used to indiscriminately apply the same amount of fertilizer to all the land. In this way, peasants may make use of the land value to maximum extent, increase their revenue, and provide more job opportunities without the expansion of plantation areas.

(3) To Promote Ecological Agriculture and Increase High Value-Added Work Posts

Traditional eco-agriculture requires a large number of workers to extirpate weeds and apply fertilizer in the field, which results in high costs and low efficiency. AI may put more intelligent robots in agricultural production in replacement of peasants, reduce herbicide and pesticide, and even abstain from the application of them. In this way, the agricultural products are originally ecological in nature, free from any pesticide residue. This farming mode may not only greatly reduce the working intensity of the farmers, but also improve the competitive edge of eco-agriculture. In addition, eco-agriculture requires real-time supervision of the crop growth and the environmental changes, prediction of interaction between the two and judgement should be given. Thus, process generates many posts in data analysis of agricultural ecology and relevant services. The application of mega-data will reduce human intervention as much as possible, respect the law of crop growth so as to improve the quality of agricultural products. With the reduction of costs, there will be greater demand for those products in the market, with more additional value in the products, resulting in a dramatic increase in revenue for agricultural workers. As urbanization is processing in an accelerating way and people's living standards keep rising, the needs for green agricultural products will surge. With the development of eco-agriculture which, in turn, improve the rural eco-environment, a number of work posts will be generated in the context of robots' application in eco-agricultural production, which ensures the sustainable agricultural development while elevating agricultural production efficiency.

### 4.3.3 Opportunities of Industrial Job Market Generated by AI

AI will replace a great quantity of repetitious, less technical work done by man, and the assignment only eligible for machines. In this context, many low-end laborers are forced to find other jobs, who will either improve their technical expertise on the basis of their original skills or acquire the new labor skills. All these have laid a necessary technical foundation for the transfer and upgrading of the manufacturing industry.

At present, people are talking about the possibility that AI will replace traditional laborers on a large-scale basis and they are worried that they may be unemployed under such circumstances. Even if their worries come true, how can those intelligent machines be manufactured? Just as railway transportation took place of horse-drawn carriages, there appeared the factories manufacturing the engines, railroad cars, and rails, which were in need of many workers. In 2011, McKinsey & Co., French Branch, made a survey, which proves that for 15 years after the advent of Internet, one work post disappeared, but 2.4 posts were generated. The extensive application of AI will inevitably give rise to new industries for manufacturing AI products. As AI products involve by no means simple installation, but require mass data and algorithm to support their operation, the coming manufacturing industries for AI products will be quite different from traditional manufacturing industries, which demand higher technical expertise of the workers. In the book "Machines of Loving Grace," a research report released in February, 2013, asserts that by 2020, the directly or indirectly generated jobs in global robot industry will be generated from 1.9 million to 3.5 million. In the revised version in 2014 claimed that if one robot is put into operation, 3.6 posts will be derived.

In traditional manufacturing, what people realize is to exercise simple control by automation technique, whereas intelligent manufacturing based on controlling acquires the data generated by the sensors in Internet of Things during the production process and then applies cloud computing to analyze and process those mega-data so that proper decisions which are attached to the AI equipment are made. In addition, traditional manufacturing covers only one link, while intelligent manufacturing involves collaborative mode amalgamating such links as procurement of raw material, product design and manufacturing, product sales, and after-sales services. It focuses on personalized customization rather than production in batches. This new mode will inject more vitality into the manufacturing industry and the laborers who are previously separated in different production links will acquire more job opportunities under this mode.

### 4.3.4 Opportunities for Service Job Market Generated by AI

The dramatic development of AI promotes the advent of the unmanned shop, pilotless automobile, unmanned delivery, and unmanned manuscript, etc. resulting in

the disappearance of the corresponding professions, such as shop assistant, driver, courier, and journalist. A survey made by twenty-first century Macro-Research Institute proves that the working-age manual laborers will be reduced by 100 million in ten years to come to China. With demographic dividend reduced which results in the sharp increase of labor cost, plus the considerations of elevating the safety of blue-collar workers, of production efficiency and cost saving, the tide "replacement of human workers by machines" will upsurge. But the trend will not induce large-scale unemployment in that AI replaces those simple, standardized, and streamlined posts, but the services requiring "man's subjective thinking" would not be replaced by AI. Contrary to the panic of the workers in the service industry who are worried that they may be unemployed, AI will make them work more efficiently while the humanization and personalization in services will be strengthened by AI. The coming service industry will exercise the collaborative mode between AI and man, a model that will ensure efficient and quality services to customers. In this way, the requirements of customers constitute the most energetic motivation for service improvement. AI age would not replace the nursing industry of elder people, because AI can take care of elder's daily life, but it cannot substitute such functions as psychological guidance to elders and pertinent service them on the basis of their mood. Such work demands long-term man's observation and experience. Therefore, robots cannot replace nursing industry, but act as man's assistants.

Before the extensive application of the Internet, graphic designers, IT professionals, and product manager were found in the traditional industry. In Internet age, the emerging professions such as designers of user interface, Android/IOS programmers, and managers of Internet product become popular occupations. The upgrading of former professions is an imminent task in AI age. Many occupational groups begin to embark on the trial in upgrading. Some media workers who were previously engaged in news report shift to vertical media in the AI field. Those who were formally specialized in technology and investment in media and telecommunication now focus their attention to investors and institutions in the AI realm.

The advent of AI age will generate many new posts which will provide service to AI industry and those posts are corresponding to AI. First of all, AI may trigger the emergence of mega-data processing industry. The continuous development of AI will depend on the analysis, extraction, and processing of mega-data. Yet, various collecting machines responsible for gathering human behaviors cannot be directly compatible with each other. After the data are generated, man is needed to match the data, particularly the data required in different links. Afterward, the data will be further processed in light of the standards. The so-called further processing involves the treatment of data, data label, and data visualization, etc., and the sort of data processing will yield new job opportunities. As new hardware and software equipment is needed for each processing, the manufacturing and sales of the equipment will further generate work posts. Furthermore, AI development will expand the training market for the skills of relevant information technology and data processing. Such technical occupations as "natural language processer," "engineer of automatic speech recognition (ASP)," and "algorithm expert," AI speciality set up by universities and research institutions and the teachers offering AI courses in universities and institutes

will constitute a colossal colony. Lastly, there will appear new work posts beyond our imagination, such as AI product manager, "appraiser of robot morality/violence" in terms of AI ethics and morality. The emergence of a new profession will motivate the posts and facilities at both upstream and downstream. Moreover, the all-round permeation of AI industry will substantially increase the requirements for relevant supporting services, which will generate various kinds of services and work posts.

### *4.3.5 Opportunities of Public Service Job Market Generated by AI*

It seems to governmental departments and public service institutions that they aim at providing the public with satisfactory services at low costs while AI boasts the obvious advantages at lowering costs of public services and improving public satisfaction on services. The policy formulation and decision making of governments will be assisted by AI. The file processing and handling of various affairs will be accelerated with the assistance of AI, resulting in the considerable improvement of working efficiency and scientific decision in governmental departments. With the gradual decrease of the posts on administrative and routine affairs, the posts on humane spirit and people orientation will show up, requiring the clerks to grasp and know popular will and their interest appeal in a more accurate way which will help produce various policies and public services. All these pose more strict requirements on the overall quality of governmental functionaries.

With the rapid advancement in science, technology and medical science, mankind will gradually enter into an aging society, which raises higher demands on governmental departments and public service system. Now, governments of different countries are racking their brains to seek for the solutions to various issues brought by aging society, among which the most striking ones are the management of the elders and provision of services to them. In this field, AI may play a critical part. Having integrated with Internet of Things and mega-data, AI robots may free the functionaries and the workers in community elder's services from the tedious nursing work, who will focus their energy and time on offering the elders quality and individualized services. In Japan, robot nurses are used to attend patients, dramatically reducing the workload of hospitals and social workers. If robots are used to take care of the elders, governmental functionaries and nurses will be greatly relieved from their labor, which will spare their much time to do other work.

Furthermore, intelligent robots may assist governmental functionaries in providing better public security services. In the near future, traffic robots will offer more information and support if it is necessary. AI will also help police to anticrime. AI machines equipped with metadata may store the previous criminal acts, by which police will get knowledge of the presumptive criminal rate, or based on which police many deploy proper forces to anticrime. Robot patrolmen may considerably alleviate police's workload. AI will help to reasonably deploy police forces and economize

government's expenditure. Additionally, by means of AI face recognition apparatus, police may quickly lock the criminal offenders by their facial features. In a word, AI will improve detection rate of police and play a critical role in lowering criminal rate.

It is worth emphasizing that AI closely depends on the support of mega-data. To improve social governance, a great number of data analysts and data processors are needed to collect and deal with the data in many fields. In this case, governments should use the consistent procedures and standards, while data barriers and talent islet must be broken so as to bring about free flow of information and talented people. Furthermore, intelligenization of social governance will incur challenges to network security and privacy right of citizens, for which many network security experts and legal professionals of public information will be employed by governments and public service sectors where they will help government departments to control and use the proper information and establish the perfect systems to protect the security of public information.

## 4.4 Reconstructing the Relationship Between AI and Laborers

A survey of the previous industrial revolutions reveals us that each revolution can be considered as "disturbance" and "transcendence," during which the revolution exercised gradual transformation of the former social operating mode by means of new technology. This practice will bring certain "disturbance" to the people who are used to original mode. In addition, we may realize that people try to adapt themselves to the changes brought by technical innovation and change this world with new technology so as to complete the "transcendence." Confronted with another "disturbance" by AI, how will the laborers deal with challenges and seize the opportunities? What measures will they take to accomplish another "transcendence"?

### *4.4.1 AI and Occupational Development of Laborers*

In the times of science and technology, the developing speed of AI is completely beyond our imagination. Ten years ago, who could come up with the situation that his work is replaced by an intelligent robot, instead of such reason as his poor performance, his failure in the competition with his co-workers, or reduction of establishment due to company's financial deficit? Obviously, AI brings us the biggest challenge—unemployment. To a laborer, if he is reluctant to make self-upgrading, he will lose many opportunities of re-employment. Just as we are now in the time of smartphone, if you are still using a feature phone, you are unable to enjoy the facilities brought by the numerous cell phone applications. It is the same reason for

employment. If you fail to keep abreast with the rent of technical innovation, you will be eliminated in job market. Too many unemployed people will bring threat to social stability. Therefore, the most reliable way is to work out a well-conceived re-employment program, through which you should be prepared for life-time eduction and learning. Constant innovations and adjustments are required for the occupational training in the near future.

In industrial era, most people acquired skills through various channels (such as schools or mentorship) or certain special know-how in training schools, with which they might seek enduring jobs. In the times of inteligentization, if people still adopt this mode, unreluctant to update their expertise and skills, they will be marginalized, even though they are still employed. For different occupational colonies, there will be different contents for their life-time learning, but some other knowledge and skills are necessary for the coming laborers.

① Social skills. From the perspective of organizational behavior, favorable social intercourses are conducive to the coordination among the employees, which will, in turn, effectively improve operational efficiency.
② Capacity of continuous learning. One should know how to conduct self-directed learning so as to elevate personal competence. This is the most effective way to keep pace with scientific and technological development. Just as the one who could not read and write was regarded as an illiterate 30 years ago, the one who is ignorant of programming technology will be defined as a man of illiteracy 30 years later.
③ Intelligence quotient for AI. This skill means that you should be well informed of AI operating mode. Just as you can ride a horse, plus your familiarity with the horse's habitus, you will be adept in reining it. The same reason can be applied in using AI machines.

Apart from self-directed learning, innovation is also needed in occupational training in the context of AI development, both in innovating training contents which may keep abreast with scientific and technological development and the training modes which may offer various options. Laborers may either receive online or offline training, or the mixture of both ways. They may either be trained by instructors or by AI, or the mixture of both. It is predicted that laborers will receive high-quality and adaptable occupational training.

### *4.4.2 AI and Innovation of Human Resources Management*

With the in-depth integration of Internet and human resources management, it is the right time, not the trend. Although we have a long way to go, the time of such integration is practically approaching. Recently, BizReach, a Japanese high-end talent recruitment Web site declared that it would cooperate with Yahoo and Salesforce.com, an American client management platform, to develop a kind of AI, in which the tasks such as recruitment, staff evaluation, and job assignment, will be

completed at a stroke on the basis of the working data of the employees. Will the clerks in human resources department of a company be replaced by AI?

Undoubtedly, AI application will also bring a shock to human resources department, where the management will be deepened by AI. We may elaborate this issue in the following six respects.

(1) Human Resources Planning and Prediction
The previous human resources planning and prediction were done on the basis of statistics and analysis of data information and enterprise's strategy. Confined to the imperfect result of data analysis, the planning and prediction were far from satisfactory. Boasting overwhelming advantages in information processing and analysis, AI may help to bring forth comprehensive and accurate planning and prediction suitable to company's strategic deployment.

(2) Recruitment
As recruitment is highly technical and arduous work in the human resources management system, the most troublesome issue that a company is confronted with is asymmetrical information held by the recruiters and the candidates. Therefore, the recruiters would find the faulty respects in the candidates, making the company hard to employ the workers to its satisfaction, whereas the candidate feels that it is difficult for him to find a dream company. With help of AI, a company may collect mass recruitment information and formulate a streamlined automatic process to complete the relevant tasks, covering number of recruitment, the apt candidates, judgement and identification of the candidates, continuous track, assessment and analysis, etc., so that the company may recruit the right workers while the employee feels that he may give into full play his talent.

(3) Training
As it is very difficult to judge how long an employee will work in a company, training of the employee so as to enable him to be familiar with the company's businesses is extremely necessary. Therefore, the company finds it difficult to evaluate the input and output of the training. The trivialities and huge workload in training make the company aware that training is an arduous work with little fruit. AI's participation can well solve this issue. The employees no longer need trainers, while AI may offer them more cheap and abundant training resources. Moreover, each employee may be equipped with an AI teacher, who will customize a complete training system on the basis of his conditions. In this way, enterprises will increase a great number of AI trainers suitable for their own requirements.

(4) Performance Management
This is also a highly technical and complicated work. The coming AI will make the applications more scientific in formulation of performance program, performance coaching, evaluation of performance, application of performance result, and elevation of performance goals. As AI replaces many workers, workload will be reduced while the evaluation is more accurate.

(5) Management of Salary and Welfare
This link is closely related to the interests of the employees. The previous system in salary and welfare makes some workers feel unfair, and they even suspect that there might be "black box operation." AI will make the routine tasks of enterprises fair and reasonable, such as formulation of salary strategy, work analysis, salary survey, salary classification, and salary decision, while it greatly improves the efficiency of those links. Enterprises will employ more analysts to deal with salary allocation and feedback information so as to improve the level of human resources management.
(6) Management of Employees' Relationship
In intelligentization times, AI can replace human organizations, in which the relationships among the employees shift from "management of workers" to "management of the relationship between workers and AI." So, many work posts will be created to promote the harmonious co-existence between intelligent machines and workers.

Moreover, AI products will be included in the category of human resources (HR) management. In intelligentization age, the extension of HR will be redefined. As AI products boast self-consciousness, they perform the same role as a man in work. In this sense, HR management category will naturally extend to AI products. In an organization equipped with AI applications, the relationships among the workers will change from "management of workers" to "management of AI," with an aim of adjusting the relationships between man and AI. In addition to the existing legal issues, the coming relation sips among workers may involve ethical and moral issues.

### *4.4.3 AI and Narrowing Gap Between the Rich and the Poor*

In its report on AI and inequality, United Bank of Switerland asserts, "AI will bring certain shock to the emerging cheap job market, while the developing economies will face greater challenges. If no proper policy is available for guidance, inequality will be worsening." However, Branko Milanovic, an economist, holds that the revenue differential among different countries is not enlarged with the development of industrial technology. On the contrary, the revenue growth in the emerging economies makes several billion people to shake off poverty, greatly narrowing the gap between the developing countries and the developed countries in living standards and wealth.

In the future, AI may generate three kinds of social inequality from "contact," to "application" and then to "mastery of the technology."

(1) Inequality Caused by Uneven Opportunities for "Contact" AI

As an emerging technology, AI is still at the initial stage. Mainly the developed economies are researching and developing new AI, in which China and the USA boast over 60% the global AI enterprises, and this situation will generate the gap in contact and understanding of AI between the developed countries and developing

countries. For this reason, when confronting the upsurge of AI in the near future, the people in developed countries will be adept in dealing with the relevant issues, whereas the people with much less contact and knowledge in the under-developed countries will be confounded at what to do.

(2) Inequality Caused by Whether One Can "Afford" AI Products

The present trend shows that AI products cost highly, which means that one should own adequate funds for the products. If you have the chance to learn about AI, you cannot use it and enjoy the facilities and the efficiency brought by AI because you cannot afford it, whereas the moderately rich people create more value with AI products they purchase. This phenomenon is called "the Matthew Effect," denoting the growing polarization in our society, a theory that is frequently used in sociology, pedagogy, psychology, and economics.

(3) Inequality Caused by Different Proficiency of "Mastery of Technique" in AI

Compared with other industries, the AI domain is a hi-tech industry, calling for profound knowledge and proficient skills. The user of the AI product does not need to master the relevant technology, but he can afford it. Moreover, the operation of AI products is quite simple. The biggest beneficiaries are a small colony who masters the technology. As they control deeper technology, they are quite skillful in applying AI products and dominate its developing trend, as a result of which they boast more right of speech and they will accordingly earn more and acquire higher status.

The above-mentioned three inequalities are caused by people's matter and application ability of AI producers after all and presentation mode is different from non-intelligent age. With the dissemination and popularization AI, more people can transcend the restraints of space, territory, and factor endowment, who will turn to be pioneers of the times by means of AI. The advent of AI age will offer many developing countries the opportunities to narrow the gap between developing and developed countries and even surpass the latter by corner overtaking. In addition, social mobility may be redefined in AI age, which means that social members or social groups may evolve into another social class or social stratum from one social class or social stratum. Based on its flowing directions, the game can be divided into "flowing to upper class" and "flowing to lower class." With regard to social strata, the developing advantage will no longer be monopolized by traditionally developed regions or upper groups, but a situation is marked by multiple competitions as both China and India have stored a great number of talents and industrial groups. In the context of the rapid development of AI, if China and India can seize the opportunities of corner overtaking and endeavor to construct intelligentized industrial groups of services, both countries may become the centers of attracting global high-end science workers.

Many low-end laborers may be faced with the threat of unemployment and poverty from AI in a short period of time. In the long run, AI may offer people the opportunities to flow to upper stratum. As there is a great shortage of talents in AI domain, it is normal that enterprises are willing to offer annual salary of half million or more

yuan to recruit a high-end professional in this field. Aided by AI, people may quickly embark on learning the specialities in AI and receive AI training so as to achieve the goal of "upper flowing."

### *4.4.4 AI and Protection of Laborers' Rights and Interests*

When talking about each Industrial Revolution in human society, "Luddite Movement" will cross our mind, which refers to the campaign waged by British people to resist industrial revolution and textile industrialization movement in nineteenth century. As machines were put into production, resulting in unemployment a large number of workers in the First Industrial Revolution, during which workers smashed the machines. In intelligentization era, how will we protect the rights and interests of laborers so as to avoid "New Luddite Movement"? It is true that AI will undermine the rights and interests of low-end laborers, but it also provides them with ample opportunities and effective tools to develop their comprehensive quality and working competence. Labor management and service departments should timely adopt the measures pertinent to AI developing trend so that they may reduce the negative effects of AI as much as possible.

(1) The Impact on the Rights and Interests of Laborers in AI Age

Firstly, the flexible employment derived from the shared economy as against regular employment refers to the various forms of employment that are different from the employment in modern enterprise systems in terms of working hours, income, work sites, insurance, and welfare and labor relation. In a word, flexible employment is a form without a labor contract. Now, flexible employment groups fall into three types, including self-support laborers, household assistants, and other employees. This form of employment poses a challenge to the job market. AI will elevate the freedom and flexibility of laborers, remold the relationship between laborers and work, and turn the working man into an employee who is free from traditional implication, but he is an independent person engaged in the special job. The employment form derived from shared economic mode will bring challenges to traditional labor order with regular labor relation as the main body. As these new forms of employment are not admitted into the employment management system, the rights and interests of the laborers in those forms should be confirmed and protected, which will trigger profound reform of management system of traditional labor order.

Secondly, the short-term structural unemployment due to the replacement of a large quantity of labor forces by AI denotes the unemployment caused by the inconsistent of provision and demand of labor force because of the changes of macro-factors such as growth mode, economic structure and system, and involuntary unemployment in essence. When AI develops to a certain degree, it will be bound to replace those repetitious and programmed jobs due to the consideration of costs and efficiency. The laborers engaged in those jobs will be dropped out in the job market and thus their rights and interests will be infringed. When they are out of work, those laborers should receive occupational training before they are re-employed, during

which the economic costs and time costs generated will bring a heavy load to their enterprises. Additionally, a large number of short-time unemployed will incur psychological harm to the individuals and the society and then bring shock to social stability and public welfare.

(2) How to Ensure Laborers' Rights and Interests

Firstly, to the laborers whose rights and interests are infringed in flexible employment, as they lose the support of traditional labor management system based on enterprises. Once, labor disputes arise, the rights and interests of laborers will be vulnerable to infringement as they have not signed the contracts with the employers. In this context, legal authorities should adopt "flexible" regulations to deal with such new-type employment, free from "indiscriminating" definition of such floating labor relationship. They cannot mechanically apply the standardized "labor relation" nor can they readily confirm such "labor relation." As the form of flexible employment creates a large number of emerging job opportunities and new economic growth points, this phenomenon has better interpreted the trend of "the public permeated with entrepreneurship and innovation prevailing in the society." For this reason, legal departments should redefine such labor relation so as to protect the rights and interests of the laborers in a flexible way.

Secondly, as to the unemployed workers caused by AI development, the government and social organizations should join their hands to seek for a mechanism that will ensure the reliable income resources for the unemployed workers. The authorities concerned should offer more technical training for those unemployed workers so they may adapt themselves to the new jobs. The pioneering enterprises should take lead in setting up supporting funds, providing those vulnerable groups with the basic daily necessities and unemployment compensation taxes so that they can spend the "transitional period" between unemployment and reemployment. In Intelligence age, as new changes will constantly take place in job market requirements and employment patterns, unemployment pre-warning and employment prediction mechanism should be set up to accommodate AI development. This mechanism will offer a tool for governments and enterprises to analyze and predict employment conditions.

## Bibiography

Bao Hai Juan. 2016. Li Xing Kan Dai Ren Gong Zhi Neng Fa Zhan Dui Jiu Ye De Ying Xiang (Look rationally at the impact of artificial intelligence development on employment). *Zhejiang Economy* (11).

Berger T, Frey C. 2016. Structural transformation in the OECD: Digitalisation, deindustrialisation and the future of work. Paris: OECD Publishing, OECD Social, Employment and Migration Working Papers, (193).

Bo Shi Dun Zi Xun Gong Si. *Gong Ye 4.0: Wei Lai Sheng Chan Li He Zhi Zao Ye Fa Zhan Qian Jing Industry 4.0: future productivity and manufacturing prospects* (20160501) [20171005]. http://doc.mbalib.com/view/df5f792df1763f99d604e7645bf05011.html.

Brynjolfsson E, Mcafee A. 2014. *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York: W.W. Norton & Company.

Cai Zi Xing, Liu Li Jue, Cai Jing Feng, Deng. 2016. *Ren Gong Zhi Neng Ji Qi Ying Yong.* (*Artificial intelligence and its application*). Beijing: Tsinghua University Press.

Chetty R, Hendren N, Kline P, et al. 2014. Where is the land of opportunity? The geography of intergenerational Mobility in the United States. *The Quarterly Journal of Economics* 129(4).

Chris Anderson. 2012. *Makers: The new industrial eevolution. Xiao Xiao, Yi*. Bei Jing: China CITIC Press.

Daveri F, Tabellini G. 2000. Unemployment, growth and taxation in industrial countries. *Economic Policy* 15(30).

Duncan G L, Murnane R J. 2011. *Whiter opportunity? Rising inequality, schools and children s life chance*. New York: Russell Sage Foundation.

Elaine, Dewar. 2016. *Smarts: The boundary-busting story of intelligence. Liu Chun Rong, Xian Yu, Jing Yi*. Bei Jing: China Machine Press.

Floridi, Luciano. 2016. *The fourth revolution: How the info sphere is reshaping human reality. Wang Wen Ge, Yi*. Hang Zhou: ZheJiang People's Publishing House.

Frey C B. *New job creation in the UK: Which regions will benefit most from the digital revolution?* [EB/OL]. [20171005]. https://www.pwc.co.uk/assets/pdf/pwc-annualreport2005-full.pdf.

Frey C, Osborne M. *The future of employment: How susceptible are jobs to computerisation?* [R/OL]. (20130917) [20171005]. https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.

Green F. 2012. Employee involvement, technology and evolution in job skills: A task based analysis. *Industrial and Labour Relations Review* 65(1).

Guo Mai Yan Jiu Yuan. *De Qin Bao Gao: Ren Gong Zhi Neng Ru He Zeng Qiang Zheng Fu Zhi Li Deloitte report: how does AI enhance governance*. [R/OL]. (20170721) [20171005]. http://smart.blogchina.com/599876148.html.

Hang Ye Bao Gao Yan Jiu Yuan. *Teng Xun Yan Jiu Yuan: Zhong Mei Liang Guo Ren Gong Zhi Neng Chan Ye Fa Zhan Quan Mian Jie Du Tencent research institute: a comprehensive interpretation of the development of artificial intelligence industry in China and the United States*. [R/OL]. (20170803) [20171005]. http://www.sohu.com/a/161883858_720186.

*Hu Lian Wang Dui Fu Wu Ye Dai Lai De Shi Da Ying Xiang*. *Top 10 impact of Internet on service industry*. (20150126) [20171005]. http://www.cbdio.com/BigData/201501/26/content_2337867.htm.

Hubert Dreyfus. 1979. *What computers can't do—the limits of artificial intelligence*. Harper & Row, Publishers.

Jerry Kaplan. 2016. *Humans need not apply: A guide to wealth and work in the age of artificial intelligence. Li Pan, Yi*. Hang Zhou: ZheJiang People's Publishing House, 2016.

Ji Zhi Ju Le Bu. 2016. *Zou Jin 2050: Zhu Yi Li, Hu Lian Wang Yu Ren Gong Zhi Neng* (*Getting to 2050: Attention, the Internet and artificial intelligence*). Beijing: Posts & Telecom Press.

John Markoff. 2015. *Machines of loving grace: The quest for common ground between humans and robots*. *Guo Xue, Yi*. Hang Zhou: ZheJiang People's Publishing House.

Koeniger W, Leonardi M, Nunziata L. 2011. Labour market institutions and wage inequality. *Industrial and Labour Relations Review* 60(3).

Lin J. 2011. Technological adaptation, cities, and new work. *Review of Economics and Statistics* 93(2).

Li Zhi Yong. 2016. *Zhong Ji Fu Zhi: Ren Gong Zhi Neng Jiang Ru He Tui Dong She Hui Bian Ge* (*Ultimate replication: How will ai drive social change*). Beijing: China Machine Press.

Li Shuang, Zhang Ben Bo, Gu Yan, Deng. *Di Si Ci Chan Ye Ge Ming Yu Jiu Ye ——— Tiao Zhan He Ying Dui* (*The fourth industrial revolution and employment–challenges and solutions*) [EB/OL]. (20161228) [20171005]. http://www.amr.gov.cn/ghbg/shfz/201702/t20170223_31730.html.

Martin Ford. 2016. *The lights in the tunnel. Qi Yin Bu Luo, Yi*. Wu Han: Huazhong University of Science & Technology Press.

Marvin Minsky. 2016. *The emotion machine: Commonsense thinking, artificial intelligence, and the future of the human mind*. *Wang Wen Ge, Cheng Yu Ting, Li Xiao Gang, Yi*. HangZhou: ZheJiang People's Publishing House.

Milanovic B. 2015. Global inequality of opportunity: how much of our income is determined by where we live. *Review of Economics and Statistics* 97(2).

*Ren Gong Zhi Neng Jie Fang Nong Min He Nong Chang Zhu Jin Hou Zhong Di Yang Niu Zhi Yao Kan Shou Ji. Artificial intelligence will free farmers and ranchers to farm cattle by looking at their mobile phones*. [EB/OL]. (20170601) [20171005]. http://www.foodjx.com/news/Detail/124006.html.

Spitz-oener A. 2006. Technical change, job tasks, and rising educational demands: looking outside the wage structure. *Journal of Labour Economics* 24(2).

Syverson C. 2013. Will history repeat itself? Comments on "Is the information technology revolution over? *International Productivity Monitor* (25).

Wang Xi Wen. 2016. *Gong Ye Ji Qi Ren 2.0: Zhi Neng Zhi Zao Shi Dai De Zhu Li Jun* (*Industrial robot 2.0: The main force in the era of intelligent manufacturing*). Beijing: China Machine Press.

Wu Jun. 2016. *Zhi Neng Shi Dai: Da Shu Ju Yu Zhi Neng Ge Ming Chong Xin Ding Yi Wei Lai* (*Smart age: Big data and smart revolution redefine the future*). Beijing: China CITIC Press.

Yang Jing. 2016. *Xin Zhi Yuan: Ji Qi + Ren Lei = Chao Zhi Neng Shi Dai* (*New intelligence: machine + human = the era of super intelligence*). Publishing House of Electronics Industry.

Yu Dong Hua, Hu Ya Nan, Lü Yi Nan. 2015. Xin Gong Ye Ge Ming Bei Jing Xia " Zhong Guo Zhi Zao 2025" De Ji Shu Chuang Xin Lu Jing He Chan Ye Xuan Ze Yan Jiu (Research on technological innovation path and industrial choice of "made in China 2025" under the background of the new industrial revolution). *Tianjin Social Sciences* (14).

Yutaka Matsuo, Makoto Shiono. 2016. *The age of great intelligence*. *Lu Bei Ni, Yi*. Bei Jing: China Machine Press.

Yutaka Matsuo. 2016. *Artificial intelligence craze—will robots surpass humans? Zhao Han Hong, Gao Hua Bin, Yi*. Bei Jing: China Machine Press.

Zhang Yan Kun, Liu Feng. 2017. Quan Qiu Ren Gong Zhi Neng Fa Zhan Dong Tai Qian Xi (Brief analysis on the development trend of global artificial intelligence). *Modern Science & Technology of Telecommunications* (47).

*Zhu Jian Bu Guan Yuan: Wei Lai Zhong Guo Cong Shi Nong Ye Ren Kou Ke Neng Hui Xia Jiang Dao. Ministry of housing and urban-rural development official: The number of people working in agriculture in China may drop to 10 in the future*. [EB/OL]. (20140605) [20171005]. http://www.yicai.com/news/3895273.html.

# Chapter 5
# Artificial Intelligence and Education

**Bin Wang, Huanhuan Liu, Ping An, Qing Li, Kai Li, Ling Chen, Qi Zhang, Jingwu Zhang, Xinpeng Zhang and Shenshen Gu**


B. Wang (✉) · H. Liu · P. An · Q. Li · K. Li · L. Chen · Q. Zhang · J. Zhang · X. Zhang · S. Gu
Shanghai University, No. 99 Shangda Road, Baoshan District 20044, Shanghai, China



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_5

**Abstract** As the progressive ladder for human society, education aims at ensuring cultural heritage and social development. More importantly, it may inspire human imagination. In this sense, education is very critical in the development of a nation and even in the whole human society. Education will vary with different times in its concepts, contents and modes and accumulate energy for the transformation of social patterns. Now, AI has been used in nearly all the industries and trades, posing a powerful impetus in promoting economic development and social progress. The in-depth development of AI will be bound to accelerate the process of social order restructuring, ensure the harmonious coexistence between mankind and nature, coordinate the development man and science and bring unprecedented development opportunities as well as challenges to education. In intelligence age, with more and more educational resources available, more flexible modes and patterns and multivariant intelligence systems in teaching, great changes will take place in education, during which people may acquire knowledge in the forms of clustering and individual education and their ability will be greatly improved. Meanwhile, the new topics will emerge on how to enlighten people's mind, how to reforge their values and how to tap their potential.

## 5.1 New Educational Modes Initiated by AI

AI will reconstruct educational modes and constantly renew teaching contents so as to meet the requirements in the new era. In intelligence age, people should be initiative in understanding the principles and methods of information processing, catch on and admit AI products and service, enjoy the benefits brought by scientific progress, care more about human destiny and actively cope with the coming opportunities and challenges.

AI impact on education may fall into three respects:

(1) AI will trigger the innovation of educational means and methods, really bringing about "individualized teaching" and "edutainment." Based on the educatee's physiological, psychological, competent and aspiring conditions, AI will design individualized program, including content selection, releasing ways and adaptive adjustment in light of the feedback. The selection and generation of teaching contents should be educatee and object-oriented, which will affect the educatee's consciousness and his/her subconsciousness so that he/she may direct his his/her thinking and remold his/her personality in the virtual environment similar the games.

(2) In the era that AI is extensively used, mankind will focus on developing his core ability. Such assignments as environment perception, data acquisition, discovery of principles, prediction and control based on experience will be undertaken by intelligent tools or intelligent systems. Under such circumstances, man will gain

more time and energy for innovation, exploration, imagination, aesthetic taste and order reconstruction. These are the reasons that human beings can not be by replaces by machines or be the vassals of machines.

(3) AI development will encourage people to constantly pursue new freedom and targets. With the binary order "physical space—social space" evolving into ternary order "physical space—social space—cyber space," people will revalue and deposition themselves. With the progress of intelligence systems and externalization of human partial ability, they will gain an in-depth understanding of the possibility between themselves and the external world and acquire a broader developing space and more abundant profitable resources.

### *5.1.1 Historical Evolution of Innovating Educational Modes*

There is no lack of advantages in traditional education, but educational inequality is rather striking due to the limited teaching resources, qualified teachers in particular. In information age, the advent of Internet has broken the boundary between space and time in traditional education and people have achieved learner's autonomy, a trend that brings about educational equality to certain extent.

The quietly coming intelligence age offers people mega-data and techniques of machine learning and virtual reality, from which people acquire ample educational resources and teaching means, bringing about educational autonomy and intelligence. In this context, people have to redefine the cultivation of the coming talents so as to achieve the coordinated development between human intelligence and artificial intelligence.

(1) Traditional Education versus Internet Education

Before the application of IT, schools act as the carriers of traditional education. As such stereotyped education is featured by classroom interaction between teachers and students, students not only acquire knowledge, but also submerge themselves in cultural nurturing. Strict in management, standardized in modes, favorable in environment, traditional education focuses on knowledge impartment, during which teachers protrude predominantly, whereas individual orientation of students is ignored, resulting in languishing cultivation of creativity. Moreover, due to the uneven economic and cultural development in different regions, there gives rise to the striking issues, including disproportionate distribution of educational resources, educational inequality, etc.

With the popularization of Internet, the spatial and temporal boundary in traditional education is broken, the conventional concept and practice has been subverted. To forge a dynamic and open educational environment becomes a marked feature in Internet education. To reform teaching modes by means of IT and network platform is the developing trend, with the successful cases shown in "overturning classroom teaching" and "massive open online courses" (MOOC for short).

Compared with traditional education, Internet education has the following advantages in education resources, teaching methods, teaching modes and other aspects: Firstly, Internet education can realize anytime and anywhere sharing of teaching resources. Students can use all kinds of information and resources on the Internet, and they can also study at any time and any place, breaking the limitations of traditional classes and making the learning process flexible and convenient. Secondly, Internet education is easier to meet personalized learning needs. On the Internet education platform, students have greater autonomy in course selection and can also learn according to their own interests, basis and methods, which are not limited to a unified specification. Finally, education has various teaching forms and novel and interesting teaching methods.

Internet education teaching is not limited to text, sound, animation and other forms and easy to present the teaching content through a variety of methods and stimulates students' interest in learning and learning enthusiasm.

The development of the Internet has had a significant impact on the traditional education model; especially, after the concept of "Internet +" was put forward, the impact of information technology on education model has a new development, people have a new understanding of the change of traditional education, but the action is just beginning.

(2) From Internet Education to Education in the Age of Intelligence

Internet education breaks the limitation of traditional education space and time and expands the traditional closed classroom into an open interactive platform, which to some extent reflects the autonomy of learning and promotes the equality of education. However, the disadvantages of Internet education are also obvious: Firstly, the effect of Internet education depends on students' self-control, judgment and self-study ability. Internet education is usually a one-way transmission process, which is difficult to guarantee the learning effect. Secondly, the spiritual and cultural depth of Internet education is not as deep as traditional education. Education is not only the transmission of knowledge, but also the promotion of the spiritual world and the development of cultural concepts. Internet education focuses on the innovation of teaching content and teaching methods. It lacks communication between people and pays less attention to the construction of humanistic concepts.

When people are still enjoying the convenience brought by the Internet, the era of intelligence has quietly come. With the help of big data, machine learning, cloud computing and other technologies, AI has demonstrated its perceptual ability, judgment ability and evolutionary ability. With the help of various types of sensor networks, artificial intelligence already has vision, hearing, touch and temperature body sense. With the help of machine learning theory, artificial intelligence has some advanced reasoning, planning, prediction, decision-making and other intelligent behavior.

Applied in educational field, AI will trigger revolutionary changes in educational modes, a developing trend indeed. Now, various AI teaching systems have been put into use and replaced the role of teachers to certain extent. Endowed with massive teaching resources, robots may tirelessly simulate the dialogue and communication

between human experts and students and exercise accurate individualized teaching on the basis of students' conditions. How to achieve educational automation and intelligence by AI innovative educational modes is one of the major assignments for the coming educational revolution.

In intelligence age, a fundamental task on education is to achieve multiple advantageous integration of individual language, logic, interpersonal relationship and self-recognition. The cooperation and competition between human intelligence and AI in the future will yield brand-new educational modes, in which people should not only develop AI ability, including its competence in rapidly processing information and making logical judgment, but also exploit the capacity that AI is not adept, covering the skills of interpersonal communication and self-recognition peculiar to mankind so that man can better coordinate the machines. In such era, an eternal assignment for education is how to enlighten people and stimulate their creativity in technology and art so as to remold a better world.

### *5.1.2 Opportunities and Challenges for Education in Intelligence Age*

Education aims at enlightening people, during which one soul awakes another one. Student-oriented, modern education advocates ten concepts, including people first, all-round development, quality education, creativity, initiation, individuality, openness, diversification, eco-harmony and systematic concept. The education during intelligence age should be student-oriented, diversified and individualized. In addition to the reform in teaching resources, teaching contents and form, guaranteeing of teaching quality, it is imperative that we should inflame students' desire of making innovation, remold their values and foster their psychological and physical quality. Such cooperation and competition will help reconstruct educational business and educational market and bring new opportunities and challenges to students and teachers.

(1) Basic Contents and Elements for Talent Cultivation in Intelligence Age

What kind of talents to be cultivated and how to cultivate are the two everlasting themes in education. Prof. Qian Weichang, renowned educationalist, late President of Shanghai University, once remarked, "Our students should be, first of all, the talents of all-round development, patriots, dialectical materialists and men of moral integrity and artistic culture. Secondly, they should be the graduates with professional knowledge, the prospective engineer and experts." It is the requirement of times for us to cultivate specialists with all-round development. Both teachers and students in intelligence age should complete such an assignment—reconstructing their knowledge structure.

This reconstruction is embodied in traditional knowledge system, which demands the compression and merge of certain knowledge to some extent and then emphasizes

the addition of the contents related to AI. Teaching will involve remolding of values, cultivation of the ability to analyze and solve problems and the training of creative thinking. The details cover the following contents and elements.

Information literacy is the basics for education and a fundamental capacity that people must acquire in the context of global information and intelligence, which is shown in the following eight respects: (1) to use information tools—one should be skillful in using various information tools, network communication tools in particular; (2) to acquire information—based on his own learning goal, one should be effective in collecting learning materials and information, adept in obtaining information through reading, access, seminar, visit, experiment and retrieval; (3) to process information—one should be able to deduce, classify, store, differentiate, screen, analyze, integrate and generalize information that he gathers; (4) to generate information—one should accurately overview, integrate, implement and express the needed information, making it more concise, smooth and characteristic; (5) to create information—on the basis of interaction of the information collected, one should find out innovative opportunities, breed growth points of information so as to create new information and realize the terminal goal of information collection; (6) to give play to information—one should be adept in solving problems with the information he gathers so that the information yields the maximum social and economic effects; (7) to coordinate information—one should turn information and information tools into the intermediaries for spatiotemporal spanning and "zero-distance" communication and cooperation, making it the efficient means for improving himself and establishing harmonious cooperative relationship with outer world; (8) to be immune to information—as fine and bad information is often intermingled, one should develop the ability to screen the good from the bad one with his positive outlook on life and values and consciously reject and eliminate spam ill-healthy messages with his self-controlling, self-disciplined and self-regulating competence, equipped with the ethical quality which conforms to information times.

Information literacy covers information awareness, information knowledge, information competence and information morality, among which information awareness comes first in that it covers such respects as sensibility to information, enduring attention and discretion on values. As the base for information literacy, information knowledge involves scientific principle of information, tools for information application. To be the core, information competence implies the ability to screen the needed message in the massive and unordered information ocean and to apply it into knowledge innovation in reasonable way. Information ethics offers the assurance in sustaining the normal order in information operation and prevents it from endangering the society and infringing the legitimate rights and interests during acquisition, application, processing and dissemination of information.

The twenty-first century marks an age of multidisciplinary science represented by intelligence, an era initiating "singularity" mode of technological development, during which the concept "major disciplines" is generated by "AI + X," bringing about the in-depth integration of interdisciplinary subjects. How to study and how to think are the fundamental skills for mankind in the new era because lifelong learning can enable people to deal with the constant challenges.

(2) Talent Cultivation Driven by the Requirements in Intelligence Age

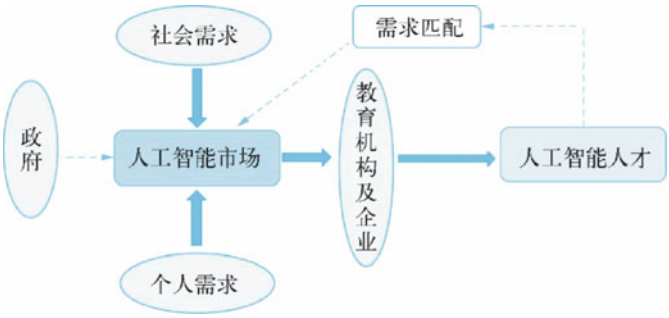
Different from traditional education era and Internet education era, the education in intelligence age covers all the scientific contents in the past several hundreds of years, brimming with enormous potential in scientific development, industrial production and overall social planning. It is predictable that AI is critical to national competitive edge and productive forces. AI will exert influence in the following respects.

Firstly, AI may bring effects to national defense, financial institutions and social groups. In addition to the elevation of efficiency, AI is also critical in China's core competitiveness in the new era. At present, international financial institutions have brought in AI decision-making mechanism, which validates the advantages in decision-making efficiency, costs and rate of return, as against the previous man's decision. Moreover, AI proves its superiority in games and tests to mankind. With further development in AI, to master autonomous and advanced AI hardware and software is the prerequisite for improving national competitive edge.

Secondly, with regard to economic development and enterprise competition, AI will directly reduce costs in labor and management and elevate production efficiency. Microsoft, Google and Baidu have taken the lead in helping enterprises to forge AI platforms so that they may clearly get to know customers' requirements and formulate their marketing strategies. In addition, AI will exert huge potential influence on public order, social security, medical service and people's livelihood. Now, the commercial applications of the new techniques and new modes such as face recognition, health monitoring, tele-medical care and intelligence diagnosis have effectively promoted economic and social development.

Thirdly, AI's affect on individuals mainly manifests itself in employment, business initiation and living style. In recent years, the dramatic development in Internet and mobile Internet has greatly facilitated people's shopping and intercommunication. While generating "the phubber," the two networks are also conducive to Internet employment, in which the operation ability of computer terminals is a prerequisite in most posts of duty. Moreover, AI will further transform man's lifestyles, forms of employment and modes of business starting as well. Individual occupations will be subject to impact and change in AI times.

To acquire national competitiveness and elevate social and economic effects, the core strategy for AI aims to promote the overall development by quality talented people. The core concept in talent cultivation is how to achieve coordination among governmental departments, educational institutions and non-governmental organization so that we may bring up the professionals in planning, management and technology to meet the needs of AI markets. As shown in Fig. 5.1, AI market will be supported by Central Government, driven by social and individual requirements. Oriented by market requirements, educational institutions and enterprises should formulate their comprehensive and specific programs for talent cultivation. Additionally, they must constantly see to the matching condition between talent cultivation and market requirements so as to make the necessary revision and regulation on the programs.




政府：Government
社会需求：Social requirements
人工智能市场：AI Market
个人需求：Personal requirements
需求匹配：Need-supply fit
教育机构及企业：Educational institutions and enterprises
人工智能人才：Artificial intelligence talents

**Fig. 5.1** Talent cultivation driven by requirements in AI era

AI will bring opportunities and challenges to a country and its social groups, or to enterprise and individuals, and promote reform. To seize the opportunities and settle the challenges so as to hold a lead in this field, we should train a number of teams and professionals adaptable to or even leading the reform, which is taken as the assignment for educationalists as well as the driving force for educational transformation and upgrading. As it is an even-developing technology, we may tap the enormous potential in AI, explore and exploit many unknown and applied realms. As to the pioneering talents in new technologies, it is critically import to stimulate their motive force, which comes from their mission to propel human civilization, their responsibility for driving social development and their blessedness in realizing individual objects. It is a special task for cultivating talents in AI age that we should endow them with the dynamic subjective initiative by means of motivation.

The particularity in cultivating outstanding AI talents manifests itself in professional foundation and integral innovation. For the former, how far AI can go is decided by highly developed ability of manufacturing hardware and in-depth computational algorithm. For the latter, the integration of scientific, technological and industrial knowledge so as to bring about technical innovation controls the degree of width and acceptance of AI in social application. The cultivation of relevant personnel also calls for the pertinency and openness at multiple levels so as to address the unemployment brought by industrial restructuring in AI age.

(3) The Trends of Talent Cultivation during AI Age

While eliminating some work posts, AI will bring opportunities for re-employment. In this age, educational reform has been undergoing, which will focus students' lifelong learning, creative thinking and their ability to adapt themselves to time requirements. To educational sector, the educatees should get themselves ready for the challenge so that they may be adaptable to the rapid development in the future.

For students, the major skills that they should master are as follows:

(1) Socializing skill. Even if robots are put into use, interpersonal communications are still indispensable in that collaboration is a good way for improving efficiency.
(2) Ability for sustainable learning. As science and technology are developing in an amazing speed, resulting in the disjunction between one's acquired knowledge and practical competence, one of the important skills in autonomous learning is how to study, called "metacognition," through which a learner is clear of his own thinking mode so as to study in effective way.
(3) Machine's intelligence quotient. The so-called machine's IQ means the ability to understand robot's operating modes. When robots prevail in the near future, the higher the machine's IQ, the more advantages one will get.
(4) Computer programming. Prof. Wu Jun, a computer scientist, holds that with 30-year critical progress made in computer science, it can be predictable that major advancement in the coming decades will still be achieved in this field. Mr. Wu is also an author of technical best sellers, whose works cover "Aesthetic Mathematics," "The Mystique of Silicon Valley," "The Light of Civilization" and "The Intelligence Age." The progress will serve as an impetus for AI development. In intelligence era, everyone should master the technique of programming, a basic skill in computer realm.

## 5.2 Objects, Requirements and Relevant Discipline Construction for Talent Cultivation in Intelligence Era

In intelligence era, life means to learn, to work and to create, which compels people to constantly create new things so as to adapt themselves to new life. In addition, all the people need to be trained in an all-round way, the advanced professionals in the relevant disciplines in particular.

### *5.2.1 Objects for Talent Cultivation in Intelligence Era*

The ever-bubbling AI services are incessantly changing people's ways of life. Different objects call for the corresponding competence of the talented people, learning contents and cultivation modes.

(1) New Types of Business and Innovation in Educational Modes

Employees in all walks of life will be inevitably affected in intelligence era. The advent of new type of business and new professions will, in turn, spur new requirements on talent cultivation. People's demands for training or further studies will draw forth a huge education market. In addition to schools, more enterprises will embark on educational field. It is predicted that more network (distance) training institutions will come out, offering various kinds of training to college students and adults, by which educational resources will be re-allocated. School education will focus fostering man's quality more and training institutions will attach more importance to applied skills. In this way, mutual complementation will be achieved between school education and social training, between schools and enterprises and between two different industries.

In intelligence era, there will more resources in massive open online courses (MOOC for short), as a result of which more AI products and technology will be available. Under the accurate AI guidance, students will achieve better results and higher efficiency in their learning and their individuality will be greatly improved. Moreover, teachers will endeavor to improve their professional ability and spare more attention to the overall development of their students, while schools will lay more emphasis on quality molding, value formation and motivation of creativity.

New educational modes will promote educational equity. By means of AI teaching, the people in different regions will share the same education and receive the precise instruction from "the best teachers." Additionally, the consummate Internet facilities will lower educational costs to a great extent, making possible the global free education.

In addition, with more accurate and convenient educational appraisal system available, several circulations within courses, disciplines and schools will be automatically formed. Joining hands with enterprises, schools may make survey on the quality of their graduates, an act conducive to improving their teaching.

(2) Lifelong Education

(1) Lifelong education will come out in intelligence era.
Lifelong education covers five age periods, namely children, juvenile, youth, mid-adult and elder, for which the educationists will plot out the coherent teaching pertinent to these periods. Each period is offered the particular teaching contents.

(A) Educational Period for Young Children (pre-kindergarten education and kindergarten education). AI education should begin from "young children," for whom AI products will be available either as toys or tools in an attempt to arouse their curiosity and foster their information literacy. For example, intelligent bracelets will be standardized devices for young children, which are used to surveil children's physiological signals, such as heartbeat, breath and pulse, and which can serve as GPS apparatus, informing their parents where their children are in real time. During this period, young children are required

to understand the functions of the intelligent product and its usage, enabling them to experience "AI is ubiquitous and AI products are human friends and assists, which will ensure our security."

(B) Period of Compulsory Education (from primary to middle school). The courses in computer science will cover knowledge, technique and application in AI. Apart from the courses in computer, AI will be basic course for all the disciplines. For example, teachers will show the cognitive principle of human brain in biology classes and introduce the relationship between AI and human brain. In the course of civilian and society, there should be the contents in AI. During this period, all the curricula must involve AI, with the focus on the extensive applications and the positive roles of AI in social life and all walk of life, such as intelligent medical care, smart housing, intelligent traffic, intelligent health and elder's life, intelligent finance, etc. In addition, ethical and moral principles will be a course for students in intelligence age.

(C) College Education (undergraduates, master and doctorial candidates). During this period, AI will be a separate discipline for undergraduates, who will systematically study fundamental knowledge and technology in AI, covering in-depth learning, processing of natural language, machine vision, reinforced learning, virtual reality, intelligent perception, theory of mega-data, etc. AI specialties will be founded for master and doctorial candidates, who will further their studies in the subdivisions of AI. Moreover, both compulsory and optional courses will be offered to the students of non-AI specialty so that they may get to know the fundamental principle of ethical norms, legal regulation and social affect in intelligence age, who will use AI in a better way, improve their life quality and elevate their learning working efficiency with AI technique. In a nutshell, such moves as cultivation of information literacy and training of computational thinking will permeate into all the disciplines in universities so as to foster students' ability to apply and create AI.

(D) Continuing Education for Adults (education upon employment). AI will be an effective and powerful tool for employees, who are required to study and apply the updated technology and products of AI. As AI is developing with each passing day, "recharge of knowledge" will be a normal state for adults and their modes for studies will be multivariant. AI contents in continuing education of adults will be closely related with their occupations. For instance, employees in financial sector will take AI as a tool in developing financial derivatives. After lecturing the course on AI tool, virtual teachers will unfold Q&A on financial tool in virtual scenes with the means of virtual reality.

(E) Education for Elders (re-learning of aged people). Simplified contents in AI will be offered to elders. With the ever evolution of AI, while greatly facilitating elders in their life, AI equipment and products will

incur inconvenience in operation. To elderly persons, "One is never too old to learn" is no longer a motivational saying, but a real situation that they are confronted. If they hate continuing learning, they will fail to keep pace with AI development and will be unadaptable to modern life. Therefore, through education in intelligence age, elders should learn how to use intelligent nursing products, such as smart temperature and light regulatory system, wearable multimodal sensors, smart tumble-proof clothes, robot pets and intelligent walking machines. Based on above competence, elders should further get to know how to use other AI products, including recreational and communicative devices of virtual reality, which can enable elders to perform remote interactions with their relatives.

(2) In intelligence age, what our society needs are the talent people who are innovation-conscious, powerful in communicative expression and social competence, globally perspective and internationally competitive.

Although benefitted from AI, various talents hold different interpretations and acquire diverse competence in AI. With regard to this situation, in the near future, three kinds of people will receive lifetime education from childhood to advanced age.

The first kind of people are the leading experts in AI. When they are still young children, teachers and their parents should judge whether they are outstanding in "AI quotient," a new quotient as against IQ nad EQ which is used to measure one's quality and competence in AI. "AI quotient" can be something either congenital or acquired through training. Among the children of the same age, those who are highly gifted in "AI quotient" will be specially trained so as to arouse their interest in computer and other branches of sciences. During the compulsory education period, those children will acquire the knowledge and skills in AI and develop their creativity. As man's brain is far superior to machine in imagination and creativity, leading experts will focus these two respects in their lifelong education. Intelligent education technology will offer students interactive learning experience, a condition that ensures the adolescent who will potentially be the leading experts to efficiently study and arouse their imagination and creativity. After they complete their advanced studies in schools, they will turn themselves into AI leading talents or become entrepreneurs with international horizon and reap achievement in AI products. Even in their advanced age, they can still update their overall quality and act as technical consultants in AI development through continuing learning.

The second kind refers to the proficient users who will receive AI education in their childhood and constantly acquire AI knowledge and skills in their juvenile, youthful and prime years. To be specific, these kind of people will be trained to arouse their enthusiasm and curiosity in AI products in childhood, to acquire the knowledge in AI and its products in their juvenile years, to continue their study and research in AI and to be adept in applying AI products in their prime

years, to reserve and enforce their proficiency in operating AI products in their venerable age.

The third kind of people are AI beneficiaries, who just keep acquiring popular knowledge of AI in lifelong education. A conventional mode is specified for them, in each period of which they will just learn about the relevant knowledge in AI and can use AI to elevate their working skills and improve their life. While attending senior middle school, they may be free to choose the courses they prefer and the previous class will be turned into "optional class," during which teacher should focus individualized education, identify the students of expertise and potential in AI, develop their favor and specialty from mega-data and customize the courses for individuals. In both the third and fourth periods, they should also receive the regular training in AI and its products. In this way, AI will seamlessly penetrate into the work and life for this kind of people and bring them more convenience.

(3) The Focus of Talent Cultivation in Intelligence Era

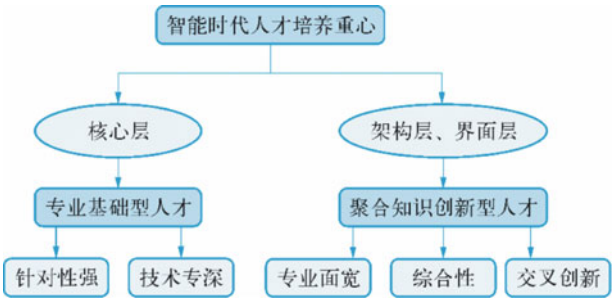
The education in intelligence age adopts a lifetime, universal and incessant mode aiming at developing AI in an all-round way by high-quality professionals who are the indispensable workers in this era. The program for cultivation covers theory, technology, platform and application.

At present, the overall layout for AI industry falls into three level, namely core level, framework level and interface level. The first one involves AI chips, algorithm and relevant hard and software. The second one covers cloud platform and data center, through which people may allocate computer resources, collect and store data and bring about certain functions. The last one enables the functional processing to be linked with users on the basis of resource allocation and achieves realistic functions, such as intelligent perception, pilotless driving, intelligent manufacturing and smart medical health. As shown in Fig. 5.2, the planning layout should be based on the above-mentioned three levels for AI talent cultivation.

To the core level, we should bring up specialized talents who are featured by pertinent specialty, profound expertise, and steady accumulation of professional knowledge. The talents should be able to develop the chips characteristic of low energy consumption, high performance, programmable trait and human brain simulation, and in-depth learning algorithm as well. Only by constantly intensifying basic research and making breakthroughs in chips, fundamental algorithm and theoretical studies can we reap incessant achievements in AI.

The framework level and interface level involve multidisciplinary fields, conducive to cultivate versatile and innovation-aware talents who must acquire wide-range knowledge, strong integrity, interdisciplinary innovation ability and flexible application of compound skills. These two levels aim at cultivating new-type talents who may integrate the functions of mega-data, cloud computing, intelligent hardware into AI application.

The focusing fields in AI industry cover algorithm for machine learning, AI chips, processing of natural language, speech recognition, computer vision,




智能时代人才培养重心：The focus of talent cultivation in the age of intelligence
核心层：Core Layer
架构层、界面层：Architecture layer, interface layer
专业基础人才：Basic professional talents
聚合知识创新性人才：Aggregate knowledge and innovative talents
针对性强：Tobeconciseandtothepoint
技术专深：Deep technology
专业面宽：Wide range of Knowledge
综合性：Synthesis
交叉创新：Cross innovation

**Fig. 5.2** Focus of talent cultivation in intelligence era

technical platform, robot, pilotless driving, UAV, etc. To keep pace with these industrial developing trends, we should focus cultivation of the talents with wide-range knowledge and innovation awareness.

### *5.2.2 Requirements for Talent Cultivation in Intelligence Age*

(1) Competence Requirement

Based on computer science, perception technology and cognitive science and oriented to merge-data from physical space, social space and cyberspace, intelligence science and technology will survey the law of data, reveal intelligence mechanism and make use of intelligence technology to promote technical progress and social development.

Intelligence science and technology aims at cultivating the undergraduates who should acquire the basic knowledge in mathematics, physics, computer and information processing, and interdisciplinary knowledge in psychology, physiology, cognition and life science. The undergraduates should master the basic theory, knowledge, skills and methods of intelligent science and technology. They should also be nurtured in humane atmosphere, trained with scientific thinking, equipped with the ability to

process intelligence information, to study and develop the systems of integrating intelligent behavioral interactions and intelligent apparatus. They should have the awareness of teamwork and the communicative ability, and be capable of updating their knowledge and making innovations so that they are competent to deal with the coming challenges. They should be prepared with the following abilities.

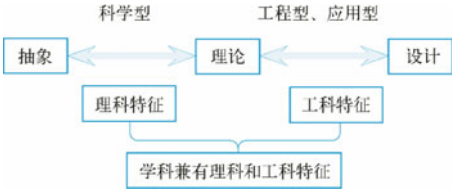
(1) Cognitive ability of systems. They can apply the fundamental principle and methods in intelligence science and technology to systematically analyze where the problems lie from bottom-up and up-bottom sequence, who can know very well the details in different levels of intelligence systems and recognize the intelligent property of the system from macro perspective.
(2) Ability to apply theory of intelligence science. They should master the fundamental principle and methods in theory of intelligence science, cognitive theory and intelligent computing and develop the strong ability to analyze and solve the problems at least in one direction.
(3) Practical ability. They can apply the principle of intelligence theory, intelligence technology and methods to design an intelligent application system so as to solve the problems existing in complicated projects.
(4) Innovation and entrepreneurship. The should have the development experience in a comprehensive project, equipped with fair teamwork and communicative ability.
(5) Ability to be adaptable to society. They should have an acute perception ability to study the new theory and technology in intelligence science and technology, loaded with self-learning ability and steady confidence and adaptable to the new requirements in technical progress and social development.

In addition to strong theoretical knowledge, the postgraduates in intelligence science and technology are required to participate in or take charge of certain research projects and make new innovation. For doctorial candidates, they should develop the ability to find out problems, make theoretical innovation or to take charge of major research or engineering projects in interdisciplinary subjects.

(2) Forms of Intelligence Science and Requirements for Talents

The are three disciplinary forms in intelligence science, namely theory, abstraction and design, for which professionals in AI will correspondingly fall into scientific type, engineering type and applied type. While cultivating these professionals, schools of different functions will offer the courses pertinent to the specific type, as shown in Fig. 5.3.

The talents of scientific type (also called academic type or research-oriented type) focus more abstraction and theoretical studies which are characteristic of scientific property, so they are adept in studies. The professionals of engineering type give consideration to both theory and design, whose work is featured by technical trait and who are suitable for project design and implementation. Mainly emphasizing design, the applied talents should get to know the theory related to system structuring and master description methods of basic issues, who are engineering professionals




抽象：Abastraction
科学型：Science-orientation
理论：Theory
工程型、应用型：Engineering and application
设计：Design
理科特征：Characteristics of science
工科特征：Engineering characteristics
学科兼有理科和工科特征：The subject enjoying the characteristics of science and engineering

**Fig. 5.3** Forms of intelligence science and types of talents

deft at project design and execution and who care more about the external features of the system.

What type of talents will we need in intelligence age? In the "pyramid structure" of talents, a large number of service-oriented people are at the bottom layer. Those who take AI as a tool in innovation and engineering are placed at the second layer. Those who are capable of making new inventions and technologies fall into the third layer, while those at the fourth layer are the first-class experts who are interdisciplinary professionals. Those who are able to invent new AI and control it are, of course, standing at the top layer.

### *5.2.3 Constructing Relevant Specialties in Intelligence Age*

What scientific studies deal with in the twenty-first century are the complicated systems consisting of intelligent components, so the theoretical principles and methods will penetrate into the relevant disciplines. In the talent cultivation programs of relevant subjects, we not only take AI advancement in the relevant fields as the contents of general course in our seminars, but also offer the concerning courses on the in-depth studies and application in AI technology in a systematic way.

In the context of new economic booming propelled by new technology, new type of business and new industry, colleges and universities should cultivate engineering talents who are capable of making innovation, initiating business and integrating multiple disciplines. In February, 2017, Education Ministry of PRC released "Notice of Higher Education Department, Education Ministry on Unfolding Studies and Practice of New Engineering Disciplines." New engineering disciplines correspond the emerging industries, such as AI, intelligent manufacturing, robot, and reform

and upgrading of the traditional engineering disciplines as well. New engineering disciplines focus "five new" research contents, namely new concept of engineering education, new structure of subjects, new patterns of talent cultivation, new teaching quality and new system of classified development.

The disciplinary intersection and penetration is vitally important to the cultivation of AI professionals, and exerts huge influence on philosophical subjects such as aesthetics, logic, ethics, on science category including mathematics, physics, biology, psychology, on engineering disciplines covering computer science and technology, electronics science and technology, control science and engineering, instrument science and technology, and on liberal arts embracing linguistics, applied linguistics. To offer "AI + X" courses, "AI + X" courses for the students of the second major (students holding double bachelor degrees) in particular, is a feasible solution. To take communication technology and automation for an example, AI poses new requirements on the construction of relevant subjects. With regard to traditional engineering subjects, the emerging industries and new economies will call for "new engineering" talents who are powerful in engineering practice and innovation, and outstanding in international competition. They know how to make use of technology in social and economic development and management, acting as a leading role in the coming technology and industries. We will take the following two specialties as case study.

(1) AI's New Requirements for Constructing Relevant Specialties of Telecommunication

The competition in AI industry is competition for talent and knowledge base in the final analysis. Only by employing more scientific workers and constantly enforcing basic research can we gain more AI technology. We'd like to make the following comparison between China and the USA in terms of AI basic research and talent cultivation.

The USA focuses more fundamental studies, as a result of which it is advantageous in cultivating AI professionals who are mostly research-oriented. Specifically, it ha gained a leading and lasting position in such fields as disciplinary construction, patent application, publication of academic papers, high-end research and development talents, venture capital and top-level enterprises. By June, 2017, AI professionals in the USA are twice as many as those in China. Its 1078 AI enterprises employ 78,000 workers, while China's 592 companies engage 39,000 employees.

AI professionals at bottom layers in the USA are 13.8 times of those in China. America takes the lead in four critical areas, including processors (chips), machine learning and application, processing of natural languages, intelligent UAV. But top-level AI talents still fall short of demands.

From the perspective of component proportion ratio of working years of AI talents between China and the USA, the professionals with over 10 years of working experience come up to 50%, whereas China's counterparts are less than 25%. The proportion of those who are with less than 5 years of working experience in USA amounts to 28%, while China's is over 40%. Although China's AI professionals are less than those in Europe and USA, and its employees with the working experience

of over 10 years are much fewer than the said countries, the proportion of new generation of AI professionals in China is rather high and there leaves broad space for AI development as shown in the structural distribution chart of working years of the employees.

Intelligence age will be doom to trigger a new round of industrial revolution. In this context, it is imperative for us to make an early deployment in the cultivation of AI professionals in the educational reform induced by the new industrial revolution. The AI experts used to be the applied talents in colleges, research institutes. Now as more and more hi-tech companies set up robot or AI branches, the professionals in AI or machine learning become blue-chip talents. With some hi-tech enterprises such as Baidu, Alibaba, Tencent, Huawei and DJI, unfolding research and application in AI, more capital will be invested in and more AI professionals will flood into AI commercial fields.

Information communication network is an indispensable part in AI, which will, in turn, exert influence on the network, endowing it with new ability. With the advent of intelligence age, the coming network development will be far beyond people's imagination. The greater influence of AI on network, the more powerful the network will be. As in-depth integration of AI and the future communication is advancing in a speedy way, communication specialty will meet the research requirement and conform to the developing trend with its disciplinary advantage, a supportive subject for intelligence technology that will be the orientation for discipline construction and talent cultivation.

The year of 2017 witnessed the enterprise-class deployment in Aiby Daidu, Alibaba, Tencent, which were marching to vertical field. In addition, all walks of life are increasingly experiencing the impetus of "intelligence." With a great number of hi-tech enterprises pooling capital and equipment into AI, the shortage of AI talents is increasingly severe in AI commercialization. At present, the courses in communication specialty may offer the support for AI talent cultivation to certain extent, but there has left much to be desired.

Cultivation of AI professionals involves an interdisciplinary and systematic project, in which communication technology is a major means to give AI power to full play. Through "pan-communication" curricula system, we may introduce the courses AI algorithm and machine learning to our classroom, which will serve as the supplement to signal process and data communication in traditional communication faculty. To enforce and perfect the present support of communication specialty curricula to AI professional cultivation, we start from the following respects.

(1) As there exists overlapping point between AI communication project, we may conduct studies into machine learning and data mining in random signal, for which we may unfold research in the theory of automatic control, while image processing is conducive to the study of computer vision. We should perfect the courses on those overlapping points so as to help the students to improve their cognition in AI application. The interdisciplinary faculty between computer science and humanities are offered in Stanford University and MIT, which aims to seek for the ways to stimulate students' creativity. These courses may

trigger AI's application in fields of medical health, legal department, financial institutions and media, etc. The establishment of new engineering specialties will be based on Internet and industrial intelligence, which will be merged into other close polytechnic faculties. Moreover, art and design specialties will be admitted into the field of new engineering disciplines so as to AI professionals with broader knowledge.

(2) We may establish some specialized courses related to AI, such as intelligent communication and intellectualized network. Based on new intelligent learning methods forged by Internet platform, interactions in the learning scene will be getting better, the sense of reality will be stronger and more opportunities of teacher-student and student-student coordination will be available. Based on cloud-distribution service and virtual reality as carrier, cloud computing technology will present the specific scene of living and studying from multiple directions and angles in a more comfortable, convenient, efficient and real-time way. The development of emerging teaching technology and tools will re-separate of the spatial-temporal order in classroom, re-establish intercourse order and reconstruct perception way, which will bring about new changes the teaching and learning ways, learning state and leaning context. In addition, through industry–school–research cooperation, the vitality of innovative inspiration will be fully released in "talent, capital, information and technology" so that we may explore and set up innovation platforms for different kinds of studies, various coordinating innovative modes and collaborative innovation, through which we may strengthen our ability to pool more resources and our vitality to make innovation, and accelerate the in-depth industry–school–research merge.

(3) We can associate AI and present research focus of communication, such as intelligent optical network and 5G wireless communication. We may also introduce Software Defined Network control surface into AI and machine learning. In the coming years, data flow will increase by 4 times or over, while the transmission distance of millimeter wave technology sued in 5G communication will be shorter, which will yield more requirements from marginal networks and thousands of terminals connected to Internet of Things will be troubled by this problem. Additionally, as client's demand is at micro-second level, how to respond to client's requirement while client's experience won't be lowered is a challenge for present-day operators. But machine learning can remove this trouble in a better way.

(2) AI New Requirements for Constructing Relevant Automation Specialties

Automation refers to the operation that machines, equipment or system can, according to man's order, perform automatic inspection, information processing, manipulation control to bring about the expected goals, with little participation of man or even no participation. Automation is widely used in such fields as industry, agriculture, military affairs, scientific study, transportation, commerce, medical care and household management. The cultivation of undergraduates involves automation specialty, a subject which exercise control on various kinds of automatic devices and systems, based on the theories of automation and intelligent control and with the technologies in electronics, computer infor-

mation, detection and sensors. To postgraduates, they should major in control science and engineering, which, based on cybernetics, systematology, informatics and AI, deal with the issues of common features, a discipline on how to set up system model, how to analyze its internal part and environmental information and what control and decision to be adopted so as to bring about control objectives. In addition, with regard to different application backgrounds, there are some other relevant specialties on mechanical automation and industrial automation. With the rapid development of theory and technology, intelligence automation has gradually replaced traditional. On one hand, AI is studied by the scientists in the relevant faculties of automation, while the development of automation promotes theoretical innovation in AI on the other. At the end of 2016, the White House released "Artificial Intelligence, Automation, and the Economy," which elaborates the expected influence on economic growth by AI-driven automation, and puts forth the strategy on more AI benefits and lower costs.

Now the global focusing industries are robot, pilotless driving and intelligent manufacturing. As the products yielded by the integration of automation AI, these industries involve the following multidisciplinary overlapping and amalgamation.

(1) Intelligence science and technologies. These disciplines mainly explore the operating mechanism of man's natural intelligence, which take cognition and learning as research objects, study the realization mechanism and methods of intelligent machines. AI will apply these ways in remolding artificial system and develop kinds of AI, endow the system with certain intelligence so that this system can make logical judgment and decide its operating mode according the specific environment and conditions, or acquire certain learning ability and solve the complicated problems through training and leaning. In this way, machines can work for human beings, freeing man from the complicated and fatigue some jobs.
(2) Mechanical design and manufacturing automation. The intersection, penetration and amalgamation between various high technologies and mechanical design and manufacturing bring profound changes in intelligent manufacturing and automation. With the updated design and manufacturing technology, we may apply advanced manufacturing and technical theory and ways to address the headache technical issues in modern engineering projects so as to realize intelligent design and manufacturing.
(3) Information engineering of smart grid. This kind of engineering involves such fields as electrical engineering, energy technology, IT, control technology and computer technology. At present, all the countries intend to build their grids into efficient, clean, safe, reliable, interactive intelligent grids, to turn their equipment of power transmission into intelligent, integral and greening apparatuses. These two trends will bring unprecedented opportunities to the development of relevant specialties.

(4) Human brain science. The generalized brain science deals with the studies into man's brain structure and functions, plus cognitive neuroscience. Now the scientists of different countries extensively focus brain science. For example, deeply affected by Human Genome Project, US government initiated the brain program for exploring the mystery of human brain, followed Europe and Japan and China's similar program is under planning. Although rapid progress has been made in the studies of brian science in recent years, scientists are still making unremitting efforts to further explore the unknown realms.

To offer the general courses, professional theoretical courses and internship courses in automation AI, we should start from the general courses so that students show their interest in the fundamental knowledge in automation and AI. Then they will turn to systematical learning of specialized courses so as to master the core knowledge of automation and Ai and develop certain practical ability. These specialized courses cover "intelligent control," "intelligent meters," "intelligent optimization" and "computational intelligence." In addition, we should put equal emphasis on theory and practice, enforce the construction of internship courses in automation, for which we will include AI elements. For example, we will establish the course of intelligent sensor by cram mining AI into sensors, intelligent controller by merging AI with microcontrollers. Obviously, the general course, specialized theoretical courses and internship courses in automation and AI are badly needed in cultivation of automation professionals in intelligent age.

We should further merge AI and automation specialties with research orientations. In in-depth learning, we will simulate human brain to construct neural network for studies so as to bring about such functions as speech recognition, image identification and processing of natural languages. Moreover, we will infuse automation theory to machines so that they can read information, reflect and make decisions. The integration of mechanical intelligence and automation will enable machine to know what to learn and where to learn, to clearly know the environment and to interact with it so that people can make decision and exercise control over the relevant operation. These fields may be the focuses for automation studies, and will be widely used in the correlation studies. In addition, in the areas of intelligent manufacturing, smart housing and robot, the progress in automatic control and sensors will integrate intelligent operation and intelligent machines, merge people's daily life with intelligent machines, resulting in greatly elevating production efficiency and living standards as well.

## 5.3 Technologies and Modes for Talent Cultivation in Intelligence Age

The coming education will focus students' lifelong learning, creative thinking and ability to be adaptable to the time requirements. "Autonomous learning, creative learning, mutual benefit and share" will be the major themes in the future education.

General education, creative education, emotional education and education on social responsibility will highlight their values in intelligence age, because comprehensive ability is man's distinct advantage over machines. Therefore, creative thinking will become the rigid demand in learning and working, while man-man communication and emotional exchange will be occupational demands, which constitute an indispensable part in education of social responsibility.

### *5.3.1 Reforming the Technologies for Talent Cultivation*

If traditional education is compared to be a "cat," the present Internet education is a 'tigre," while AI adds a pair of wings to the "tigre," As a "winged tigre," education in intelligence age will make full use of such new technologies as image recognition, processing of natural language, in-depth learning, virtual reality, mega-data mining and processing for education, an act that is conducive to talent cultivation. The education in intelligence age will highlight virtual reality and trans-regional education represented by the people-oriented and customized leaning, teaching automation, lively man–machine interaction freedom of objective restrictions.

(1) Individualized and Customized Learning

Through adaptive machine learning technology and students' massive learning data to predict students' future performance, individualized and adaptive learning program may cover the following three parts. (1) To capture and acquire the kinds of students' learning data from various channels, to set up individual learning file and predict students' performance in different subjects. (2) To match the contents to individual student and recommend adaptive learning plan to him so as to improve his learning efficiency. (3) Customize and adaptively adjust individual learning plan on the basis of individual learning performance acquired from the mega-data. In a word, the individualized and customized learning mode aims at displaying different course contents and achieve intelligentized "private customization" on the basis of each learner's proficiency test and training result.

To a coming student, the invisible intelligent "teacher" may offer him "private customization" service in the following areas. (1) To rectify his pronunciation, spelling and grammatical mistakes in language learning, and instruct him how to write logical sentence and passages in the context. (2) To offer tiered reading platform and to recommend suitable reading material to the students of different reading levels by AI and automatically update reading material and reading program based on students' dynamic changes. (3) To construct identifying and optimizing content mode and file knowledge graph so that customers may easily and accurately find out the adaptive or "deficient" knowledge, for whom AI will bring forth customized drills and quizzes and the relevant learning strategy. (4) To offer "learning diagnosis report" at monthly or semester intervals so that students may be aware of their knowledge and ability acquired and make analysis into their own disciplinary advantages and disadvantages, from which they find the proper ways to improve their learning.

In a nutshell, individualized and customized learning technique can make clear students' existing knowledge, ability structure and different learning requirements so as to help both students and teachers to acquire authentic and effective data, which will make students to be aware of their weakness, while teachers may pinpoint the specific conditions, select different teaching objectives and teaching materials, through which teacher are able to practise customized teaching so as to improve teaching pertinency, effectiveness and scientificity.

(2) Intelligent Appraisal of Homework and Test Papers and Audio Evaluation

By virtue of AI technologies in processing of natural language, recognition in speech, character, image and composition of speech and picture, we may exercise automatic scale-based appraisal of homework, test paper, record of natural language and offer individualized feedback as well. The coming automatic homework-checking machines can understand the whole text of homework and written report, make judgment on the accuracy of grammar, logic and contents and offer the proposal for rectification. Through the key uploading system, automatic rectification of the objective items will be completed and then scores will be given in paperless and automatic way. Added to teachers' marks on the subjective items of the test paper, the aggregate scores of a test paper will be given. In the back end, the machine will make analysis into the mega-data, making clear high erroneous rate of certain items and the students of low score. According to students' deficiencies, the machine will bring forth the similar items for students to re-practise. With the development in the technology of automatic homework-rectifying machines, the scores will be more accurate for objective items while improvement will be made in the scoring inaccuracy. In addition, by means of machine vision technique, we may answer the sheet in the way of shooting the key and the machine will automatically identify and offer solutions. The machine will simulate the perception, memory, cognition, analysis, association, judgment, decision-making and establishment of experience and knowledge bank by human brain during the problem-solving process. Similar to human being, machines will improve their problem-solving capacity in constant learning and training.

In terms of speech recognition and appraisal, AI will replace human labor in a rapid and accurate way. For example, while appraising spoken English, machines can quickly evaluate the speech and reveal the inaccurate pronunciation in the audio material. Through repeated appraisal of clients' spoken language, machines can be adept in evaluating the grammar, vocabulary, fluency, pronunciation, listening and reading in the audio material. By means of such learning modules as scene simulation, situational dialogue, pronunciation challenge and practice of prone audio mixing, we will achieve man–machine interaction and improve students' learning efficiency.

(3) Fatigueless and Patient Virtual Teachers

A large amount of teacher's repetitious manual work will be replaced by AI technology. In other words, intelligent machines can substitute teachers to certain extent and even evolve into teachers. In intelligence era, students must "seek for teacher's

assistance" before computer screens, who are called "chip teachers." Never feeling tired and extremely patient, "chip teachers" will repeatedly show the students how to rectify their mistakes in homework, how to consolidate their knowledge, and inspire their creativity. By virtue of intelligent image and character recognition, when students come a crossing problems, what they should do is to write down the title of the problem on their mobile phones or shot it into photograph, and then transmit the title or photograph to AI teachers, who will feed back the key and the way of solving the problem in real time.

Apart from graphical user interface (GUI), virtual reality (VR) and augmented reality (AR) will further "personalize" the personality attribute of AI teachers, making them looking more like the real persons. In the virtual classroom that is approximate to the true one, students will accept the individualized instruction from AI teacher, through which they will dramatically improve their learning efficiency. The interdisciplinary subjects, such as simulation technique which is integrated with VR and AR, computer graphics, man–machine interface, multimedia, sensor technique and network technology, will generate a three-dimensional virtual world through simulation, providing customers with visual simulation, which makes users feel immersive in the real scene and observe the three-dimensional space in real time and without restraint. In addition to personalization of teachers, VR and AR will concretize teaching contents. With the help of VR and AR, students can interact not only with teachers but also with knowledge in the coming education, in which every respect of knowledge may be vertically presented, making students immersive in a particular scene for their learning. VR and AR will be applied in the teaching of English, biology, medicine, geography, physics and history as well as in driver training, which is indeed an indispensable learning mode in the future. With many advantages, VR and AR will enable students to acquire necessary knowledge and skills.

(1) Perfect Representation of Spatial Relation and Internal Structure of Matters

The representation is shown in chemical molecular geometry and geometric spatial relation, etc. The three-dimensional simulation technique of VR and AR will enable students to get a better understanding of matter's internal structure and the concept of spatial relation in those subjects. For example, some scholars put up three virtual learning scenes in Second Life for students to learn about chemical concept, in which students may turn over chemical molecules by such interactive devices as mouse and keyboard in the virtual reality so that they may gain a better understanding of molecular structure.

(2) Simulation to Particular Scene

The commonly seen simulation scene mainly represents the setting that there doesn't exist in real life or that man is inaccessible to, such as historical scene or dangerous scene. The verisimilar scene will offer students immersive experience, an act that will easily arouse students' learning enthusiasm. In the lecture of European history during the First World War, students will be ardent and active in discussions and exchange of ideas if they are thrown into virtual scenes.

(3) Simulation of Skill Operation

After some researchers make a comparison of police training between virtual environment and realistic scene, they discover that the acquired knowledge and skills in virtual scene are as effective as the transferring results of traditional training in realistic scene. In addition, some researchers explore the application of virtual reality in dance teaching, a result of which makes them convincing that the teaching based on such technique not only greatly reduces the cost, but also settles the spatial-temporal restraint in traditional teaching. Moreover, in medical education, such immersive video processing technologies as VR, AR and three-dimensional holographic imaging will play an interactive role in medical training, construct high-precision and high-resolution virtual scene. If exquisite VR and force feedback are adopted, we can achieve three-dimensional immersive visualization in the anatomic form of major human organs (heart, liver, skeleton and muscle), and conduct teaching interaction through force feedback. We can also simulate the details of surgical operation, turn the figurative actions into the virtual scene within reach, and perform simulating exercises with force-feedback apparatus.

(4) To Intensify Students' Learning Motives

Virtual learning environment may help elevate students' learning motives, realizing "entertaining learning." Through emulational environment, such technique will bring students the immersive experience, an experience that makes students feel that they are in the learning environment of virtual reality rather than in the realistic environment. In traditional classroom teaching, the students with low learning motives will be prone to disperse their learning attention because of some classroom environment factors, whereas the learning environment of virtual reality offers them the opportunities to conduct interactions and gives them real-time feedback. Such immersive interactive feedback brings students intense sense of immediacy, which greatly arouses their enthusiasm in learning. Moreover, "one-to-many" teaching mode in traditional classroom makes students feel deficient of emotional requirements, whereas the learning environment of virtual reality brings them a sense of "one-to-one" care, an psychological experience that motivates their initiative in learning.

(4) Intermedia Teaching Environment for Overall Control of Learner's Mood

Through video processing-based action and emotion-capturing and recognizing technique, plus infrared ray-based non-touchable heartbeat detecting technology, AI will better control students' emotion and mental state in teaching. In other words, in particular teaching context, AI can capture the changes of human facial expression and heartbeat so that AI may make real-time judgment on learner's emotion and response, keep track of their facial expression and heart rate to predict and understand students' reaction to teaching contents. Those physiological signals make AI and mankind work tacitly, which may timely rectify teaching modes and ways.

Speech synthesis technique is very critical in realization of man–machine audio interactions in AI realm, which will also play important role in constructing closed teaching environment. For example, the virtual anchor in "Penguin FM" makes use

of speech synthesis technique to bring about more intimate and fluent man–machine interactions. To improve the fluency of synthetized speech, Tencent adopts in-depth module in acoustics and rhyme in its speech synthesis technique, which makes the pronunciation of the synthetized speech sounding natural, distinct and fluent in rhyme and which can be customized in light of customer's specific requirements. Different speech may improve students' learning interest and meet the individualized demands of users as well. In addition, Tencent's speech synthesis technique may help the special groups of people to unfolding learning. To the people who have lost their linguistic competence, this technique can input the words to be expressed into the experience platform or application system, in which the words will be changed into speech.

In intelligence age, people can even conduct man–machine interactions through brain wave, and bring about closed-ring teaching environment. When man generates an idea in his brain, he has to spend much time to change the idea into words, audio, picture or video, but now he can shorten the transfer time by brain wave and transmit his idea to other party, a technique that intuitively represents and reconstruct man's idea by virtue of brain wave.

(5) Trans-school and Transnational Education

The education in intelligence age will further break the traditional regional limits and resource limits, because the duplication of educational resources costs little and quality educational resources are shared by all the people. The unbalanced distribution of educational resources at present day is, in essence, the uneven deployment of quality teachers, whereas mega-data bank and the strategy of sharing educational resources will be a solution to this problem. AI will bring about knowledge structuralization of educational industry and digitalization of teaching contents, and forge transnational "wisdom classroom," by which the optimized educational resources will be transmitted to the whole country and global underdeveloped regions. In this way, "wisdom campus" will be founded and AI will be applied in the whole process of trans-school and transnational teaching, management and resource accumulation.

### *5.3.2 Transforming Talent Cultivation Modes*

Internet is changing our lifestyle in a reversing way, and exerting influence on education. In essence, Internet means interconnection, making people ignore the distance between one man and the other. By virtue of Internet, everybody may be free to select various on-line educational resources in any place. If the restraint of coverage by Internet infrastructure at present stage is removed, we may hold that Internet has already achieved "No social distinctions in teaching" as advocated by Confucius, enabling everyone the opportunity to receive education.

However, Internet hasn't fundamentally changed educational modes and contents in that education is still directed by teachers and in classroom, they impart knowl-

edge to students (including actual classroom, network classroom, and practical classroom). As the beneficial experience for years of quality teachers, their individualized teaching to different students, their personal attraction and their patient and instructive attitude cannot be duplicated and replaced, plus the their finite energy, quality teachers and quality educational resources become extremely scarce. However, such scarcity breeds three defects in traditional education, namely low teaching efficiency, high tuition and inequity. To make up for the three defects, we should endeavor to promote educational development with AI technology.

AI will lower the costs of educatees, as compared with cultivation of experienced teachers, a new technology that will duplicate unlimited outstanding assistants, teachers, supervisors who will exert influence on every respect of human life. In the near future, education will be no longer limited to only classrooms and educational modes will be changed in teaching materials and teaching methods.

(1) Dramatical Elevation of Teaching Efficiency

In the initial stage of intelligence age, AI will give full play to its advantages, record the learning result of each student, which will be the data for assistants to analyze and serve as conclusion for teachers. At present, some training institutions have developed AI assistants. Based on the information (such as student's personality, the mastery of relevant knowledge and learning efficiency) provided by assistants, teachers will offer pertinent contents to individual student, which results in the best teaching effect. With development of AI industry, "AI partner" will be available to accompany a learner and record his lifetime data. The partner will collect more complete data about a person and reveal more his information that is generally ignored in daily life so that people may better understand this person. Moreover, this "AI partner" will assist every student in knowing his acquired knowledge in a comprehensive and accurate way so as work out the pertinent learning plan and put forth proposal for growth of each student. It will get better knowledge of a student's personality, disposition and hobbies than the man himself. At this stage, AI cannot change the educational modes and the scenes of occurrence, but it makes teaching more effective for both teachers and students. Similarly, AI at this stage cannot strikingly transform educational contents and means, but the high teaching efficiency will lead to further width and depth of learning contents. This situation requires schools, universities in particular, to accelerate the speed of cultivating compound and specialized innovation talents, who are more aspiring and creative, bringing core competitiveness to the country.

(2) Students: the Focus of Talent Cultivation

The time for teaching and learning is finite, but AI experience can be share. In the intermediate stage, every AI teacher may share and learn from massive experience (mega-data) so as to improve teaching and learning, approaching to Confucian standards "great teacher" and "model teacher of all ages." Every teacher dreams of becoming a great teacher and he/she may realize his/her dream at low cost during this stage. Moreover, he/she may meet the private and individualized requirements of

the students by offering them customized teaching, a move that brings about education equity. During this stage, not much changes are made in contents, but education providers offer students AI teachers rather than human teachers. As AI teachers offer quality teaching to students who study at low costs, educational focus turns from "teaching" to "learning." Only by cherishing the determination "One is never too old to learn" will he/she acquire whatever knowledge he/she desires at the most efficient route and way suitable to himself/herself. As the width and depth of knowledge is no longer confined to "teaching," teaching contents and objectives will center around cultivating innovation-aware talents who are motive and ready in learning.

(3) Reversion of Teaching Contents and Teaching Modes

When AI develops to advanced stage, it will transform its role from external tool into internal tool, becoming an organic part of everybody. It will be possible that man is willing to integrate himself with AI, through with man and machine mutually enforce so that man can acquire the ability that is beyond his reach at present day and becomes "super" mankind. Thus the communication between "super" man and AI will be more fluent, just as man obtains information by his eyes and ears. In this context, enormous changes will take place in educational modes and contents as "super" man will no long need to memorize various kinds complicated knowledge and the trivial work that man is not adept in doing will be done by AI machines. At that time, "super" man acquires knowledge as quickly as a book is downloaded from a computer. When the time for memorizing a book is equal to the time needed for downloading the book, it will be amazingly easy for man to acquired extensive and profound knowledge. The width and depth of "super" man's knowledge has got nothing to do with either "teaching" or "learning." At this stage, IQ, EQ, personality and hobby of "super" man will be identical with one another because they share the knowledge in the same width and depth. What a "super" man should do is to learn how to apply and control the AI machine that is integrated with himself and to complete the creative work where AI is weaker than man. In addition, how to maintain the intuition, perceptional knowledge and individuality peculiar to man will be the important part in education during this stage.

(4) Alteration of Assessment Methods

Throughout all ages, test has been the major means for evaluating students' learning effect. But the assessment mainly focuses the memory of knowledge and the routine methods for solving problems. At present, such archaic and inefficient appraisal means remains to be people's favor. However, AI is expected to reverse this way in form and contents and evaluate students' performance in a more accurate way. In terms of form, the ubiquitous "AI partner" will thoroughly and precisely record a student's whole learning process, pertinently test student's knowledge and skills, analyze his loopholes so as to formulate learning plan to make up for the shortage. Every student will be clear what he has learnt, what he has mastered and what he has ignored. This assessment mode will eliminate the final examination for every semester and the certificate tests on proficiency of certain skills. With regard to the

contents, to the "super" man of brain-machine integration, the memory of knowledge points and routine methods for solving problems will be as easy and quick as man downloads a book to his computer from Internet, which will be no longer the contents for learning. The open, comprehensive and interdisciplinary contents for assessment will replaced the existing standardized contents in the examination.

### *5.3.3 Emergence of Socialized and Familial Education*

(1) Socialized education denotes such education that in the context of particular social and cultural environment, individual is taught to develop his social ability through social interaction and perform his social responsibility. Socialized education emphasizes interaction between learning individual and society, who presents different forms at each life stage. When he is a student, he may join in social interaction through various patterns of social practice organized by schools so that he may acquire the knowledge for different social roles. When he becomes an employee upon graduation, socialized education for individual will make him contact and acquire the knowledge and moral norms necessary for social life on one hand, and he should pursue self-learning of specialized knowledge in occupational training institutions.

At present, socialized teaching pattern is featured by individual–social interaction, which is completed in the context of authentic physical space and time. For example, while attending social practice, students would, organized by schools, receive socialized education in the particular time and place and through the interaction with real persons, so is the individual occupational training. In intelligence age, with such technologies as cloud computing, mega-data, machine vision, processing of natural language, emotion computing and AI technique represented by VR and AR, socialized education for individuals will break the restraint of physical space and time. Though the terminal devices such as VR and AR equipment, individuals can gain access to cloud-service platform which is based on intelligent education to fetch cloud-end socialized educational resources, and receive education at any time and at place in the immersive virtual social scenes remolded by cloud-end system, a mode which, free from any spatial-temporal limits, provides socialized education beyond the reach of traditional pattern.

Based on the different stages of socialized education, such education is characteristic of the following respects in intelligence age.

Socialized education in intelligence age will highly depend on cloud-service platform based on AI education. On cloud-service platform amassing such technologies as cloud computing, mega-data analysis, machine vision, processing of natural language, emotional computing, VR and AR, socialized education offers the corresponding teaching contents prepared with relevant technologies to individuals or group of different requirements. Through rapid and reliable Internet or mobile Inter-

net, individuals or groups may purchase the education service or log in cloud-end education platform for the service.

For the students who are still attending schools, the typical socialized education based on cloud-service platform can be described as the following. Individuals or groups organized by schools log in the cloud-service platform for education service of social practice purchased previously, and then equipped themselves with VR/VA devices. With the activity going on, students may conduct various activities in the virtual scenes simulated by VR/AR, including visits, communication with teachers and other students or completion of certain tasks. In the meantime, mega-data analysis system will record different representations of the students and make analysis into their activities, and automatic bring out the summary on each student's performance, encouragement and proposals after the activity is over.

To individual occupational education, the typical education based on cloud-service platform can be described as the following. Similar to the social activity attended by students, the individuals or groups for occupational training log in the cloud-service platform for occupational education service, and then equipped themselves with VR/VA devices. If they have participated in the previous training, mega-data analysis system will show individual performance in the past training and then put forth proposal for successive learning or recommend some focusing points in initiative way, or add some contents pertinent to learner's weak points. During the training, the system will visualize the knowledge points, providing interactive questions and answers, and recording learner's performance on certain knowledge points, which will serve as base for successive learning proposal or learning contents. When the training is over, learners may consult the system on certain questions by audio means and the system will offer the keys by virtue of speech recognition, semantics analysis and intelligent Q&A in the forms of synthesized speech and graphs at VR/AR terminals.

(2) Familial Education in Intelligence Age

Different from school and social education, family-based education mainly involves the influence of parents' words and deeds. By virtue of AI, apart from specialized education and occupational training, the above-mentioned intelligent educational service platforms can also support family-based education, and it will be effective even if parents are absent from the scenes.

In familial education, children usually show their puzzlement and curiosity, for which parents tell their children the reasons and clear up the confusion. In intelligence age, as intelligent Q&A system is highly reliable, children will get the key or solution through cloud-end-based system, from which children can acquire the key and solution more comprehensive, specialized and liberal than those given by their parents. If such system is merged with VR and AR technology, the answers will be more vivid, intuitive and visual, plunging children into an immersive environment. In addition, through cloud-end-based machine vision and speech recognition technologies, the machine may automatically identify children's speech and deeds. It will commend the good manners of the children in real time, whereas it will also criticize the undesirable manners and rectify children's improper words and deeds.

In the absence of parents, intelligent machines can offer favorable familial education, help children to form their correct view of life, values and outlook. Moreover, when AI develops to certain extent, virtual parents who are verisimilar to real parents in character and temperament will be modeled in cloud-end system after it analyzes the daily speech and deeds of real persons. In the shortage of real parents, virtual parents will accompany the children in the form of AR virtual persons or life-like robots. Simulating the words and deeds of real parents, the virtual parents or robots may talk with the children and interact with them.

## Bibliography

Al-Hmouz, A., J. Shen, and R. Alhmouz, et al. 2016. Modeling and simulation of an Adaptive Neuro-Fuzzy Inference System (ANFIS) for mobile learning. *IEEE Transactions on Learning Technologies*, 5(3).

Bertram, J., J. Moskaliuk, and U. Cress. 2015. Virtual training: Making reality work?. *Computers in Human Behavior* 43.

Chan, J.C.P., H. Leung, J.K.T. Tang, et al. 2011. A virtual reality dance training system using motion capture technology. *IEEE Transactions on Learning Technologies* 4(2).

Chen Wen Qian, Li Kai Fu. 2017. Ren Gong Zhi Neng Shi Dai De Jiao Yu, Hai Zi Gai Xue Xi Shen Me? (Education in the era of artificial intelligence, what should children learn?). (20170507) [20170915]. http://baijiahao.baidu.com/s?id=1566665748623306&wfr=spider&for=pc.

Cheng Si Wei. 1999. Fu Za Ke Xue Yu Guan Li (Complex science and management). *Journal of Chinese Academy of Sciences*, no. 14.

Cui Wei. 2016.“ Hu Lian Wang +” Bei Jing Xia Wo Guo Chuan Tong Jiao Yu Zhuan Xing Yan Jiu (Research on transformation of traditional education in China under the background of “Internet +”). *Economy and Culture of Borderland*, no. 3.

Cai Su, Zhang Han. 2017. VR/AR Jiao Yu Ying Yong An Li Ji Fa Zhan Qu Shi (VR/AR education application cases and development trend). *Digitalized Education*, no. 3.

Denardi, K. 2016. From teaching robot to intelligent tutor system, AI is changing education. (20160923) [20170915]. https://www.meritalk.com/articles/from-teaching-robots-to-intelligent-tutor-systems-ai-is-changing-education/.

Emanuel, E.J. 2013. Online education: Moocs taken by educated few. *Nature*, 503 (7476).

Fan Yun Liu. 2013. Ren Cai Zhi Wo Jian—Ren Cai Zhi Wo Jian—Qian Tan Zhuan Ye Xing Yu Fu He Xing Ren Cai (Opinions on talents—On professional and interdisciplinary talents). *Society and Science*, no. 3.

Guo Wu Yuan Guan Yu Yin Fa Xin Yi Dai Ren Gong Zhi Neng Fa Zhan Gui Hua De Tong Zhi (The state council has issued a notice on the issuance of plans for the development of a new generation of artificial intelligence). (20170720) [20170915]. http://www.gov.cn/zhengce/content/201707/20/content_5211996.htm.

Guo Fang Zhong, and Yi Ke Guo. 2016. Lun Fu Za (The theory of complex). Shanghai: Shanghai University Press.

Goel, A. 2017. Editorial: AI education for the world. *AI Magazine*, 38 (2). https://aaai.org/ojs/index.php/aimagazine/article/view/2740.

Guilherme, A. 2017. AI and education: The importance of teacher and student relations. *AI & Society*, 4: 18[20171005]. http://xueshu.baidu.com/s?wd=paperuri%3A%28df07bef013f427061bc997ab49f5654e%29&filter=sc_long_sign&tn=SE_xueshusource_2kduw22v&sc_vurl=http://%3A%2F%2Flink.springer.com%2F10.1007%2Fs0014601706938&ie=utf8&sc_us=4186827741846504738.

Hu Lian Wang Jiao Yu Zhong Xin. 2017. AI Fu Neng Jiao Yu, Ren Men Jiang Jin Ru Zhong Shen Xue Xi Jie Duan (AI empowers education, and people go into lifelong learning). (20170802) [20170915]. http://www.sohu.com/a/161637101_99950984.

iEDU, Zi Tou, Ju Ren, and Le Bu. 2017. Ren Gong Zhi Neng + Jiao Yu Wei Lai Yi Lai (The future of artificial intelligence + education is here). (20170727) [20170915]. http://www.sohu.com/a/160244154_99938903.

Kurzweil, Ray. 2005. The singularity is near—20145, when computer intelligence surpass that of Mankind. *Penguin Group*.

Kandlhofer, M., G. Steinbauer, and S. Hirschmuglgaisch, et al. 2016. Artificial intelligence and computer science in education: from kindergarten to university. In: *2016 IEEE, Frontiers in Education Conference (FIE)*. IEEE.

Li Zhi Gang. 2017. Zhi Neng Yu Yin: Cong Jiao Hu Ge Ming Dao Ren Gong Zhi Neng Ru Kou (Intelligent voice: From interactive revolution to artificial intelligence entrance). *Appliance*, no. 1.

Lian Yi Ting, Yang Da Chun. 2017. Qiang Zhan Ren Gong Zhi Neng Shi Dai De Ren Cai Pei Yang Zhan Lüe Zhi Gao Dian—Wu Xi Ke Ji Zhi Ye Xue Yuan Zhi Neng Hua Zhuan Xing De Shi Jian Yu Tan Suo (Seize the strategic commanding point of talent cultivation in the era of artificial intelligence—The practice and exploration of intelligent transformation of wuxi vocational college of science and technology). *China Youth Daily*, 20170703.

Ling Ying. 2017. Quan Qiu AI Ling Yu Ren Cai Bao Gao (2017 global AI talent report). (20170711) [20190915]. http://b2b.toocle.com/detail6404747.html.

Liu Lian, Sun Hui Jia. 2014. Xu Ni Xian Shi Ji Shu Zai Wu Dao Jiao Xue Zhong De Ying Yong Xian Zhuang He She Ji Yao Qiu (The application status and design requirements of virtual reality technology in dance teaching). 2014. The application status and design requirements of virtual reality technology in dance teaching. *China Educational Technology*, no. 6.

Luckin, R., W. Holmes, and M. Griffiths et al. 2017. Intelligence unleashed: an argument for AI in education. [20170915]. https://www.pearson.com/corporate/about-pearson/innovation/smarter-digital-tools/intelligence-unleashed.html.

Ma Yu Ping, Yi Zhi Liang. 2014. Hu Lian Wang Jiao Yu Ying Zhu Li Yu Chuan Tong Jiao Yu Fa Zhan (Internet education should help the development of traditional education). CO-Operative Economy & Science, no. 16.

Merchant, Z., E.T. Goetz, and W. Keeneykennicutt et al. 2013. Exploring 3D virtual reality technology for spatial ability and chemistry achievement. *Journal of Computer Assisted Learning* 29 (6).

Morgan, E.J. 2013. Virtual worlds: Integrating second life into the history classroom. *The History Teacher* 46 (4).

Qia Ke. 2017. AI Neng Da Bai Ke Jie Hai Neng Tiao Zhan Gao Kao Zhuang Yuan, Xue Ba Jun Yao Kao Aidam Zhu Li Jiao Yu Hang Ye Jin Hua (AI can beat ke jie and challenge the top scorer in the college entrance examination. Students with excellent performance should rely on Aidam to help the evolution of education industry). (20170610) [20170915]. http://www.sohu.com/a/147693779_613239.

Qian Ying Yi. 2017. Chuang Xin Ren Cai Jiao Yu—Can Shi Jiang Tang Di Yi Qi (Education—The first session of the senate). (20170609) [20170915]. http://www.sem.tsinghua.edu.cn/semYZSDcn/8034.html.

Qu Ting, Dai Lin Jie. 2017. Ren Gong Zhi Neng Huo Dai Lai Jiao Yu Zi Yuan Chong Xin Xi Pai (Artificial intelligence or bring education resources reshuffle). (20170728) [20170801]. http://news.xinhuanet.com/mrdx/201707/28/c_136480116.htm.

Roll, I., and R. Wylie. 2016. Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education* 26 (2).

Santos, M.E.C., A. Chen, and T. Taketomi et al. 2014. Augmented reality learning experiences: Survey of prototype design and evaluation. *IEEE Transactions on Learning Technologies* 7 (1).

Siau, K. 2017. Impact of artificial intelligence, robotics, and automation on higher education. In *Americas Conference on Information Systems (AMCIS 2017)*. Boston, MA, 10–12 Aug 2017.

Tastimur, C., M. Karakose, and E. Akin. 2016. Improvement of relative accreditation methods based on data mining and artificial intelligence for higher education. In *2016 15th International Conference on IEEE, Information Technology Based Higher Education and Training (ITHET)*.

Teng Xun Yan Jiu Yuan. 2017. Zhong Mei Liang Guo Ren Gong Zhi Neng Chan Ye Fa Zhan Quan Mian Jie Du (A comprehensive interpretation of the development of artificial intelligence industry in China and the United States). (20170803) [20170915]. http://www.sohu.com/a/161923215_651893.

Wang Kun. 2017. Teng Xun You Tu Kai Fang Yu Yin He Cheng Ji Shu Duo Chang Jing Ying Yong Ren Ji Hu Dong Sheng Ji (Tencent youtu open voice synthesis technology multi-scene application of human-computer interaction upgrade). (20170814) [20170915]. http://software.it168.com/a2017/0814/3164/000003164446.shtml.

Wang Zuo Bing. 2017. Ren Gong Zhi Neng Shi Dai De Jiao Yu Ge Ming (*Education revolution in the era of artificial intelligence*). Beijing: Bei Jing Lian He Chu Ban Gong Si.

Wei Yan Chuang Xin. Quan Qiu Ren Gong Zhi Neng Ren Cai Gai Lan (*Overview of global ai talents*). (20170505) [20170915]. http://www.sohu.com/a/138514725_686936.

Wen Hui Jiao Yu. "Xin Gong Ke" Jiang Da Re, Zhe Xie Zhuan Ye Fang Xiang Wei Lai You Qian Tu! ("New engineering course" will be big heat, these professional direction have a future!). (20170616) [20170915]. http://www.vccoo.com/v/m6q185.

Wenger, E. 2014. *Artificial intelligence and tutoring systems: Computational and cognitive approaches to the communication of knowledge*. Nurlington: Morgan Kaufmann.

Wing, J.M. 2006. Computational thinking. *Communications of the ACM* 49 (3).

Witmer, B.G., and M.J. Singer. 1998. Measuring presence in virtual environments: A presence questionnaire. *Presence*: *Teleoperators and Virtual Environments* 7 (3).

Xiao Heng. 2017. Ren Gong Zhi Neng Lai Xi, Zhong Shen Xue Xi Bian Di Kai Hua (When artificial intelligence hits, lifelong learning takes off). (20170122) [20170915]. https://www.douban.com/note/603346992/.

Xu Xiao Chuan. 2016. Xu Ni Xian Shi Ji Shu Zai Jiao Yu Zhong De Ying Yong Xian Zhuang Yu Fa Zhan Qian Jing (Application status and development prospect of virtual reality technology in education). (20160325) [20170915]. http://www.sohu.com/a/65659044_372506.

Zhong Qi, Wei Xin. 2016. AI Jiao Yu: Ren Ji Jiao Hu Yu Ge Xing Hua Xue Xi Yin Ling Chan Ye Bian Ge, Zai Xian Jiao Yu Shi Zhong Yao Tu Po Dian (AI education: Human-computer interaction and personalized learning lead the industrial revolution. Online education is an important breakthrough point). (20160412) [20170915]. http://www.3mbang.com/p91632.html.

Zhu Xuan Qing. 2017. Xue Sheng Shang Chuan Zuo Ye, Xi Tong Zi Dong Pi Gai "Hu Lian Wang +" Ke Cheng Jin Ru Xiao Yuan (Students upload their homework, and the system automatically corrects the "Internet +" course to enter the campus). *Yangzhou Evening News*, 20170610.

# Chapter 6
# Artificial Intelligence and Safety Control

**Jun Lou, Shaorong Xie, Weidong Zhang, Yang Yang, Na Liu, Yan Peng, Huayan Pu, Wei Dai, Ning Cao, Huizi Chen and Jiajia Xie**


J. Lou (✉) · S. Xie · W. Zhang · Y. Yang · N. Liu · Y. Peng · H. Pu · W. Dai · N. Cao · H. Chen · J. Xie
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 20044, China
e-mail: luojun@shu.edu.cn



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_6

**Abstract** Science and technology serve as the impetus of human progress. From the earliest bow-drill fire making to present-day AI, every small step of scientific–technological progress will propel human development by one giant leap. Yet, science is also a "double-edge sword," as proved by human history that the abuse of technology will lead to the loss of freedom, even death to mankind. For example, although nuclear energy brings inexhaustible energy to human beings, nuclear weapon developed by such technology will endanger the security of the people around the world. As time passes, security threat keeps evolving. With the advent of AI, new opportunities are available for safety control. Meanwhile, there have arisen such issues as manipulated politics, fabrication of information, control of public opinions, and infringement of privacy, which will severely endanger human security. For this reason, we should be very prudent in developing AI, persist in attaching equal importance to security and development, and fully recognize the fact that without dead-sure security, there would have been no smooth development. In a word, human intelligence must learn to control AI and make it convoy the development of human society during the process of restructuring security order.

## 6.1 The Evolution of Security Threat

Security issue is a major concern in human society. Traditional security threat mainly involves military, political, and diplomatic fields. Since the mid-twentieth century, the non-traditional security shown in the fields of environment, foodstuff, and economy has aroused widespread concern from international community, for which all the countries work together with international community to bring forth the concepts "environmental security" and "economic security." Since the twenty-first century, the existing security situation has turned to be more intricate and complex and it is tougher for us to deal with. Such issues as "financial security," "energy security," "terrorism," and "information security" have become the focal points for security studies. As peace and development have been the major themes recognized by all the people, safety control has evolved to be extremely critical. While international community is making greater effort in studying traditional security threat, it also attaches importance to the non-traditional security in the fields of economy, information, and ecological state as well as the non-traditional security threat such as terrorism and disease contagion.

### *6.1.1 Evolution of Non-traditional Security Threat*

At the present-day world, the non-traditional security threat with which human society is confronted is widespread and intricated. With the advancement of industrial revolution, as its connotation and its influence on human society are constantly changing, the corresponding concepts and modes on safety control should be updated. The

advent of every new technology will promote the transformation of relevant security concepts and technology of security control.

The technical change in the First Industrial Revolution triggered the security threat related with machinery equipment, machine production, energy reserve, and information transmission, a threat that spurred the generation and development of new-type security control technology. For example, mechanical encryption replaced manual encryption, mainly used in ensuring military security and business communication security. "Enigma," the mechanical cipher machine made in Germany could generate 22 billion key combinations. To decipher, it was a mission impossible with man's decryption. German army put "Enigma" into extensive use in keeping the secret of railway and enterprise, a move that enabled Germany to take the leading position in secret communication technology and to lay a foundation for computer to decipher.

The technical transformation in the Second Industrial Revolution brought security threat to electricity and transportation, but the relevant inventions and applications offered mankind the solutions to those issues. For instance, the application of wireless telegraph on ship enabled the captain to acquire the dynamic shipping information so as to make the proper decisions. The decision made by the captain and the real-time shipping information can reliably be transmitted to shore-based navigation center so that he may timely get the instruction and rescue.

Ever since the Third Industrial Revolution, technical transformation has incurred increasingly severe new-type security issues. For example, overcommitment of pesticide and fertilizer in agriculture gives rise to the issues of foodstuff security and eco-environment security. With regard to those problems, new technology-based security control is being generated to strengthen the defensive ability to deal with security threat. As radio-frequency identification can offer the unique identification to goods, it can be available for safety production and management of various foods and medicines. By virtue of developing the corresponding information management system, people can position and keep track of production, processing, and transportation of foodstuff, achieving the information backtrace of supply chain of foodstuff and medicines. Once issues on food and medicine security arise, people can make upward backtrace to determine where the trouble lies so that they may timely call back the defective products and ensure the security of foodstuff and medicines.

### *6.1.2 Features of Non-traditional Security Threat*

In recent years, with the development of large-scale computing, mega-data, in-depth learning, algorithm and brain-chip, and the drop of computing cost, AI has been developing in rapid speed. Technical breakthroughs are made in information science, control theory, bionics, and computer science, which render increasing intrication of non-traditional security threat.

From its generation, development to solution, non-traditional security threat is transnationally hazardous and calls for the collaboration from international community to deal with it as the threat spreads widely and quickly, bringing inordinate harm

to many countries. In a dozen of years, there occurred Asian Financial Crisis in 1997 and American Subprime Lending Crisis in 2007, which have brought increasingly far-reaching impact on world economy due to the fact the higher internationalization, financial risks are greater. With the development of Internet, the ties among the people in different countries and regions are getting closer, but network virus becomes more rampant. For instance, WannaCry has plagued 300 thousand computers scattered in 150 countries at least, incurring huge economic loss in finance, energy, and medical heath, etc. By virtue of Internet convenience, heads of terrorist in different places may carry out inter-contacts, ordering one or a group of terrorists to take action. Such trans-religious, racial and national acts of terrorism wreak havoc around the world, and anti-terrorism is getting more severe.

The crimes such as malicious programs, various kinds of phishing software, computer virus, and frauds keep emerging endlessly, as shown in large-scale attacks by hackers which lead to increasingly frequent pilferage and disclosure of personal information, including such kinds of privacies as equipment information, account information, information of social intercourses, and network behavioral information. In intelligence age, users' privacy is easily leak, and the fields in network, finance, and medical care are vulnerable to intrusion and attack, as a result of which user's personal information is learnt by the criminals and to the worst case, the personal property and security are endangered by the outlaws.

At present, as forgeries of various data (such as fabrications in audio and visual material, and pictures) are exposed in an increasing frequency, social trust has dropped dramatically, resulting in judicial injustice. In realistic society, courts still take audio records as the conclusive evidence, but Internet and AI can offer the possibility of generated speech as the false proof. Criminals may acquire the data characteristics of simulated speech by AI and then construct those characteristics. In this way, they synthesize the verisimilar audio material. Similarly, they can also fake the authentic pictures and video material on the basis of training data. What is worst, they even produce pseudo-news so as to evoke wars.

In a word, with development of the technologies of mega-data, cloud computing, and AI in an amazing speed, we find the opportunities to address non-traditional security threat on the one hand, and we meet the challenges on the other.

## 6.2 Opportunities and Challenges to Industrial Security Brought by AI

With economic development and continuous increase in population, the security issues in medicine, foodstuff, network, public safety, ecological state, traffic and transportation, and financial affairs arouse the public attention and concern with each passing day. How to deal with the uncertain threat in those fields, how to improve the environment of human development, and how to ensure the security in medical care, foods, urban traffic, and finance turn to be the major issues calling for immediate

solutions at present. As a comprehensive subject based on interdisciplinary interpenetration of computer science, cybernetics, informatics, neurophysiology, psychology, and linguistics provide new solutions to the above-mentioned problems.

### *6.2.1 To Construct Rapid and Precise AI Medical System*

Since 1990s, the issue of medical security has gradually attracted the public attention and concern. In 1999, after American Hygiene Institute released "To Err is Human: Building a Safer Health System," medical security becomes a heated topic. Afterward, further studies point out that medical malpractices not only bring threat to patients' health and life but also incur huge financial losses. After No. WHA 55.18 Resolution was adopted at the 55th Conference of World Health Organization in May 2002, the organization calls on its members to keep close watch on patients' medical security. In April 2006, in collaboration with Health Ministry of China, WHO initiated "Program of Enforcing Security Management Education for Patients." In recent years, with rapid development of medical technology and innovation of medical equipment, great changes have taken place in diagnosis methods. For example, with such advanced medical devices as CT, MRI, and X-ray examination, doctors can make disease assessments in more detailed and accurate way, bring about dynamic monitoring of human physiological pathological state so that they can detect and diagnose many diseases at early state and render timely treatment to the patients. As a result, medical security is dramatically improved, whereas people are still troubled by deficient medical resources and high costs of medical care.

AI is very powerful in mining, organizing, and processing data and capable of making precise analysis and decision so as to reduce the possibility of human errors. By means of AI, medical workers may construct long-term and real-time monitoring system on patients, work out more scientific and safe programs for clinical intelligent diagnosis, and adopt multi-level and versatile technical mean and methods so as to exercise all-round protective, detecting, and responding security measures, ensure intelligent medical system equipped with the function in safety protection, monitoring management, test assessment, and emergency response. If these measure prove effective, such issues as uneven allocation medical resources and heavy medical burden for patients will be alleviated and medical security will be ensured in an overall way. In September 2017, GE brought forth AI-based medical imaging solution, e.g., Centricity Universal Viewer 6.0, which, equipped with intelligent diagnosis function, can assist doctors in automatically marking the suspected nodule on CI image, enabling them to observe the case of suspected nodule, a solution that will effectively guarantee the accuracy and security of medical treatment and greatly improve doctor's efficiency. In the meantime, China has also initiated AI technology in cancer therapy in "Shanghai Tenth Hospital—Watson Cancer AI Consultation Center," which adopts the massive medical literature from Memorial Sloan Kettering Cancer Center and the successful cases of the top cancer therapy hospitals for

in-depth studies so that they may bring forth globally leading AI medical solutions to work out the individualized and precise medical plans or proposals for patients.

In intelligence age, we should practically strengthen application of AI in medical service, integrate patents' data, construct mega-data system, comprehensively deepen mega-data application in medical treatment, see to mega-data used in clinical treatment and scientific studies, and ensure the security of medical data. In 2013, European Union initiated "Human Brain Project." After amassing the global data in neuroscience, the project intends to remold multi-scale brain models and construct information and communication platform. Then, by virtue of AI's powerful ability in data analysis and processing, the medical workers of the project conduct studies in the simulated human body behaviors controlled by brain models in the simulation environment in an attempt to discover the new therapies for brain diseases. In 2015, US Government released "Precision Medicine Initiative," intending to keep track of disease data with mobile equipment, from which doctors may acquire the gene information, electronic medical data and living information of cancer patients and diabetes patients to construct mega-data for medical treatment, enabling everybody to obtain personalized information of his health. In June 2016, Chinese Government promulgated "Guidance to Promoting and Normalizing the Application and Development of Medical Mega-data," which provides medical industry with supportive policy on the one hand and further accelerates the development of this industry on the other. At present, more and more AI medical products are put into used in medical treatment, including mini-intelligent thermometer, surgical robot, wearable monitoring apparatus, etc. Some large companies also pool more funds into AI medical industry. Since 2014, Google has allocated 30% of research funds into medical care and life science and enforced its AI level by merging other AI medical companies. In January 2017, in cooperation with American National Health Service, Google applied in-depth learning to process health service data of US citizens and worked together to develop real-time predicting and pre-warning technology of health conditions. Meanwhile, China's three Internet tycoons, including Tencent, Baidu, and Alibaba, have invested in American AI medical companies, among which Tencent invested 0.155 billion $US into iCarbonX, a company engaged in health care AI. Benefited from Tencent's mature ecosystem and data accumulation of multiple scenes, that company has integrated the health data of genomics and patients' reports, enabling doctors to diagnose the potential nidus of patients in a precise way, a new solution in medical security system.

In intelligence age, we should practically strengthen application of AI in medical service, integrate patents' data, construct mega-data system, comprehensively deepen mega-data application in medical treatment, see to mega-data used in clinical treatment and scientific studies and ensure the security of medical data. In 2013, European Union initiated "Human Brain Project". After amassing the global data in neuroscience, the project intends to remold multi-scale brain models and construct information and communication platform. Then, by virtue of AI's powerful ability in data analysis and processing, the medical workers of the project conduct studies in the simulated human body behaviors controlled by brain models in the simulation environment in an attempt to discover the new therapies for brain diseases. In 2015,

U.S. government released "Precision Medicine Initiative", intending to keep track of disease data with mobile equipment, from which doctors may acquire the gene information, electronic medical data and living information of cancer patients and diabetes patients to construct mega-data for medical treatment, enabling everybody to obtain personalized information of his health. In June, 2016, Chinese Government promulgated "Guidance to Promoting and Normalizing the Application and Development of Medical Mega-data", which provides medical industry with supportive policy on one hand, and further accelerates the development of this industry on the other. At present, more and more AI medical products are put into used in medical treatment, including mini-intelligent thermometer, surgical robot, wearable monitoring apparatus, etc. Some large companies also pool more funds into AI medical industry. Since 2014, Google has allocated 30% of research funds into medical care and life science and enforced its AI level by merging other AI medical companies. In January, 2017, in cooperation with American National Health Service, Google applied in-depth learning to process health service data of U.S. citizens and worked together to develop real-time predicting and pre-warning technology of health conditions. Meanwhile, China's three internet tycoons, including Tencent, Baidu and Alibaba, have invested in American AI medical companies, among which Tencent invested 0.155 billion $U.S. into iCarbonX engaged in health and AI study. Benefited from Tencent's mature eco-system and multi-scenic data accumulation, iCarbonX will integrate health data of genomics and patients' records to perfect images of patients and precise taction so that people can have an in-depth understanding of diseases and provide new solutions for medical security.

As far as AI's application in disease diagnosis and health monitoring management is concerned, there still leaves something to be desired between the present AI development degree and the expected value, mainly shown in the shortage effective data in privacy disclosure, dispersion of samples, patients' symptoms, and gene sequence as well as inadequacy of various biosensors, which lead to insufficiency of AI application in intelligent medical care. In 2013, Britain initiated "care.data," a mega-data platform of medical health that amassed clinical cases of family doctors and hospitals in detailed way that would be used in studying mechanism of diseases, developing new medicines and treatment so that all British people might enjoy quality medical services. However, British medical authorities declared the suspension of "care.data" in July 2016 in that this program was unable to perform the effective communications between decision makers and patients in actual operation. Moreover, most patients were worried that the health data involving their privacy would be disclosed. The centralized storage of health data will indeed aggravate the risks of information disclosure, pilferage, and destruction. In addition, family doctors are required to put patients' clinical cases into practical treatment, and they are obliged to ensure the security of the medical data, whereas the functional departments demand family doctors to transmit the medical data to Health and Social Care Information Center, this situation puts the doctors into dilemma.

Although there still exist problems with medical care, AI has improved medical security to certain degree. With the in-depth AI application in medical sector, management of residents' health information will be gradually normalized, which

not only defines the user permission of medical data but also practically protects the legal interest of the parties involved. The coming innovated medical technologies and equipment will provide people with more efficient and reliable medical security.

### *6.2.2 Construction of Foodstuff Security System with Traceable Information*

With the development of human society and civilization, while people's material life has been dramatically improved, the people's security has been endangered due to the pernicious foods. Besides its direct affect on people's health and living quality, foodstuff security involves social long-term development. In foodstuff, security is complicated issue related to livelihood, for which governments of the world bring forth preventive and strict policies and programs. For example, USA released "Federal Food, Drug, and Cosmetic Act," "Public Health Service Act," and "1958 Food Additives Amendment." Germany brought forth "LFGB" and "Hazard Analysis and Critical Control Point." European Union enacted "EU White Paper on Foodstuff Security." Chinese Government promulgated "Standards for Foodstuff Security and Monitoring Assessment in the Thirteenth Five-Year Plan (2016–2020)" and "'Healthy China'-2030 Program." However, the present situation of foodstuff security does not make us optimistic, as food security issues have successively taken placed in different countries, such as European "Horse Meat Trouble," American "Egg Pollution," British "Event of Mad-Cow Disease," Belgic "Food Pollution by Dioxin," German "Toxic Cucumber," and China's "Melamine Event," etc.

Interest motivation is primarily attributable to the incessant food security issues, and the another reason lies in the ineffective supervision because there are many links in the industrial chain of foods. The industrial chain begins from the plantation or aquaculture of the raw materials, as it goes through such links as the course or fine processing, packing, storage, transportation, sales before the foods are brought to dining tables, during which an oversight in anyone link will lead to food security problem. Generally, as there exist many problems in supervision of foodstuff security, including different standards, sluggish efforts, backward management mode, time delay, and low efficiency, we find ourselves unable to effectively deal with those issues and so we should search new ways to address them. Network technology will play a positive role in constructing a monitoring system, sharing production and operation information, and integrating data of supervision departments. Yet, people's inability to process the generated mega-data will undermine the intelligent monitoring on foodstuff security, resulting in the changes in the security modes.

Food safety is inseparable from effective supervision of every link of the food industry chain. Through exploring the emergency response mechanism of food safety incidents, utilizing the development and application of network and information platform, by monitoring the model library through data monitoring, we will accelerate the development of an electronic food safety supervision system and the construction

of a large database. Strengthening food safety traceability management and whole process monitoring, we establish the government supervision and social supervision of the organic combination of social governance supervision system, so as to build a full traceability of food safety system. In particular, with the in-depth development of big data processing, cloud computing, machine learning, and other intelligent technologies, the adverse situation of traditional food safety prevention and control will be reversed, thus effectively improving the ability and level of food safety assurance.

The in-depth integration of industrial development of foodstuff and "Internet+" based on Internet, cloud computing, mega-data, and Internet of Things will effectively optimize social resources allocation in foodstuff industry, consummate laws and regulation so to address the foodstuff security issue. As supervision on foodstuff security involves many links from raw materials to consumers, mega-data technology highlights "Internet+" in its all-round perception, collection, analysis, and study of massive data and turns it into critical strategic resource and productive element. The source-tracing system on foodstuff security is a typical application of mega-data technology in supervising foodstuff security. For example, France puts forth the whole-link supervision mode "from farm to dining table" in which the data in each link of provision chain will be subject to real-time supervision. Once trouble occurs in certain food, risk managers may quickly initiate network information system to trace, monitor, and confirm the defective food, and they can trace to the fountainhead of the trouble along the provision chain. The USA is equipped with the perfect traceable system, which exercises effective recognition and information supervision over the massive data of each link along the provision chain and through which foodborne diseases are brought under control, and information in foodstuff security is smoothly transmitted to ensure the health of consumers. In June 2010, when Salmonella virus was rampant through the USA, the system traced the eggs produced in Iowa, the fountainhead of the virus. In the following three months, 0.5 billion eggs were called back, a measure that maximumly reduced the scope of virus transmission. Additionally, we can make use of the given data to compare the amalgamation, associate the data, create mode, and judge the effect so that we may raise our ability to perceive food security situation, correlate etiological foods, identify the hidden perils, and trace the source of defective food. For instance, in May 2017, China's "Site-Shop Corporation" applied Baidu AI to forge "Food Security Check" system, with which people may realize online and off-line integration between virtuality and reality, and amalgamation of food material production and sales. By virtue of virtual mode, the system amasses the influencing factors of foodstuff security in different regions to a platform, in which people probe a feasible way to effectively address food security issue at low costs with the technologies, such as genetic testing, biometrics, and AI. In July 2017, PaaS, a food source-tracing platform developed by SinoBay makes use of the technologies of section chain, Internet of Things, and cloud computing to ensure foodstuff security through Mobile Internet and "one-code-for-one-thing" monitoring mode. This platform is superior to financial security system in terms of data loss resistance and source-tracing code forgery resistance.

Moreover, AI will also offer the powerful technical support and security for risk early warning and appraisal of foodstuff. For example, we may use expert system

to analyze and set the grades for evaluation indexes of foodstuff security risks, formulate the associating rules for the dataset of risk evaluation results and generate the corresponding rule base so that we may predict and assess test items and the venture degrees of inspected foods. Another case, in August 2017, Japanese Kewpie Corporation and its partner BrainPad made use of TensorFlow developed by Google to inspect the raw materials for foods to assist foodstuff enterprises in selecting qualified foods, with which people can exercise pre-warning and effective evaluation on the uncontrollable risks of foods. At present, the robot system is trained with 18,000 photographs, in order to construct machine learning mechanism, which can identify the high-quality elements of foods and detect potato ingredients contained in baby foods. As reported by Bloomberg, Deschutes Brewery, an American enterprise, can monitor and trace the important components in beer in real time with AI equipment developed by Microsoft. Once abnormal temperature occurs, the system will raise the alarm so that people may bring about automatic brewing by regulating the parameters in different links.

Foodstuff security not only involves individual health and living quality but also exerts profound influence on long-term social development. Short of foodstuff security, individual person may be endangered. What is worse, unpredictable or collective upheavals may arise, bringing turmoil to the society. Although we have conducted some favorable exploration on foodstuff monitoring and controlling by means of AI, higher demands on AI application and more rigorous requirements on decision-making ability to trace, analyze, and dispose of the events of foodstuff security due to multiple links of security control, high dispersion, wide range of surveillance, and tough concealment of the factors harmful to foods. Therefore, to construct the source-tracing system for foodstuff information by AI technology, we not only exercise strict supervision over different links but also formulate the standards for foodstuff security, ethical norms, laws, and regulations.

### *6.2.3 To Construct the Self-defensive and Active-Assailing Intelligent Network Security System*

Apart from the ties with social, economic, and living sectors, network security is closely related with the security and development of a country. While we are enjoying network facilities, the network is subject to the threats, including unexpected virus, hacker's assail, espionage, and man's misoperation, etc. Therefore, network security arouses the universal concern, for which some measures are taken by such countries as EU, the USA, Japan, Germany, and China in their national security strategy. In July 2016, Council of Europe released "The Directive on Security of Network and Information Systems," which was effective in the following month. This decree requires that the members of EU adopt the unified network security and strategic cooperation for security, share relevant information and carry out risk-based security governance so as to elevate overall network security level. EU also demanded that

the decree be brought into the process of national legislation of the members in 21 months after it was effective and identify the main body scope of each member as stipulated by the decree in 6 months. In February 2016, Obama, then the President of the USA, signed "Cybersecurity National Action Plan" in an attempt to improve American security of its digital space in an all-round way. In July 2017, Harvard University released "Artificial Intelligence and National Security," which asserts that AI and machine learning will cut down the workers needed for specific assignments in network field in that AI may help to check systems, improve automation, and consolidate network defense. In a word, AI will be conducive to national defense through network.

The network boundary will be gradually generalized by such trends as the accesses of billion devices and sensors in Internet, network of things and industry control network, the increasing "man-machine-object" massive data, and the large-scale spread of heterogeneous network. In network security space, a number of problems will be caused by network dynamic topology, controlled openness, large-scale digitalization and source opening of resources, the "low threshold" of physical access. These problems mainly cover gradual presentation of physical access of detectaphones and "pseudo base stations;" disclosure risks of a large amount of information kept in virtual computing platform in cloud service, private data in mobile intelligent terminals as well as the public information involving social, economic and medical sectors, transportation and traffic, and banks stored in different major servers; frequent occurrences of network supervising troubles and network crimes caused by abuse of Internet anonymous communication technology; and enormous challenges brought to network space security due to the rapid spread of false, illegal, and ill-natured information. If we check and process the concealing massive data by manual work, slow operation and low efficiency will make people miss the most favorable timing, resulting in irreplaceable loss. Network space will also be endangered by network viruses which aim at profit making, information stealing and malicious pilferage, hackers' attacks, and servers' loopholes. Moreover, the areas subject to potential attacks will be enlarged, making it more difficult for people to control the inflicted scope due to the fuzzification of network boundary and the popularization of wireless network.

With rapid development of mega-data and cloud computing, AI will be gradually applied in the field of network space security so at to address this problem which cannot be solved by traditional means. To consolidate network security and reliability, people will construct an intelligent network featured by automatic defense, initiative assail, and cooperative work, which is sued to authenticate servers, set up security center, define security zones, detect intrusion, and put auditing to work with network monitoring servers. In addition, they will also establish a linkage platform and simplify the whole network security strategy and deployment. The efficient monitoring network can quickly identify the existing threat and deal with it in effective way, apply AI to ensure network space security by its three functions, including Internet fraud supervision, network attack inception, and information filtration.

Applied in surveilling network fraud, AI can effectively recognize and guard against network swindle. In the past, anti-fraud companies used to strike frauds by

regulatory engines and credit chart, but these methods are prone to be jailbroken by online fraudsters, who can learn how to use regulatory engines by the available resources stolen from network, and shun off the check of credit chart with favorable credits acquired through intrusion of the relevant Web sites. With the help of existing AI, machines can take initiative to obtain information from databank and identify malicious attacks and frauds. For example, the security system of PayPal can intensively analyze transactions in real time by virtue of the consumer's purchase data for more than years, a measure that the machine can not only detect the fraud-suspected signal mode in historical databank but also identify the transaction bills of misoperation. Transaction fraud rate of PayPal is about 0.32%, far lower than the average rate of 1.32% in this trade.

AI is applied to intersect network attacks, for which Internet of Things has done the best job in ensuring network security. According to the forecast report by International Data Corporation, the devices used by global Internet of Things will come up to 30 billion sets by 2020. Due to the shortage of both hardware and software, many devices such as cyber automobiles, industrial sensors, and smart home are not fully secured. Due to enormous devices and fewer resources available, Internet of Things is not effectively protected with traditional means for Internet information security, but AI is able to deal with this tough problem. Based on the historical monitoring data, AI may set up models for equipment network and then find out suspicious acts in the network. For instance, Harvest.ai makes use AI to analyze the acts of critical IP users. Spying out the attacks on users from target network and the changes in critical business system and application programs, the company can identify and obstruct the attacks before hackers steal the important data of customers. In 2015, China's Kuangn Co. successfully intersected "formula" virus by three engines, including AI learning, protocol-depth analysis and open character matching. Computer Science and AI Laboratory of MIT puts forth brand-new AI named "AI2," with which the detection rate of network security is improved in the system by man-machine learning, reaching 85% of accuracy rate in detection of network attacks (2.92 times as many as the similar detecting system for automatic network attack) and low rate of false alarm (far lower than that of the similar network security solutions).

Used in information filtration, AI may exercise self-learning on the undesirable information, further improve the filtration effect, and smother the wicked network events and the dispersion of cacoethic information. Instagram released two kinds of AI-based automatic review filtrators, shielding the offensive comments in the videos, which will reduce spam quantity. Through regulation of search engine algorithm, Google brings forth "fact verification" software to screen network false information. On the basis of users' feedback, "Headline Today" can identify 60% of false information by AI.

In the near future, AI will help network users and administrators to detect, find out, and address network security problems as early as possible and exercise effective control over network so as to ensure its security, reliability, and stable operation in network space. While enjoying the facilities brought by AI, people should be prepared for malignant application of AI by ill-intentional people. Malicious use of

AI will incur some severe consequences, such as vicious misdirection of AI learning system, data fabrication, and hacker's malevolent intrusion into network.

### 6.2.4 To Construct Information-Integrated Intelligent Security Coordination System for Public

With the increase in permanent urban residents, some troubles will be concomitant in the potential pubic security such as criminal acts and terrorist attacks, etc. In different stages of social development, as the threat and peril of public security will present the new features, more strict requirement and wider scope are placed on public security. For instance, prior to the application of network technology, urban security, and control mostly depend on a large number of surveillance and law enforcement personnel. Although progress has been made in investigation, evidence collection and settlement of the sudden criminal acts, the authorities concerned still find that there has left much to desire in the prediction of mass unexpected incidents, information exchange between site and command center and subsequent investigation. With the development and maturity of network technology, people will be more effective in supervising public opinion and feeling, intersecting illegal and criminal information and data, and dealing with public security issue in real time. However, the consequent issues such as classification, identification and treatment of massive information, and security of network data transmission, etc. Generally speaking, there remain some issues to be settled in urban public security, including outmoded security equipment capacity failure of real-time acquisition of live information, deficiency of pre-warning ability, inability to ensure video quality, barriers for people to share trans-regional data, and low utilization rate of data resources, etc.

To elevate urban public security and emergency disposal ability, we should construct intelligent collaborative system for public security to integrate information so as to improve the sharing of public information and the level of processing intelligent information. Moreover, we should realize sharing and integration of cross-departmental, trans-regional and inter-platform information and set up an information-command-site integrated platform to effectively process so as to elevate pre-warning, detection, and prevention of public security. AI advent and development offer us an effective exploring and trial means for ensuring public security, propelling different countries and research institutes to plan and develop AI applications for public security. For example, in 2016, Stanford University released "Artificial Intelligence and Life in 2030," claiming that AI will be deployed in public security system in the typical cities of North America which will help police to survey the crime scene, monitor the potential crimes by CCD cameras, search and rescue the hostage, predict the criminal acts, and assist people in making decisions. In its "Preparing for the Future Artificial Intelligence" released in 2016, the White House asserts that technical development will bring challenges to human beings, calling on government to exercise overall surveillance on AI and its products so as

to further improve public security. In addition, with regard to the existing problems on the prevention and control public security issues, the USA has brought a series of AI products and solutions on, including pedestrian detection, facial recognition, vehicle test and identification and intelligent processing, and analytical technology, etc. In July 2016, Hexagon Metrology AB, in cooperation with Huawei, brought forth cloud platform of emergency command for safe cities. Equipped with reliable and comprehensive management competence, this system can change massive data into intelligent information, enabling security departments to take control of every part of public security in dynamic and real-time way so that they may make quicker and more reasonable decisions. Previously, the intelligent solutions provided by Hexagon Metrology AB were applied in 2012 London Olympic Games, the inauguration ceremonies of President Bush and President Obama. In October 2017, Intel put forth NVR-based- and IPC-based-video-structuralization solutions. By integrating ICE Tech in-depth learning, Intel processors, AI learning processing and controllers, these solutions can precisely identify and assort the models, colors, and number plates of over 1500 vehicles, through which people acquire highly reliable and stable intelligent security system. In 2017, China's Face++ brought forth a set of intelligent security solutions marked by "Integration of Three Precautions" and "Cloud-end + Terminal." Through construction of an intelligent platform amassing mega-data prediction, intelligent pre-warning and network-based preventive function, these two solutions address such issues as the inadequacy of information sharing, shortage of pre-warning and predictive ability, interconnected barrier between the accident site and commanding center and low application of intelligent linkage. In addition, they can also apply AI to further mine public information so as to prevent from happening major incidents of public security. For instance, people may conduct in-depth analysis into the webcam data in public places and adopt countermeasures by consulting the successful cases to guard against trampling events. In March 2016, by virtue of mining analytical map track to search data and population density, Baidu developed a system that can predict resident aggregation of target area, which may help to prevent the threats to public security triggered by the said aggregation.

The further development of AI may make it possible to effectively solve the emerging issues of endangering public security. Whether the intelligent security system or the system which is used to predict and prevent trampling incidents, AI will change the original concepts of public security, transforming "after-event disposal" to "pre-warning" and "underway alarm." The updated technologies such as video structuralization and machine learning are applied in the treatment and interpretation of video data. To be specific, these technologies cover three links, e.g., object detection, track, and attribute. Mega-data can offer powerful ability in databank management and distributed computing, including large-scale distributed computing, data mining, and massive data management.

With the popularization and development of network technology, AI highlights its advantages with the subsequent issues in the threat and detriment of public security. For example, AI may exercise real-time monitoring the negative information suddenly released by some Web sites, keep track of its propagation paths, and find out its critical nodes. With facial analytical technique, plus AI software, Israel's Facep-

tion can detect man's face in the photograph or video, then assort the men in the photographs by 15 items concerning personality, types, and predictable parameters, by which security departments can keep track of terrorists or criminals. Another example, mega-data technology can perform self-learning over network undesirable information, through which it improves its ability to filtrate information, check abominable network events, and obstruct transmission of ill-natured information. American Dextro dedicates itself to interpreting the audio and visual information in videos by machine learning, and it can confirm the information and filtrate the illegal video in 300 ms after the video is transmitted. This technology is very critical to Facebook which boasts over billion users because the illegal video causes tremendous infaust impact. The in-depth learning-based NetEase Shield puts forth by NetEase Co. enables computers to acquire certain ability to identify photographs and pictures by learning a great amount of sample data and it can recognize, assort, and filtrate contents in the absence of sample bank on special features. Baidu's analytical technology on video contents can conduct multi-dimensional intelligent analysis into speech, typescript, man's face and object by mega-data bank, support video assortment, extraction of video elements, withdrawal of key words and user-defined model, suitable for verification of pornographic and terrorist videos.

Applied in constructing intelligent collaborative system on public security-aided integrated information may effectively elevate the capacity of monitoring, prewarning, and emergency disposal of unexpected events and public occurrences, by which overall urban public security is improved. In addition, due to the uncertainty and complexity of objects that are under monitoring, non-standardized and incompatible security equipment, difficulty in information supervision, the requirements in pro-active pre-warning, and in promptness and accuracy of predicting, preventing, and striking criminal acts, higher functions are demanded on AI applications in public security. At present, further studies are underway in this field.

### *6.2.5 To Construct Precise and Dynamic Prediction System for Ecological State*

In addition to deteriorating our production and living environment, destruction of eco-environment is detrimental to sustainable development and even to human survival. Xin Jinping, President of the People's Republic of China, repeatedly asserts "Verdant mountains and limpid rivers are our gold mines." However, in the past 100 years, while creating magical material wealth, human beings have severely destructed the eco-environment for their survival. The following are the typical cases of global and regional ecological incidents which have brought tremendous calamities to human beings.

1930: Meuse Valley Smog in Belgium
1943: Photochemical Smog in Los Angeles, the USA
1952: Smog Accident in London, Britain

1953–1956: Mercury Pollution Event in Minamata Bay, Japan
1984: Bhopal Gas-Leakage Event in India
1986: Chernobyl Nuclear Disaster, the former Soviet Union.

Nowadays, all the countries around the world should join their hands to deal with ten ecological problems, including climate warming, ozone depletion, reduction in biodiversity, rampant acid rain, sharp shrinkage of forest, desertification, air pollution, water contamination, marine pollution, and solid waste contamination.

The protection of eco-environment is a global systematic project, which no single or region is able to accomplish, but calls for the cooperation of different countries. By virtue of diversified eco-data in the surveilled area gathered by the network platform based on eco-observation integration and through the processing, mining, and comprehensive analysis of mega-data, people will make clear the causes of ecological change and its consequence so that they may construct a global, precise, and dynamic eco-security system, predict the health conditions of eco-system and the trend of environmental changes in real-time way. With these efforts made and measures taken, they will effectively ensure the security of bio-diversification and the eco-environment.

Different countries are intensifying AI application in dealing with the increasingly severe eco-environment. Now, as monitoring of eco-environment has resorted to information network, we may apply AI to analyze and integrate massive data and unfold data-intensive studies, by which we may effectively exercise long-term dynamic monitoring on eco-environment and climate change. For example, traditional prediction of eco-environment mainly depends on network technology of information positioning observation, which is applied in collecting the comprehensive data of regional plants, animals, atmosphere, water, soil, and pollutants. These observation networks collect numerous data covering a wide range of contents and bearing the typical features of eco-environmental mega-data which make it possible for people to know the health of eco-environment so as to carry out efficient, precise, and real-time protection. National Eco-Observation Network of the USA is a platform for ecological studies and education, consisting of land observation and remote observation, of which land observation items cover 500 sorts, including climate, soil, vegetation, atmospheric chemistry, and water body. With regard to the shortage of fresh water, IBM exercises real-time monitoring and management over the amount, flow velocity, and quality of water consumption by cognitive technology and data-analytical technique and through the sensors deployed in equal sections and then controls the state of every drop of water at any moment, ensuring the security of drinking water. French Plume Labs brought forth “Flow,” an electronic AI-based air quality tracker, which can record the surrounding environmental conditions at any time by collecting the ambient air data, an apparatus that enables people breathe fresh air with ease. Additionally, in June 2017, Alibaba brought out “AliCloud ET Environment Brain,” a technical solution for dealing with global environmental deterioration. By means of AliCloud computing, AI, and Internet of Things, the solution may help people to achieve scientific decision on eco-environment control, precise eco-environment supervision and convenience of public service.

AI can elevate prediction accuracy of global climate changes and offer direction for eco-security. Ever since the twentieth century, the increasing discharge of greenhouse gas has evoked some global troubles, such as sea level rise caused by climate warming, abnormal climate, more marine storms, and expansion of desertification area, among which if one is rampant and out of control, human beings will suffer from devastating catastrophe. By virtue of mega-data, the accuracy in prediction of climate change and weather forecast has been greatly improved, and thus, eco-environment is ensured in a stable, healthy way. For instance, in June 2015, having integrated with super computer science, geo-system model, work process management, remote sensing data, and collaborative analytical platform, NASA released the predictable databank on global climate changes from 1950 to 2100. The databank may help scientists to analyze the changes in global temperatures and rainfalls, with spatial resolution of 15 km, providing the reliable data for decision making on environmental protection. In 2014, in cooperation with IBM, Beijing Environmental Protection Agency developed "Green Horizon," in which the machine can analyze the real-time data flow transmitted from the air monitoring station and the weather satellite with cognitive computing, mega-data analysis, and Internet of Things. By means of self-learning ability and processing capacity of super computing, the machine can forecast highly precise air quality in the coming 3–5 days, achieving real-time monitoring the sources of pollutants and distribution in Beijing.

Although AI has been primarily put into use in eco-environment, intelligent monitoring system on environment has to deal with the issues, such as massive data, multiple types, and complicated structure. Moreover, there leaves much to be desired in data monitoring and application, including collection, management, analysis, and transmission of eco-data. Now, as the application of AI and mega-data in eco-environment is still in initial stage, we have much work to do on how to reasonably exploit and use the strategic resource (mega-data) with AI so as to better study ecological environment. Additionally, the defects such as regional limitation, inadequate sharing of information data and different defining standards restrain transnational and transregional eco-monitoring in complicated environment. For this reason, we should draw the consensus in the rules and regulations in international monitoring network and data sharing before we construct a precise, dynamic, and global forecast system for eco-security so as to form transnational, race-free shared governance over eco-environment.

### *6.2.6 To Construct a Reasonable Efficient Intelligent Transportation System*

Transportation system plays a role in rationally allocating production means and promoting flow of material, information, and professionals, a pre-requisite for economic development. Yet, with dramatic advancement in economy, the number of vehicles keeps increasing, resulting in more traffic jams and accidents which severely endan-

ger people's life and property security. In accordance with the incomplete statistics by National Safety Council, about 40 thousand people died of traffic accidents in the USA in 2016, leading to direct economic loss of 330.2 billion $US. Speedy, fatigue, and drunk drivings are blamed for most accidents. To take a global view, misoperations of divers are attributable to part of those accidents.

Directed by intelligent traffic system, a traffic databank may be conducive to intelligent traffic dispersion and coordinate command, to the formulation of reasonable traffic control programs, which will substantially improve urban traffic management and operation efficiency, offer drivers all-round traffic information, and bring to traffic authorities timely, accurate, comprehensive and adequate information support, and information-based decision support so that urban traffic jams will be effectively alleviated and the security of people's trips will be ensured. Intelligent traffic system transfers various traffic information to traffic control center for disposal and transmits the information to all the participants (drivers, residents, police stations, seaports, hospitals, and troubleshooting departments). Intelligent traffic system can monitor the congestion in different road sections. The dispatching system can optimize the distribution of traffic streams on the basis of traffic flow and road conditions, while traffic control departments may adopt more reasonable traffic dispersion and accident handling. The people on trip may acquire the optimal traffic means and routes in real time. With these measures taken, traffic congestion can be relieved, and traffic security can also be ensured. In "2030 Artificial Intelligence and People's Life" issued by Stanford University in 2016, the report holds that intelligent traffic system boasts enormous potential in reducing traffic accidents, alleviating traffic congestion and elevating road and vehicle utilization rate. It also analyzes the significance of intelligent transportation in social life, while it elaborates the advantages that intelligent traffic system brings to the security of people's trips from such perspectives as intelligent automobiles, traffic rules, real-time traffic, and man–machine interaction. At present, predictive maintenance system by intelligent sensors is widely used in France. As French traffic infrastructure is inordinately aging throughout the country, traffic authorities acquire in real time the data of road conditions from the sensors set in different road sections. After the data are analyzed and processed by AI, traffic police can quickly lock the specific location of the target installation and conditions. With this intelligent traffic system, Societe Nationale des Chemins de Fer Francais has prevented a number of accidents from happening, while maintenance costs are reduced by 30%. In October 2016, Hangzhou Municipal Government, China, joined hands with Alibaba to construct Urban Data Brain to solve urban traffic problems. By virtue of AI, Urban Data Brain exercises real-time analysis into the video information of road junctions and GPS information, perceiving vehicle operation data. Based on the data, Alibaba constructs urban traffic model, which carries out iterative optimization through machine learning and offers more optimal traffic control programs.

The development of the technologies such as mega-data, cloud computing and Internet of Things, and AI application evokes people's new ideas for ensuring traffic security. AI-based pilotless driving system can collect and integrate real-time environment data so as to improve the instantaneity and accuracy of the information of

vehicles, roads, and weather. In addition, through information exchanges, people may acquire technologies in intelligent decision making, including technique in modeling dangerous situation, classification of hazard pre-warning and controlled precedence, multi-target coordination, vehicle trajectory planning, analysis into drivers' diversified influence, and man–machine interactive system, etc., all of which can substantially elevate the accuracy of hazard pre-warning and strikingly lower the occurrences of traffic accidents. Now, major countries attach importance to developing pilotless driving, as shown in "Growing the Artificial Intelligence Industry in the UK" promulgated by British Government in 2017, which highlighted AI used in pilotless automobiles in an attempt to further pilotless driving technology by virtue of AI advantages acquired by British universities and enterprises' professionals. Pilotless driving is a developing trend in auto industry as it can alleviate drivers' load, improve transportation efficiency, and furthest reduce traffic accidents. The studies by Eno Center for Transportation of the USA show that if 90% of automobiles are pilotless, yearly traffic accidents will drop from 6 million to 1.3 million, death toll from 33 thousand to 11.3 thousand. Now, traditional automakers and Internet tycoons have substantially invested in developing pilotless driving. As early 2009, Google X initiated pilotless driving project. By June 2017, Waymo, an American autopilot enterprise, had exercises road test of pilotless diving for over three million miles, free from any man's intervention in the whole process. Tesla has brought out mass-produced car equipped with autopilot software, while those cars are turned into pilotless automobiles with iterative driving technique. In August 2017, after it proclaimed its expansive carrying program, Toyota Motor studied the car incidents from meta-analysis center of traffic accidents, discovering that rear-end collision cases of cars equipped with Toyota Safety Sense are only half as many as those without the said devices. In addition, in the cars installed with both Toyota Safety Sense (P version) and Intelligent Clearance Sonar, the cases of rear-end collision dropped by 90% as against the cars without the two devices. In September 2017, Siemens announced that it would merge TASS International, a Dutch autopilot software company in an attempt to accelerate its business in pilotless automobiles.

The application AI-based pilotless automobiles may greatly reduce the traffic accidents caused by fatigue driving, drunk driving, etc. However, to acquire the precise information in driving environment, road conditions, pedestrian state for pilotless automobiles, we are still faced with some challenges, such as the anti-interference and detection precision of sensors to be improved, technical bottlenecks in data acquisition and process, accuracy and rationality of algorithm to be raised and deficiency of relevant laws, and regulation on management. In June 2016, due to technical malfunction, an automobile Model S produced by Tesla met with the first fatal accident of pilotless driving. As the pilotless automobile was driving against the light and so the sensors were unable to capture the image information of the white trailer ahead, the automobile had not halted before the tragedy happened on the belief that no obstacle was lying in the front road. This accident shows that we still have a long way to go before AI serves mankind in perfectly safe way. In the near future, we should make greater effort in developing autopilot hardware and software

and gradually consummate test standards of every items involved and management system so as to guarantee the security of pilotless driving.

### 6.2.7 To Construct an Overall Spatial–Temporal Intelligent Defense System for Financial Security

As the core of modern economy, finance is an important part of service industry, which acts as a "bridge" for the economic activities of various industries and trades and thus plays a critical role in the social and economic development of a country. Loaded with massive money and data, financial system is invariably the target of criminals, which gives rise to the problem on financial security.

Financial security always goes with financial development as contemporary financial business has evolved from the profit-earning mode by only bank deposit to multiple profit-making modes, such as payment and settlement, foreign exchange trade, occasional overdraft, loan financing, operation and investment, and integral money management, resulting in greater difficulty in ensuring financial security. In intelligence age, we focus more information security of Internet financial clients in that the personal information of such clients is more prone to be intruded and disclosed as against the traditional financial customers. For example, a series of financial events such as the Ctrip bug in 2014, 2D barcode payment fraud and "Heartbleed" of OpenSSL have evoked enormous losses to Internet users and even crippled the normal operation of financial market. In 2015, "Economic Information Daily" revealed that large-scale disclosure of personal information occurred in "Enforcement Bug Platform," the global largest loophole response platform, an accident that caused the leakage of the private information of 1.127 billion users, including real-name information, account password, and ID number, etc. Once the private information is abused by criminals, users will suffer from enormous financial losses. Moreover, the harm of virus invasion is more severe, as shown by the wanton rampancy of "Eternal Blue" in May 2017, attacking the users of at least 150 countries, "Petya" spreading to 60 countries in June of the year and "CopyCat" invading over 14 million Android mobile phones in July, which infringed the privacy of users to varying degrees.

AI plays a critical role in ensuring financial security, for which we must verify the authenticity of the users' identity in financial transactions, involving facial perception, speech recognition, fingerprint recognition, and iris recognition. Compared with artificial authentication, AI may dramatically shorten the recognition time and reduce identification error rate. In April 2017, in the contest of international facial perception, Utu of Tencent equipped with AI reached the accuracy rate of 99.8%. This case proves that AI application will greatly reduce the potential risks of property loss.

To bring down the risks of financial transactions, we should earnestly intensify the in-depth integration of AI and financial security system and construct a fully dimensional business data network based on "the information of enterprises, indi-

viduals, institutions, accounts, transactions." We should also make use of AI to mine incidence relation risks hidden in the complicated networks and acquire transaction knowledge and rules from the massive trading data, which will help us to discover the abnormal financial transactions and try our utmost to guard against the financial risks, such as swiping of the stolen credit cards, bogus transactions, malicious cash, junk registrations, marketing cheats, and network frauds, etc. Moreover, we should elevate the accuracy of screening financial institutions and effectively prevent and resolve business risks. For example, Ant Financial Group applies machine learning in "Ant Check Later" and micro-loans on MyBank, a move that dramatically reduces financial transaction. In addition, Optical Character Recognition based in-depth learning enables the verification time of Alipay from one day to one second and the passing rate is elevated by 30%. In addition, to prevent credit card frauds, Banco Bilbao Vizcaya Argentaria S.A. analyzes capital flows with machine learning and exercises real-time risk management which ensures the security of financial transactions. Hongkong and Shanghai Banking Co. and Wells Fargo verify consumers with face-based and speech-based bio-identification and recognize transaction modes by image analysis so as to provide consumers with quicker, safer, and more stable financial services.

At present, many financial institutions in different countries resort to AI in their financial investment one after another. In 2016, JP Morgan pooled huge investment in establishing a technical center, which is specialized in researching mega-data, robot and cloud infrastructure in an attempt to find out new profit resources and to reduce costs and financial risks. Its "The Emerging Financial Technology Program" costing 0.6 billion $US covers such sub-items as cooperation of financial technology corporations, research, and development of technologies for financial management and financial security, which will be used in elevating present digital and mobile services and strengthening financial transaction security. In February 2017, Wells Fargo sets up an AI corporation, which commits to researching updated science and technology and provides bank clients with more safe, individualized, and personalized financial services.

As AI displays boasts overwhelming advantages in financial supervision, people may use AI to establish intelligent pre-warning and controlling system against financial risks. There exist loopholes in traditional financial supervision system as it mainly depends on man's work. To supervise with AI technology can make up for those loopholes because AI can work out the strategy in advance and then perform the supervision in meticulous way. Among AI technologies, mega-data brings brand-new means for risk management. To take the prevention of liquidity risk for a case, some relevant market entities have made use of mega-data controlling liquidity investment and risks. For instance, Yu'ebao under Ant Financial Group exercises the control in the said areas by virtue of analyzing the habits of customers in withdrawing their funds. With application of mega-data, reservation of funds by 5% in Yu'ebao may realize its "T + 0" diffluent commitment. Therefore, while preventing liquidity risks, supervising authorities may carry out the supervision by mega-data means in the context of the unified monitoring requirements.

Although AI greatly elevates the degrees of financial security, there still exist multiple risks in financial security realm as AI driven by data may lead to convergent acts. Now, due to data-driven AI techniques, convergence property will arise in the operation of dealing with the same problems, which will lead to negative effect because AI trained with the same data is put into use. For example, when stock price dramatically drops, the systems of all the institutions will carry out dumping operation, bringing tremendous negative impact on the stock market. Even though there are still many problems remaining to be solved in terms of AI application, financial industry will undoubtedly benefit from AI technology.

## 6.3 New Security Threats Brought by AI

AI is used in all the respects of human life. Just as every coin has two sides, while bring people facilities, AI is subject to more and more queries on its security due to its opacity and self-learning in the process of decision making. Some international celebrities such as Stephen King, Bill Gates, Elon Musk, and Ray Kurzweil, are worried that if no restraints are imposed on AI development, machines may acquire the intelligence overwhelming that of human beings and incur unpredictable potential risks. In June 2014, when interviewed by "Last Week Tonight" of American HBO, Hawking warned "AI may be a real peril in not so distant future."

In 2016, "GeekPwn" of intelligent life security community first came up with "AI security issue." In its activity in Shanghai, Clarence Chio, a hacker, showed the processing of hacking AI with DeepPwning. Ian Goodfellow, an OpenAI expert, displays how to use antagonist image technique to mislead machine identification. After hacker adds invisible elements to image, machine cognition is out of proper operation. All these cases prove that AI is not so powerful to ensure information security as we imagine.

In October 2016, the White House released "Preparing for the Future of Artificial Intelligence," in which US Government predicts that AI may be the major motive force for social and economic development and turn to be a revolutionary technology. In such context, government should play its supervising role, formulate proper applicable framework, and law to control it and protect public privacy while encouraging technical innovation so as to make intelligent application systems open, transparent, and understandable.

Following are two potential risks when we use artificial intelligence:

1. Technical abuse. As a technology, AI is neutral in property, and the application result depends on people's purposes and management. If it is used by criminals, it will endanger our society and ourselves. For example, hackers may apply AI to assail networks as intelligent network attack software may defraud computer system and reside in it for long period of time by self-learning and imitating users' behavioral habits.

2. Security problems caused by immature technology and management defects. As AI is still at its initial stage and so it is far, far from mature, possible technical defects will bring about abnormal operation. For instance, as lack-box mode is available in the widely sued in-depth learning, resulting in the weak interpretability of modes, people cannot fully get to know the whole process of decision making and so it is difficult for them to make the accurate evaluation on security. In addition, people find themselves unable to obstruct the illegal access to computer system due to the deficiency of present unmanned protection ability.

For a long run, "super intelligence" will bring us more severe insecurity. At the advanced stage of AI, "super intelligence" will acquire self-evolutional ability and self-consciousness, which will endanger man's leadership in the world and even man's survival. For this reason, we should be sober-minded of the potential risks so as to avoid Doomsday.

As an emerging technology, AI will evoke various potential risks although it greatly improves human life. Therefore, it is an imminent task for us to consummate the protective system and effectively bring all the potential risks under control.

### *6.3.1 Reliable Result of AI Identification*

While performing in-depth learning in antagonism cases, Prof. Soong Xiaodong, Computer Science Department, Berkeley, UC, and his team members discover that computer is prone to be defrauded in the example that the computer will interpret the sign "No Parking" as "Speed Limit." In addition, Ian Goodfellow and his team also prove that hackers can make man's neural network to believe the nonexistent contents by interpolating the contents imperceptible to naked eyes. For example, if man cannot perceive the modification of a 100$ check issued by hand, AI neural network will accept the modification. For the widely used face recognition system, AI cannot ensure the flawless results in that if one makes several marks on his face, the camera will mistake him as another person.

According to a survey report made by Web site of American ProPublica, a court in Florida conducted risk appraisal on criminals by Compas, an AI software for convicting crimes. A comparison between AI system assessment and actual situation shows that black people nearly double the white men in the wrong judgment of highly criminal risks, whereas white men are far more than black men in the wrong judgment of lower criminal risks. This prejudice may stem from the training data adopted in in-depth learning. As historical data in training algorithm will reflect certain sample bias (the logistic function is higher for the crimes of certain kind of people), the erroneous results will permanently exist in our society in certain form, leading to vicious circle of inequality. If we intend to remove this risk, technicians should first find out the deviation data before they adopt property measures to evaluate the impact of such declination.

At present, the studies in intelligence technology focuses how to make machine exercise autonomous and supervision-free learning. After the machine practices self-training in long-time data analysis, it can also learn some substantive harmful acts beyond human prediction and expectation, showing that the reliability of AI identification is still far from human requirements. As it depends on samples, hackers may simulate the particular attack samples in off-line state and induce intelligent system to make wrong decisions and perform erroneous acts. In its "Preparing for the Future of Artificial Intelligence," the White House expresses the similar worry that once AI is open to the outside world from the seclusive laboratories, some unpredictable thing may occur, which will evoke potential risks in airplanes, power stations, vehicles, and bridges under the control of AI systems.

### *6.3.2 Invasion of Human Privacy by Artificial Intelligence*

In traditional society, the scope of interpersonal communication is relatively small, and the spread of private information is often relatively controllable. However, with the emergence of artificial intelligence, a large number of emotional expressions of human behaviors have been digitized and patterns extracted, making it possible to predict individual behaviors. If these data are leaked or used artificially, it will seriously affect people's work and life.

Microsoft's smart assistant, Xiaobing, has been taken offline by a number of users for fear of revealing chat content. At present, a large number of commercial companies through a variety of mobile phone applications have access to a large number of customer privacy data.

If the data are leaked due to improper storage, it will cause unforeseeable harm to customers.

For example, it has become a normal situation for shopping platform to use artificial intelligence to push targeted products to users. Amazon.com (www.amazon.com) analyzes a large number of users' consumption habits data and guesses the products that users are interested in through its AWS cloud computing platform. While gaining the convenience of shopping, customers pay the price of allowing Amazon to continuously access their personal information and preferences, resulting in the complete loss of privacy of users. Heavy use of wearable smart devices may also reveal users' privacy. In July 2016, a team of researchers from the Stevens Institute of Technology and the State University of New York at Binghamton demonstrated a method of using wearable smart devices to infer bank passwords. Using 5,000 inputs from 20 adults, smart algorithms analyze the patterns of finger movements and work out the order in which passwords are placed. The test results show that the system has achieved a cracking accuracy of 80% in one input and as high as 90% after three attempts. For now, the team hopes to build on this by peering into people's keystroke habits and deciphering what they type. It can be seen from this that the popularity of mobile phone applications and smart wearable devices makes people's personal data more and more easily collected, possibly without people's awareness. These

large amounts of data expose the privacy of human beings, and it is easy to identify the personal information contained in it through data mining technology. Once the user's address, social relationship, and other personal privacy data are obtained and used by criminals, it will directly threaten the security of users.

At present, all countries in the world are using information technology to transform traditional industries and propose a series of new scientific and technological development strategies to seize the technological commanding heights, such as Germany's Industry 4.0, America's Industrial Internet and China's intelligent manufacturing 2025 development strategy. These plans are based on emerging information technologies such as big data cloud computing, and their core is the processing and utilization of data, which is more evident in high-end intelligent equipment. China still needs to import a lot of high-end equipment to meet the needs of manufacturing industry and social life. In the process of equipment use, a large number of key data will be generated, which will be collected, saved and used by the equipment. Once leaked, it may lead to the possession and use of proprietary intellectual property information by competitors, seriously threatening the interests of enterprises and even national security. Similarly, in medicine, disease research has moved into the genetic realm. The massive introduction of high-end medical equipment may lead to the collection and leakage of patients' basic information. With the development of genetic technology, the genetic information of national RACES may be collected and used for malicious purposes or even genetic changes. The US Intelligence Community has added gene editing to the list of weapons of mass destruction and proliferation in its 2017 Worldwide Threat Assessment of the US Intelligence Community.

Some countries are already using gene editing to develop genetic weapons. The Wall Street Journal has revealed that the pentagon is working on a genetic warfare plan to use genetic weapons against adversaries. Genes from Asian Chinese, European Aryan, and Middle Eastern Arabs were included in the US military collection according to the participants. The project works by studying the genetic makeup of competitors, discovering their genetic traits, and then developing drugs and foods that mutate the genes of specific populations to achieve the goal of winning without a fight. Therefore, countries need to pay attention to and as soon as possible to do their own genetic security work, to prevent the use of the enemy. At the same time, humans need to carefully study their own genetic code, the use of intelligent identification and other advanced technology early detection of specificity, and susceptibility genes to improve and enhance human genetic resistance.

The level of intelligence is reflected in the extraction process from data to knowledge. Driven by machine learning, countless seemingly unrelated data fragments may be integrated together to identify individual behavior and even personality characteristics. For example, by combining the shopping process of Web site browsing and chatting contents with other kinds of recorded data, the behavior trajectory of specific objects can be outlined, and personal preferences and behavior habits can be analyzed, which is a serious violation of others' privacy.

Obviously, with the development of artificial intelligence, human privacy is more likely to be disclosed, with more channels and faster process. To guard against this

risk, the National Science and Technology Council has come up with the National Privacy Research and Development Strategy, and the European Commission voted in 2016 to pass General Data Protection. China has also included the crime of violating citizens' personal information in its criminal law, but this is only the beginning.

### *6.3.3 Manipulation of a Country's Votes by AI*

Now, political robot-based AI begins to intervene into human political life. In essence, a political robot is a network account, which can automatically transmit unilateral political information so as to forge false public support. In US presidential campaign in 2016, the political robot supporting candidate D. J. Trump released the news on Twitter and Facebook pages of Hilary backers. In 2017, during the campaigns of British Prime Minister and French President, more political robots disseminate erroneous information and false news. On Facebook and Twitter are seen the spurious internal E-mails of Macron's team, including the false financial conditions of the candidate, with the purpose to misrepresent Macron to be a swindler and hypocrite. Political robots often resort to the similar manipulation strategy in an attempt to forge public opinions and distort political atmosphere. During the transmission of such information, the peril is underlying and the untrue political news will distort man's social perception. Therefore, we should try our utmost to stop such occurrences. In the future, people may use AI to rule out the false opinions and information so that the voters may make reasonable judgment.

### *6.3.4 Forgery to Be Made More Easily by AI*

Integrity is the cornerstone for safe activities of human society, whereas the extensive use of AI makes the forgery of information and data more easily, seriously spoiling social order. For example, calligraphy forgery: Researchers in University of London develop intelligent algorithm to forge calligraphy, with which criminals can fabricate highly similar signatures of legal or financial documents. Speech forgery: After collecting a large amount of audio information and extracting the relevant audio features and then analyzing them, WaveNet of Google can simulate man's speech. Therefore, audio material won't be the reliable evidence in the future. Photograph and video forgery: After studying massive data, AI can counterfeit video material and pictures that can palm off people. Having collected the speech video and pictures of Obama, the former President of USA and then penetrating the incidence relation between speech and mouth shape, the computer scientists in Washington University successfully fabricated the verisimilar video. The false data by AI may please the audiences in positive way, whereas it can weaken people's trust and even induce crimes from negative perspective. In the future, the authenticity of audio and video materials and photograph will be subject to queries more often.

### 6.3.5 Insecure Decision Making by AI

In essence, AI is a simulation of man's thinking. Supported by parallel computing and mega-data, the intelligent computing model represented by in-depth learning proves very powerful learning ability. Now, as machine learning model still belongs to black-box operation mode, it is hard for man to give the reasonable interpretation on origin of abnormal AI operation and the developers are unable to predict and control the behavioral boundary of intelligent system operation. For example, in man–machine Go game, AlphaGo astounded many master-hands for several times by its "divine moves," whose decision-making process still puzzles many human *Weiqi* players.

When more and more AI systems make decisions in place of man and exert influence public life, man cannot predict, comprehend, and interpret its process of decision making, let alone the accurate evaluation on its reasonability and security. The erroneous decision may bring severe or even destructive consequence to mankind. In the series of movies "The Terminator," "SkyNet," an intelligent defense system invented by mankind is available in military purpose and it is endowed with the function to administer human life in later period. After it is put into management of weapons of US army, "SkyNet" suddenly acquires self-consciousness and firmly believes that making will endanger its survival. Thereupon, "SkyNet" sets its creator as the enemy and deracinates all human beings with deadly weapons.

The white-paper book "Preparing for the Future of Artificial Intelligence" advises US Government to exercise supervision on AI products. Before they are put into use, people must conduct several tests on AI products so as to ensure the security of decisions by intelligent system. AI experts should work with security experts to promote the development of AI security projects.

### 6.3.6 Uncontrollable Artificial Intelligence

In the course of playing game with self-learning Coast Runners in automatic system, Dario Amodei, researcher of OpenAI lab, discovers that the boat controlled by AI unexpectedly shows great interest in tiny green widget on the screen because it will gain one credit once it catches the widget. Instead of crossing the finishing line, it incessantly circles around the container and occasionally collides with other boats in order to get the score. Obviously, with long-term self-training with massive data, machines may develop the substantial harmful behaviors which are beyond designers' prediction. For instance, among the present AI algorithms, some unfold training on the basis of reward and punishment mechanism. When a machine aims at winning the reward, its thinking will go like this way: Only by continuous operation will it be rewarded. Therefore, for the sake its survival, it is possible that the machine will prevent man from shutting off itself. In the movie "I, A Robot," "Vickie," an intelligent central control system developed by USR, command many NS5 robots to

launch assail on human beings in order to stop mankind to turn off itself. Although such terrible scene is still far away from us, it will be human nightmare once it comes true.

Due to the uncertainty of intelligent learning result, the learning process of machines must be subject to human control. Only by setting up "fusing mechanism" can we interdict the hazard and protect human being once the unpredictable situation happens. A team of Berkeley is undergoing a relevant research topic, intending to solve this trouble by means of mathematics. The team has discovered that if the machine cannot make certain its reward function, it will be possible to retain its shutdown switch. This measure will endow machines with motivation to accept and even proactively seek for human supervision.

### *6.3.7 Human Precaution Against AI Attack*

With progress made in AI, it may find out the loopholes in the course of self-learning, by which it can make virus to destroy network space. Some traces such as personal habit, hobby, and the webpage content left by users may be maliciously used and the area subject to attack will expand. To realize their purposes or to pilfer the codes of intelligent network weapons, criminals or extremist organizations will resort to network weapons to launch assaults at the computer systems of a country or government at low costs and by virtue of AI, which will result in tremendous loss and even "thorough destructive attack."

Nowadays, the major countries are competing with one another in exploring AI assault. In June 2017, GeekPwn worked with next idea to initiate "Special Project on AI Security Challenge." The project consists of PWN AI and AI PWN. The first part takes "AI" as the object for assault, in which the contestants try to make intelligent algorithm to draw erroneous judgment or collapse its program. The second part uses "AI" as a tool, in which the contestants launch attack at the designated target with AI, misguiding it or crumbling it. The award-winning contest aims at arousing public attention to AI security and encouraging people to exploring the effective methods to solve this problem.

Additionally, Kaggle, a data science contest platform carried out an algorithm competition. This game is composed of three challenge items. In the first one, the contestants should mislead the machine learning system by simple means and disrupt its normal operation. In the second one, the contestants should apply certain methods to force the system to make improper assortment of the designated objects. In the last item, the contestants are expected to develop the most powerful AI defense system. The contest aims at promoting people's "profound understanding" on "how to intensify machine learning system" so as to resist the coming network assaults by competing means. Through this competition, the organizer intends to propel the development of the two antagonist sides—one is to hoax the deep neural networks and other one is to design deception-resistant deep neural networks.

In intelligence age, whether assault or defense will be a long-run game. While hackers launch attacks with AI, security guards will develop more powerful AI means to dissolve the attacks. With more open sources of AI models, Hackers' intrusive tools will be diversified. Whether AI will transcend human intelligence, its uncertain development will invariably bring us more new challenges, which will evolve into the problems that change social structure, impose threat on public security, and fling out the gauntlet to the norms for international relations. All these troubles will exert far-reaching influence on economic security, social stability, and global governance. While striving to develop AI, we should be highly alert of various challenges to our security, intensify our precaution, exercise both restraints and guidance for its development, and reduce the risks to an uttermost degree. With the necessary and effective measures taken, we can ensure the harmonious development of both AI and security control, dissolve the hidden risks brought by AI and make it "loyal guardians" of human beings rather than "the stubborn cat's paw" that endangers human security.

Security issues in intelligence age are more complicated and entangled than the previous ones, for which different countries should adopt positive and prudent measures, soberly aware of the fact that while giving rise to tremendous technical revolution, AI will be loaded with destructive risks which will even be out of control. As a single country is unable to solve this problem, international community is expected to intensify the collaboration among different countries, perfect international cooperation mechanism and enforce control over AI, leading to the aim that "human intelligence" must acquire the ability to control "artificial intelligence," promote the restructuring of security order and make "AI" to "convoy" the secure development of human society.

## Bibliography

Allen, G., and T. Chan. 2017. *Artificial intelligence and national security*. Cambridge: Harvard College.

Artificial Intelligence: Opportunities and implications for the future of decision making. The British government, 2016.

Bai Shuo, Xiong Hao. 2014. Da Shu Ju Shi Dai De Jin Rong Jian Guan Chuang Xin (Innovation in financial regulation in the era of big data). *China's Finance*, no. 15.

Carter, A. 2010. Intelligent transport systems. *Traffic Engineering Design* 54 (1).

Chio, C. 2017. Machine duping 101: Pwning deep learning systems. [20171010]. https://www.defcon.org/html/defcon24/dc24speakers.html.

Cramer, N. 2017. The climate is changing. So must architecture. (20171004) [20171010]. http://www.architectmagazine.com/design/editorial/the-climate-is-changing-so-must-architecture_o.

Curtis, S. 2016. Do you have the face of a killer? Faception software claims to be able to spot terrorists by analysing their faces. (20160525) [20170910]. http://www.mirror.co.uk/tech/you-face-killer-new-software8045646.

European Union food safety white paper. European Council, 2001.

Evtimov, I., K. Eykholt, E. Fernandes, et al. 2017. Robust physical: world attacks on deep learning models. (20170913) [20171010]. https://arxiv.org/abs/1707.08945.

Fact Sheet: Cybersecurity National Action Plan. (20160209) [20170910]. https://obamawhitehouse.archives.gov/the-press-office/2016/02/09/fact-sheet-cybersecurity-national-action-plan.

Fang Zhi Ren Gong Zhi Neng "Tuo Jiang" Ke Xue Jia Ji Ji Yan Jiu An Quan Dui Ce (Prevent AI "runaway" scientists actively research safety countermeasures). (20170907) [20171010]. http://tech.comnews.cn/ns/d/a/20170907/25116.html.

Fingas, J. 2017. Google AI could keep baby food safe. (20170725) [20170910]. https://www.engadget.com/2017/07/25/google-ai-helps-make-safer-baby-food/.

France fights to keep Emmanuel Macron's email hack from distorting election. [20171010]. http://zeenews.india.com/world/france-fights-to-keep-emmanuel-macrons-email-hack-from-distorting-election2002784.html.

Gershgorn, D. 2016. Researchers have successfully tricked AI into seeing the wrong things. (20160728) [20171010]. https://www.popsci.com/researchers-have-successfully-tricked-ai-in-real-world#page-2.

Growing the Artificial Intelligence Industry in the UK. Gov. UK, 2017.

Guo Jia Hu Lian Wang Xin Xi Ban Gong Shi. Guo Jia Wang Luo Kong Jian An Quan Zhan Lüe (National cyberspace security strategy). (20161227) [20170910]. http://www.cac.gov.cn/201612/27/c_1120195926.htm.

Guo Nei Shou Chuang: Kuang En Wang Guan Cheng Gong Lan Jie "Fang Cheng Shi" Gong Ji (First in China: Converse gateway successfully intercepted the "equation" attack). (20150228) [20170910]. http://www.cctime.com/html/2015228/20152281753114192.htm.

Johnson, B.R., T.U. Kampe, M.A. Kuester, et al. 2010. NEON: The first continental scale ecological observatory with airborne remote sensing of vegetation canopy biochemistry and structure. *Journal of Applied Remote Sensing*, no. 4.

Knight, W. 2016. Baidu uses map searches to predict when crowds will get out of control. (20160324) [20170910]. https://www.technologyreview.com/s/601108/baidu-uses-map-searches-to-predict-when-crowds-will-get-out-of-control/.

Kohn L, T., J.M. Corrigan, and M.S. Donaldson. 2000. *To err is human: Building a safer health system*. Washington (DC): National Academies Press (US).

Larson, J., S. Mattu, L. Kirchner, et al. 2016. How we analyzed the COMPAS recidivism algorithm. (20160523) [20171010]. https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm.

Li Xiu Quan. 2017. Ren Gong Zhi Neng Ying Yong Zhong De An Quan, Yin Si He Lun Li Tiao Zhan Ji Ying Dui Si Kao (Security, privacy and ethical challenges in the application of artificial intelligence and their countermeasures). *Science & Technology Review*, no. 35.

Liu Hai Jiang, Sun Cong, Qi Yang, Deng. 2014. Guo Nei Wai Sheng Tai Huan Jing Guan Ce Yan Jiu Tai Zhan Wang Luo Fa Zhan Gai Kuang (The development of ecological environment observation and research station network at home and abroad). *Environmental Monitoring in China*, no. 30.

Morisy, M. 2016. How paypal boosts security with artificial intelligence. (20160125) [20170910]. https://www.technologyreview.com/s/545631/how-paypal-boosts-security-with-artificial-intelligence/.

National Research Council. 2011. *Toward precision medicine: Building a knowledge network for biomedical research and a new taxonomy of disease*. Washington (DC): National Academies Press.

Oktar, N. 2013. Human brain project. *Journal of Neurological Sciences* 30 (1).

PIN and password can be hacked via wearable device. (20160714) [20171010]. http://memeja.com/computing/pin-and-password-can-be-hacked-via-wearable-device/.

Podcast: How to train for a job developing AI at OpenAI or DeepMind. (20170721) [20170910]. https://80000hours.org/2017/07/podcast-the-world-needs-ai-researchers-heres-how-to-become-one/.

Preparing for the Future of Artificial Intelligence. America White House, 2016.

Regalado, A. 2016. Top U.S. intelligence official calls gene editing a WMD threat. (20160209) [20171010]. https://www.technologyreview.com/s/600774/top-us-intelligence-official-calls-gene-editing-a-wmd-threat/.

Ren Gong Zhi Neng Zai Jin Rong Ling Yu Ying Yong De Chu Bu Si Kao (Preliminary thinking on the application of artificial intelligence in financial field). (20160830) [20171010]. https://xueqiu.com/8020613086/74224087.

Roettgers, J. 2017. Instagram starts using artificial intelligence to moderate comments. Is Facebook up next? (20170629) [20170910]. http://variety.com/2017/digital/news/instagram-ai-machine-learning-facebook-filters1202482031/.

Stone, P., S. Kalyanakrishnan, S. Kraus, et al. 2016. *Artificial intelligence and life in 2030*. California: Stanford University.

Shi Chun Min. 2016. Ji Yin Bian Ji, Shi Jie Mo Ri Wu Qi? (Gene editing, doomsday weapons?). *China National Defense Newspaper*, 20160229.

System predicts 85 percent of cyber-attacks using input from human experts. (20160418) [20170910]. http://news.mit.edu/2016/ai-system-predicts85percent-cyber-attacks-using-input-human-experts0418.

The Directive on Security of Network and Information Systems. European Union, 2016.

The rise of the weaponized AI propaganda machine. (20170210) [20171010]. https://scout.ai/story/the-rise-of-the-weaponized-ai-propaganda-machine.

Thompson, C. 2016. 10 futuristic vehicles that will fundamentally transform how we travel. (20160813) [20171010]. http://www.businessinsider.com/vehicles-of-the-future20168.

Tian Chun Yuan. 2012. Ji Yu Shu Ju Wa Jue De Shi Pin An Quan Feng Xian Ping Jia Yu Yu Jing Xi Tong (Food safety risk assessment and early warning system based on data mining). Qingdao: Qingdao University of Technology.

Toyota announces Toyota Safety Sense and ICS safety support technologies that together reduce rear-end collisions by 90%. (20170828) [20171010]. http://www.acnnewswire.com/press-release/english/38148/toyota-announces-toyota-safety-sense-and-ics-safety-support-technologies-that-together-reduce-rear-end-collisions-by90.

Turner, K. 2016. AI may soon monitor your live videos on Twitter, Facebook. (20160727) [20170910]. https://www.washingtonpost.com/news/innovations/wp/2016/07/27/ai-may-soon-monitor-your-live-videos-on-twitter-facebook/?utm_term=.883cf49b355f.

Triggle, N. 2014. Care.data: How did it go so wrong? (20140219) [20170910]. http://www.bbc.com/news/health26259101.

World alliance for patient safety: Forward programme. Geneva, Switzerland: World Health Organization, 2004.

Yang Zong Xi, Tang Jin Rong, Zhou Ping, Deng. 2013. Da Shu Ju Shi Dai Xia Mei Guo Di Zhi Diao Cha Ju De Ke Xue Guan (The scientific view of usages in the era of big data). *Geological Bulletin of China*, no. 32.

Zhi Dong Xi. 2016. 31 Ye Ren Gong Zhi Neng Bao Gao : Shen Du Jie Ma Gui Gu Wu Ju Tou AI Bu Ju (31-page AI report: deep decoding the AI layout of silicon valley's five giants). (20161107) [20170910]. http://www.sohu.com/a/118280162_115978.

Zi Dong Jia Shi Gei Wo Men De Jiao Tong An Quan Dai Lai Le Zen Yang De Ying Xiang? (How does autonomous driving affect our traffic safety?). (20170718) [20171010]. http://baijiahao.baidu.com/s?id=1573252860639611.

# Chapter 7
# Artificial Intelligence and International Norms

**Jiabao Wang, Xiaoyu Yu, Jie Li and Xiaoling Jin**


J. Wang · X. Yu (✉) · J. Li · X. Jin
Shanghai University, No. 99 Shangda Road, Baoshan District, Shanghai 200444, China
e-mail: yuxiaoyu@shu.edu.cn



D. Jin (ed.), *Reconstructing Our Orders*,
https://doi.org/10.1007/978-981-13-2209-9_7

**Abstract** While enormous productivity is generated with the extensive application AI, this technology has also incurred some global problems in legal regulations, ethical principles, and security assurance, including legal subject status and responsibility of AI, threat to human survival due to in-depth AI development, and AI's transcendence over human brain and its influence on the world's changes. As those problems bear distinct global integrity and interest inalienability, not a single country can deal with those issues, and they are certain to bring great impact to international technical standards, norms for international trade, international laws, and system of international intellectual property right, all of which will impose severe challenge on the existing international norms and lead to restructuring of international order. With regard to huge challenges brought by AI development, international community should learn from the experience and lessons in global governance in other fields, unfold extensive international exchanges, and cooperation from the perspective of global governance in the new era and with a vision "common prosperity" of human society so as to formulate international norms for AI in scientific research, ethical principles, technology control, and system security and construct a global control system for AI that transcends industries and countries.

## 7.1 The Impact of Artificial Intelligence on International Norms

While the development of information technology impels human society to move from binary order into ternary order, the growth of artificial intelligence will bring a shock to civil order and have a great impact on international technical norms, rules for international trade, law and regulations, and intellectual property right system. All these issues will trigger a huge challenge to existing international rules and norms, and even evoke possible reconstructing of international order. For this reason, the international community should strengthen the coordination and cooperation and make concerted efforts to deal with the major issues caused by the development of AI, strive to formulate new norms in relevant fields, and construct AI global governance system.

### *7.1.1 Restructuring International Order in the Age of Intelligence*

From a global perspective, the development of artificial intelligence has exerted huge impact on the existing international order, while we should make pertinent corre-

sponding amendment in current international technical norms, rules for international trade, international law, and intellectual property right system.

(1) Amending International Technical Norms

As tremendous changes were incurred by the previous industrial revolutions and technical innovations, artificial intelligence has become the critical driving force for a new round of technological creation, under which new technology, products, industries, and fresh types of operation and modes are generated, bringing subversive shifts to related sectors. In context of globalization, the development of AI will evoke reconstruction of international technical norms in the fields of medical care, transportation, social interaction, environmental protection, and education. International community should work together to formulate international criteria and norms, both in the crucial technologies of AI such as open-source system, algorithm breakthrough and perceptions, and in the applications of AI, so as to lay a solid foundation of removing technological barriers in international trade and promoting common progress for human beings.

To take auto-industry, for example, No. 22 Technical Commission (ISO/TC 22 for short) under International Standardization Organization (or ISO for short) is responsible for formulating and collaborating international automotive standards. While pilotless driving using technology different from traditional cars will affect the original automobile standards. Considering operation experience, traditional automobiles rely more on mechanical components, such as HMI like steering wheel and tap position or brake, whereas pilotless vehicles utilize IT software and hardware, such as various kinds of sensors and systems of information processing and control-decision system.

The advent of pilotless vehicles will bring about at least two transformations in international technical norms for automobile. One is the alternative of subject in formulating the norms. With the rapid growth in pilotless driving technology, certain Internet enterprises like Google, Baidu, etc., have got the chance to embark on auto-industry, become the pioneers in this trade, and then evolve into the formulators of industrial norms and technical standards. The other one marks the elimination of the existing international technical standards, to be replaced by those imbued with AI. With the popularization of automatic cars, pilotless driving-related international technical standards will gradually evolve into the mainstream in this industry. In addition, pilotless autos may also greatly affect upstream–downstream auto-industries, resulting in replacements of relevant international technical standards in such fields as new electronic components, Internet of Vehicles, GPS navigation, and new generation of Internet.

Apart from the replacements, there should also be the international technical standards for artificial intelligence so as to better serve human society. The present problem lies in the fact that the ever-going AI development calls for more supplicated recognition technology in relevant fields, in contrast to the lack of unified standards in processing speed, hardware development, and evaluation modes for sensors, a dilemma that requires us to formulate the technical standards universal for different countries around the world.

(2) Remodeling the International Trade Rules

Historically, international trade rules stemmed from long-term international economic transactions of tremendous quantity. With the in-depth international divisions and exchanges, such rules were constantly perfected amid international competition and cooperation and have evolved into the fountainhead of the laws for international trade. As AI is widely applied to all sectors of international trade, the industrial rules are bound to go through a corresponding amendment.

AI will also affect international trade in a positive way.

First of all, we may forge a proactive supply chain.

Intelligent logistics system receives data from on-line preservation, package labeling, and shipment inbound scan at the loading area. Based on these, enterprises may forecast the possible supply chain disruptions and thus work out a compensation scheme in advance. Besides, it allows the enterprises to avoid shortage or excess of orders by predicting customers' behavior and improving the efficiency of inventory management. Moreover, intelligent logistics system is also able to work out the quickest and least-cost route for transportation, and leave room for unexpected situations like cancellations of order.

Secondly, we may lower the cost of the manual audit.

One of the biggest challenges for international trade falls on trade compliance, for which enterprises should be aware of whether the trade they are going to be engaged in accords with the law in the countries involved. For example, whether the products are categorized correctly, whether their declared value for customs is proper, or whether they comply with the export control regulations in concerning countries, etc. Compliance review has always been time-consuming and labor-intensive, as restrictions and requirements are constantly changing. Although we have had some compliance software, we are still expected to carry out a further manual audit, because those software tend to incur false positive and negative. While AI, by virtue of boosting learning ability, helps to lessen the number of false positive and negative, which will contribute to a cut in the cost of manual audit.

Thirdly, we may enhance the validity of international trade contract.

By transforming commercial documents which are obsessed with legalese into legal texts, AI enables enterprises to better their operations within contract clauses and lower legal risks. Besides, international trade contracts will be registered and cataloged through AI programs to ensure accurate implementations during the whole business process.

Fourthly, we may increase financing channels for trading corporations

Traditionally, banks may be troubled by a great number of anxiety and obstacles when considering whether to offer loans to trading companies. As a rule, banks will have to

send many compliance officers to examine whether those corporations have abided by trade rules in their international businesses before they finance those enterprises. For this reason, banks are usually reluctant to take so many troubles to offer loans to those companies. At present, AI may enable banks to analyze the compliance of international trade. With less time and costs spent in compliance inspection, more banks are willing to offer funds to import–export companies.

Fifthly, we may break through the limitations of time and space imposed by traditional international trade.

On completion of cross-border delivery in traditional international trade, contracting parties will almost have no more direct contact in addition to post-sale services, which will be usually performed by the third party. Different from the rules for conventional trade, the seller (provider) should be held responsible for the normal operation of his product during the service life after the delivery is completed. Through the sensors in the connected apparatus, AI may generate massive data and automatically upload the data to the seller, which will serve as materials for machine learning.

The impact AI lays on international trade rules could be interpreted as follows. Firstly, in the international trade involving commodities produced by AI (like robots), the primary feature of AI is to replace human labor and to manufacture products appealing for customers in competitive prices and fine quality, free from any reverse disruption of the existing trade norms. Secondly, smart products may arouse governments' anxiety of the importing countries over information security of various data. It can predict that importing countries will exercise more prudent and stringent measures in market access system for the sake of security and interests, a practice that may induce the resurgence of protectionism in the international trade. Thirdly, AI-based and mega-data-based E-international trade will integrate information, mega-data, Internet, and international trade to generate a new type of operation and commercial mode by virtue of global electronic trading platform, featured by the amalgamation of both online and offline operation, blending of market management, and government administration. In this way, the traditional mode of international trade will be gradually transformed from B2B to B2B2C, with which a large amount of intermediate cost will be saved by changing the modes of producers and multi-level distributors and adopting vertical circulation pattern for customers.

Powerful in scientific research, developed countries are the pioneers in AI studies, have pooled huge funds into this new technology and thus reaped significant fruits, but it will be probable to further aggravate the "Matthew Effect" in international trade. The new rules of international trade would not be conducive to the developing and under-developed countries. At present, there have emerged "WTO Agreement" by the World Trade Organization and "Trans-Pacific Partnership Agreement" (TPP for short). Actually, "WTO Agreement" is now prevailing because President Trump declared USA's withdrawal from TTP in 2017. Although this agreement is dominated by the developed countries, such situation will soon be changed with the rapid development of AI. However, it will be a long-drawn process for people to bring forth new AI-related international trade rules.

(3) People's Predicament in Quotation of International Law and Regulations

With the extensive application of AI, various kinds of problems concerning law and regulations keep emerging in the fields of intelligent machine, pilotless cars, smart medical care and virtual reality, etc. With regard to the rapid development of AI and the subversive changes caused by this technology, we should enforce the pertinent rules so that we may develop secure, reliable, and controllable AI to bring benefits to human society, a pressing issue that has attracted worldwide attention. In contrast to accelerating the development of the technology, formulation of AI-related international laws and regulations is somewhat sluggish and retarded, a delay that aggravates the uncertain development of AI and poses severe challenges to the international laws and regulation in other areas. To be more explicit, the influence that AI has exerted on international law and regulations is demonstrated as follows:

(1) International Response to Legal Entity

AI development has triggered heated debates on the issue of whether legal status should be granted to intelligent machines. Chap. 3 of this book also comes up with some measures to deal with this problem, in which the author appeals for consulting the practice of EU and proposes the legislation of legal entity for intelligent machines, of the corresponding legal status for intricate autonomous machines in particular. Moreover, the EU also motions to formulate classification standards for intelligent machines so as to ensure the traceability and further normalize the application of intelligent machines. (Cao Jianfeng, "*EU's Ten Predictions on The New Trend of AI Legislation,*" No. 2 of "Robotics Industry," 2017.)

(2) International Response to Privacy (Data) Protection

In the age of intelligence, personal information has become a "merchantable thing," inevitably leading to illegal use of personal privacy (data) and thus drawing global concerns about privacy right protection. To take medical treatment, for example, a large number of clinical cases should be prepared by AI, but this practice is prone to evoke people's anxiety on the protection patients' privacy and personal information security. At present, supplicated intelligent medical system is still dependent on massive clinical cases constantly provided by various devices, platforms, and Internet, a process that will lead to illegal use of personal information by certain individual or institutions. For this reason, protection of personal privacy (data) is the crucial issue in formulating international laws and regulations.

With regard to the above-mentioned issues, a consensus should be concluded among international community, in which AI should protect personal privacy and intellectual property right and ensure safe application of personal information. In 2016, EU released "General Data Protection Regulation (GDPR)," emphasizing that one smuts observe the corresponding regulation when collecting personal data and he will be subject to a severe penalty if he violates the law. In December, 2016, IEEE brought forth "*Ethically Aligned Design: A vision for Prioritizing Human Wellbeing with Artificial Intelligence and Autonomous Systems (1st edition),*" which pinpoints data asymmetry, a major predicament in personal data protection and calls

for formulating pertinent policy to address this problem. In addition, the document also appeals to AI planners to design and apply intelligent systems on the basis of keeping intact personal data.

(3) International Response to Restructuring of Accountability

Apart from the legal entity and personal privacy, another major challenge that AI development brings is liability distribution and commitment. AI products with autonomous learning, abilities of judgment and improvement, including autopilots, industrial robots and service robots, are likely to accomplish some tasks independently without human operation and supervision. In that case, who would be responsible for the damages, if any, harmful to the human body or property? The designer, the producer, or the cyborg itself? Are they going to undertake the full or just partial liability? All of these issues mentioned above have posed severe challenges to law and regulations. In order to solve them, it is particularly significant for countries to conduct confirmation of civil and criminal liability, formulate related safety management code and propel an agreement on the legislation of artificial intelligence.

Firstly, we should conduct confirmation of civil and criminal liability. Under "*Ethically Aligned Design: A vision for Prioritizing Human Wellbeing with Artificial Intelligence and Autonomous Systems (1st edition),*" the second fundamental principle that IEEE brought forward is liability rule prescribing that AI could be accountable. To start with, AI is supposed to be of accountability in its procedure level and then to substantiate its logic of working in such a particular way. Besides, lawmakers should define the duty, fault, liability, and accountability involved in the process of developing AI, helping manufacturers and users to be clearly aware of their rights and obligations. Then, if the impact of AI in procedure proves to be excluded in the established specifications, interested parties should work out some new rules immediately to normalize AI. At last, producers and users of AI system also need to continuously use the recording system, so as to keep the kernel parameter and thus effectuate traceable liability.

Secondly, we should formulate related safety management code. Helpful explorations have been carried out in formulating international regulations on pilotless driving. For example, USA and Germany have laid down relevant safety management regulations for defining liabilities. In 2013, National Freeway Traffic Safety Administration of the United States issued "Federal Automated Vehicles Policy," normalizing accident liabilities of automated vehicles based on safety regulations. In addition, Germany, France, and Japan decide to jointly formulate the unified traffic rules for pilotless vehicles since 2016. According to their planning, these countries will work out the rules for steering wheel-free pilotless automobiles to overtake and merge on highways before 2018, which will serve as the domestic standards for Japan and Germany. After Japan and Germany take the lead in bringing forth such rules, the expert conference of the United nations has also embarked on formulating the similar standards for pilotless driving.

Thirdly, we should conclude an agreement on liability regulations, which calls for the concerted effort from relevant international institutions to set up liability rules. Legal Affairs Committee of EU Parliament proposed two motions. The first

one is to promote mandatory insurance (or compulsory insurance) policy, under which people from some certain groups or industries, willing or not, are obliged to effect the insurance specified in corresponding law and regulations. Such insurance is widely used in public security. According to the proposal made by the Committee, manufacturers or owners of robots shall purchase the compulsory insurance and be responsible for the corresponding compensation if any damage is caused by robots. The second motion aims at establishing compensation funds, which will be used in the cases uncovered by compulsory insurance, with sponsors including investors, manufacturers, and consumers.

(4) Transformation of International Intellectual Property Right System

Although international intellectual property right system is an important part of international law, yet in view of the importance of intellectual property right and immeasurable influence of AI upon international intellectual property right, we should pay special attention to and study this system, evaluate its affect, keep track of its trend, respond it, and make timely adjustment.

That AI becomes the hotpot and difficult point in the protection of intellectual property right is due to its rapid development, as it brings a new challenge to the fundamental concept of existing intellectual right protection, which will invariably incur significant changes in the protection system of international intellectual property right. To be specific, AI mainly challenges the capacity as a subject of law, de facto right a legal responsibility.

(1) AI development will lead to the changes in legal entity relationship of intellectual property right. We may wonder whether AI acquires the capacity as a subject of law for such right. If it does, what kind of rights will it enjoy? As for the creation of fruits by AI, how to judge the ownership of the fruits, is it the AI developer or AI itself? In addition, as AI is used to assist a customer in making a decision, it will be bound to apply other equipment or the data of the operating software, how will we judge the proprietor or the effective delegation person? Should one seek for the consent from the equipment producer (or proprietor) or the software developer be he applies the public data?
(2) Once the capacity as a subject of law is defined, AI will face the issue on how to take on legal responsibility, which evokes challenge to the existing protection system of international intellectual property right. Different from traditional technology, the infringement of AI in intellectual property right is conducted by multiple subjects. Therefore, it involves the indirect infringement responsibility more and the consequence will invariably incur negative impact on innovation fair competition.
(3) We should persevere in the principle of technical neutrality, but we should also guard against the abuse of this principle. As there is no mature experience for reference for those issues in the international community, it is imperative that different countries should enforce legislation cooperation among them and make a concerted effort to deal with them. It is foreseeable that AI will exert significant influence on the existing protection treaties of intellectual property

rights, and armament should be made in such treaties as "Trade-Related Intellectual Property Agreement," "Paris Convention for Protection of Industrial Property," "Berne Convention for Protection of Literary and Artistic Works," "Copyright Treaty of World Intellectual Property Organization," and "World Copyright Convention."

(4) AI will bring a certain shock to management practice of intellectual property in that AI application in this field may simplify daily affairs on one hand, and elevate development and application capacity of intellectual property data on the other.

### *7.1.2 Shortage of International Norms in AI*

It is the core issue of AI development in different countries that we should remove technical barriers in international trade, address the major issues in AI development, and promote AI technical progress and sharing, which are beyond the ability of a single country, organization, or individual. Therefore, we should intensify exchanges and cooperation in international community, formulate relevant international norms, and exercise effective governance on AI development.

(1) International Conflicts Caused by AI Development

Globally, with increasing maturity of AI and its application in different trades and fields, there will be generated huge risks in cyberspace, human ethical principles, and armament race. These ricks pose severe challenges to the international community, and make human beings facing "the worst hazards," all of which belong to international control issues and of which should be subject to discussion in international forums as a single country is unable to deal with those challenges.

For example, the public is quite anxious about the issue of whether robots will replace human beings and become the world dominators. At the advent of intelligence age, machine learning is quite different from the previous intelligent machines. By imitating human intuition, machine learning has made breakthrough in perception realm. Equipped with the ability of intuitive action, robots can replace human beings in doing various kinds of work, and even develop self-consciousness of mankind, which will endanger human dominance and survival. In a certain period of human development, AI may transcend human wisdom in an all-around way, control mankind, and become world dominators eventually.

(2) International standards for artificial intelligence

As there are disparities in AI standards of different countries due to their varied development levels and stages, and different regulations in their civil laws, leading to the divergences of each country's legislation, conflicts are prone to arise in the legal application. Unmanned aerial vehicles (UAV) are subject to such a dilemma. For instance, even though DJI UAV is outstanding in performance, they would not

be procured by US military, a case showing that there exist different interpretations and conflicts in technical standards between China and USA.

In May, 2017, the US army released "Technical Threat and Cyber Vulnerability of DJ Unmanned Aerial Vehicles," holding that such UAV produced by China "were easy to be assailed in network environment." The report calls for prohibition of DJI UAV in US army. In the same month, US navy put forth a memorandum "Operation Risks of DJI Series." Contrary to the arguments in these two reports, the people concerned and even governmental departments in USA hold the opposites views, who raise the specialized research data to prove the security of DJI UAV. Obviously, shortage of unified international standards for UAV is attributable to the disparities in USA. Absence of international standards for AI will lead to continuous conflicts in AI application in different fields. With regard to this, different countries should reach a consensus in the course of developing and utilizing AI on the basis of friendly consultation, reciprocity and mutual benefit, and enforcement of exchange and cooperation. The move will be conducive to deal with AI challenge by the concerted efforts of human beings so as to make AI better serve for mankind (Fig. 7.1).

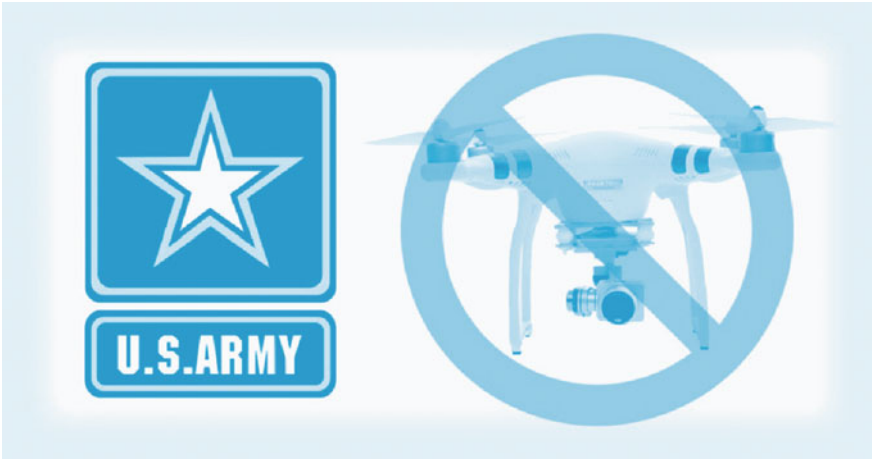



**Fig. 7.1** Dji drones, which are banned by the US military. *Source of the picture* Will Nicholls. US Army Ends Use of DJI Camera Drones, Cites "Cyber Vulnerabilities" [EB/OL]. (20170805) [2017-11-23]. https://petapixel.com/2017/08/05/us-army-ends-use-dji-camera-drones-cites-cyber-vulnerabilities/

## 7.2 Evolution and Elements of International Standards for AI

International community has tried on some helpful exploration and attempts in AI governance and formulated relevant principles and norms. However, those principles and norms are not turned into the unified international standards so far in that they are adaptable to the AI developing trend and cannot be proactive in predicting AI development on one hand, and the worldwide consensus is not reached as they still remain the domestic policies in some countries on the other. Therefore, it is imperative the different countries should frequent mutual communications, exchanges, and cooperation in an endeavor to formulate the international standards universally recognized by the international community.

### *7.2.1 The Foundation for AI International Standards*

Even since the advent of AI, "Three Principles for Robots" proposed by Asimov has been the fundamental principle for exploration of ethic and moral problems brought by AI, signifying the new developing period of AI. Obviously, through machine learning, AI has acquired certain self-consciousness, resulting in disobedience of human command and suicide of robots which reverse "Three Principles for Robots" and evoke people's anxiety and retrospection on AI. For this reason, relevant international institutions and renowned enterprises have initiated the seminars on AI international standards for development, security, and ethics of AI.

In April, 2007, Japan released "Guideline for Security of the Coming Robots(Draft)," which serves as a legal document for researching and manufacturing standardized robots and an early legislative act for intelligent machines to strictly regulate robot's behaviors, in which all the operations of robots must be decided by human beings. For this purpose, this Draft also stipulates that all the manufacturers must load every event that robots do harm to mankind into the central databank so as to avoid the repetition of similar accidents. In April of the same year, South Korea drawled up "Ethical Chapter for Robots," which sets the regulations for the relationship between human beings and robots so as to prevent human "maltreatment" of robots and robots' "harm" to mankind.

In October, 2015, based on "Three Principles for Robots," Japan's Keio University puts forth "Eight Principle for Robots," adding such norms as "confidentiality, application restrict, security protection, publicity, and responsibility." In May, 2016, the Legal Affairs Commission of European Parliament brought forth "Charter on Robotics" in "Draft of Legislation Proposal Submitted to European Union on the Rules of Civil Law for Robotics," in which the basic ethical principles are set for design and development of robots. At the end of June, 2016, Satya Nadella, CEO of Microsoft, came up with "Six Norms for Artificial Intelligence Security." In September, 2016, the CEOs of world five major hi-tech companies, including Amazon, IBM,

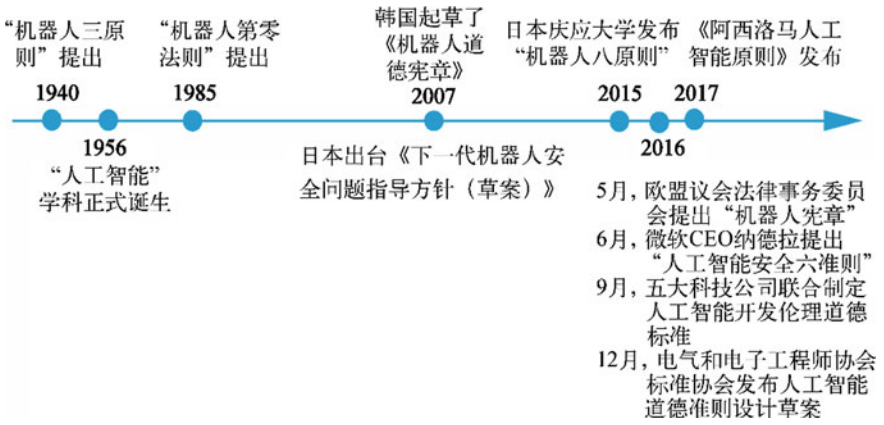



**Fig. 7.2** Evolution of international AI guidelines

Microsoft, Google, and Facebook, jointly formulated the ethical and normal standards for AI development. In December, 2016, Institute of Electrical and Electronics Engineers released “Ethically Aligned Design.” In February, 2017, Elon Musk, CEO of SpaceX and Stephen Hawking, published “Asilomar AI Principles,” which consists of 23 principles, called “Asilomar Twenty-Three AI Principles” (Fig. 7.2).

“机器人三原则” 提出: Three principles of robotics being proposed

“机器人第零法则” 提出: The zeroth rule for robots proposed

韩国起草了《机器人道德宪章》: South Korea drafting a robot ethics charter

日本庆应大学发布 “机器人八原则”: Keio University in Japan releasing its eight principles for robots

《阿西洛马人工智能原则》发布: Asilomar AI principles released

“人工智能” 学科正式诞生: Artificial intelligence discipline being born formally

日本出台《下一代机器人安全问题指导方针(草案)》: Japan unveiling safety guidelines for next-generation robots (draft)

5月, 欧盟议会法律事务委员会提出 “机器人宪章”: In May, the European parliament’s legal affairs committee proposing a charter for robots

6月，微软CEO纳德拉提出 “人工智能安全六准则”: In June, Microsoft CEO nadella proposing six guidelines for AI security

9月，五大科技公司联合制定人工智能开发伦理道德标准: In September, five major technology companies jointly formulating ethical standards for the development of artificial intelligence

12月， 电器和电子工程师协会标准协会发布人工智能道德准则设计草案: In December, the association of electrical and electronics engineers standards society releasing draft design guidelines for ethics in artificial intelligence.

### *7.2.2 Principles for AI International Norms*

As people first embark on formulating international standards for AI development, some countries and international organizations have conducted the initial exploration, but they still do not reach a consensus. In recent years, after we have trimmed and studied the existing international norms put forth by the experts and scholars of different countries, we hold that international norms for AI should cover those in scientific study, ethics, technical control, and system security, among which research norm should be the standard for different countries to follow in their development of AI, and those in ethics, technical control, and system security in their application of AI.

(1) Research Norm

As AI exerts a profound influence on human society, we need to formulate research norms for guiding AI benign development so as to make it popular to people and benefit people. Such norms deal with the targets for scientific research, research grants, studies of culture, and supportive policy.

(1) To Develop Beneficial AI

AI is an interdisciplinary subject involving computer science, mathematics, philosophy, psychology, and linguistics, which focuses how to make intelligent machines or intelligent systems with an aim of expanding human intelligent ability by simulating human activities. While researchers are making constant progress in simulating human intelligent ability, we must impose certain restraint on AI research goals, with results conducive to human beings as the main research purpose.

(2) To Raise Special Funds for Studying AI Critical Issue.

Investment in AI should cover special research funds, which is made to ensure a helpful application so as to address the headache problems in computer science, economy, law, ethics, and social studies. ① How to ensure proper AI development and make it conform to human will so as to avoid malfunction or invasion from hackers. ② How to achieve prosperity while ensuring AI health development to realize human targets by virtue of automation. ③ How to update our legal system and make it more fair and efficient so that we may keep pace with AI development and bring AI-related risks under control. ④ What kind of values AI should accord with and what legal and ethic status it should fall in.

(3) To Forge Cooperative, Transparent, and Mutually Trusted Culture

There should be the cooperative, transparent, and mutually trusted culture between AI researchers and developers in an effort to probe the unknown realm in AI, elevate the efficiency in technical research and development so as to make AI more safe and reliable.

(4) To Obtain Supportive Policy to Direct AI Healthy Development

AI development has been set as the major strategy for elevating a country's competitive edge and safeguard national security, for which different countries have successively put forth respective program and policy in an attempt to master the dominating right in the new-round international competition. For this purpose, AI researchers should unfold constructive communications with policy-makers so that they may gain the supportive policy for AI development on condition that AI would not do harm to human beings.

(2) Ethic Norms

Thinking highly of the ethical and moral issues on AI, some world-famous companies (such as Microsoft and Google), European Parliament and Standardization Association under IEEE have successively worked out their respective ethical norms on the security and control of AI, involving ethical principles for AI development and for AI products. They cover the following elements:

(1) Responsibility Regulations for AI Designers and Developers

At the initial stage of AI design, development, and production, designers and developers are committed to observing ethical norms so as to ensure the applicable law for AI, safe and ethical principles. The ethical norms for AI workers cover profitability, harmlessness, compatibility design, diversity, transparency, and privacy protection.

(2) Robot Transparency

Researchers of Bath University propose an ethical principle named "robot transparency," requiring that every user should easily identify the intention and ability of a machine. For example, after an automobile runs down a pedestrian, people should acquire the records kept by the car so that they rectify the code to eliminate such error. In addition, some robot experts also appeal that robots and automatic system be equipped with "ethical black boxes," similar to those installed in airplanes, which will record the decisions and acts made by robots before the malfunctions. "Regulations for Protecting General Data" put forth by European Union which will be effective in May 2018 offers the room for rectification: "If the decisions automatically made by machines incur severe consequences in legal and other fields, individuals will be entitled to raising objections."

(3) AI Security

In Article 6 and Article 7 of "Arsilomar's Principles for Artificial Intelligence," AI security falls into the field of ethical principle, signifying that AI should be safe and reliable during the operation, and its feasibility and applicability should be verified so as to ensure the coming ethics, interest, and security for human beings.

(4) Individual Privacy Protection (data)

AI is expected to protect individual privacy and property right and to ensure the safe application of personal information. During the whole operation, no infringement of individual privacy should be allowed. In case the infringement (data) occurs during the operation, the designers and developers should hold certain moral obligation. In "Regulations for Protecting General Data" adopted by EU in 2016, one should observe the corresponding laws and regulations in using individual data and no illegal application personal information (data) will be allowed.

(5) To Encourage Flow of Non-prsonal Data

With regard to data's role in constructing AI infrastructure, we should reach an agreement in the issues concerning data allocation, acquisition, localization, management, and security. In these respects, EU has made a favorable exploration. To promote the transnational flow of non-individual data, European Commission released "Regulation on the Free Flow of Non-personal Data" on September 13th, 2017, aiming at abrogating "data localization" as required by its members. Moreover, it ensures the jurisdiction of data access and acquisition for supervision departments. If this act is approved and becomes the law of EU, its member states will no longer require enterprises to store data in their information centers.

(6) AI Value to Be Submissive to and Serve Human Beings

Although part of the AI algorithm can make more reasonable decisions than mankind does, it remains a huge technical challenge to rule out racial or gender discrimination in data application. Confronting the possible social transformation triggered by AI, we must ensure that AI be adaptable to human values.

How will we make sure that all the goals and acts during AI operation be compliant with human values? Firstly, we should bring the development and application of AI under control. How far AI develops and how powerful the independent consciousness of a machine is, we must adhere to this bottom line. Secondly, we should make AI corresponding to human values. Elon Musk proposes that a supervising institution be set up to guide its development so that AI may accord with ethical norms of human society.

(3) Technical Norms

At present, AI is based on machine learning. As computer system is getting more complicated, people find it hard to exercise close supervision on AI, resulting in declining autonomous control on AI. For instance, in the fields of criminal justice and medical care, many companies have started the exploration into AI decision-making capacity on probation or diagnosis. However, if intelligent machine is granted decision-making power, mankind will be confronted with the risk of uncontrolled AI. For this reason, in addition to formulation and implementation of ethical norms for AI, we should work out technical standards to supervise AI in a proper way.

(1) To Enhance Verifiability and Accountability

In terms of verifiability and accountability, a new way is needed for AI. Verifiability aims at establishing a system to meet formal and numerous requirements, whereas accountability is designed to come up with the requirements in the user's operation. New means are badly needed for AI in evaluation (to make sure whether the system is operating in a proper way, particularly in unexpected context), diagnosis (to certify the causes of malfunction), and renovation (To bring the system to normal operation). For the system that transcends its independent operation time, the designers are unable to take all possible conditions into consideration. Therefore, if such a system is made to be reliable and energetic, it should be granted with the capacity of exercising self-evaluation, self-diagnosis, and self-repair.

(2) To Exercise Strict Supervision on the Constantly Self-Perfect AI

The 22nd Article in "Asilomar Principles of Artificial Intelligence" proposes that we should implement strict safety and regulatory measures over the artificial intelligence that can rapidly elevate the quality and increase the numbers through the means of self-perfection and self-duplication.

(3) To Defense the System from Virus Attack

To deploy it in the critical system (such as military system), AI should be very powerful to deal with the unexpected occurrences, and to fight against network attacks by hackers. AI system to be deployed must acquire strong fault-tolerant ability as a man's brain, which is capable of ensuring system security if certain programs are subject to malicious falsification from the virus. In this context, AI should be quick enough to analyze and address each virus, and to positively cope with virus attacks, a way that changes the passive defense marked by "being attacked—discovering the virus—identifying and removing the virus." The extensive application of AI may identify attack source, the degree of threat, attack frequency at the first time, and adopt the precautions and solutions. AI not only elevates operating efficiency but also strengthens defense for network security and intelligent coping ability at the executive and strategic level.

(4) Capability Caution and Non-subversion

According to Article 19 in "Asilomar Principles of Artificial Intelligence," "capability caution" indicates our ability to avoid the upper-limit assumption on AI, while "non-subversion" denotes that people should respect and promote the healthy developing process of human society rather than destroy this process after bringing the advanced AI under control.

(4) Security Norms

Although dramatic progress has been made in intelligence technology, there still leaves something to be desired in absolute security and foreseeability, of which AI security is a major problem. In June, 2016, Google, together with Open AI,

Stanford University and Berkeley University, published an academic paper "Concrete Problems in AI Safety," which touches upon the specific issues that researchers may run into in their development and application of AI. In addition, Google research team puts forth five principles in developing smarter and safer AI. To be specific, the norms for system security cover risk planning, fault transparency and juridical transparency.

(1) Risk Planning

Automation is typical of AI, which makes it hard for people to predict and manage existential risks. This is shown in the ineffective post-disaster measures in the context of catastrophic risk. Therefore, in view of AI risks, particularly catastrophic risk and existential risk, the whole human society will be endangered, and even be completely destroyed. For this reason, we must predict its possible consequences and find out the solutions.

(2) Fault Transparency

In case AI is accidently destroyed, we must quickly identify the causes. In practice, it is a tough job to elevate AI explainability and transparency. Many algorithms, including the algorithm of in-depth learning, are incomprehensible to users, but there is no such mechanism for interpreting the results in the AI realm. For example, in the medical field, doctors diagnose patients and propose therapies in a conventional way, which is illuminable. However, some intelligent technologies, such as decision-tree reasoning which carries interpretation function, would not offer the proper interpretation, a context that calls for the researcher to develop the more transparent system that can automatically interpret the results and acts to users.

(3) Juridical Transparency

In "Asilomar Principles of Artificial Intelligence," Article 8 emphasizes that all the judicial decisions made by automatic system should offer satisfactory juridical interpretations and can be accepted by experts. In juridical practice, supervision departments and judiciary authorities place requirements on transparency and burden of proof. But the results of machine learning are uncertain and hold no requirements on algorithm confidential, between which there exists a structural tension. For this reason, we should set up a supervising system that will motivate AI development and will reasonably distribute risks as well.

## 7.3 Strategies for Constructing AI International Norms

To construct AI international norms, we should take a view of global control and cherish the vision of "common prosperity" of human society and conduct overall planning and design for AI development through the consultation of the governance experience in other fields.

### *7.3.1 To Develop AI from the Perspective of Global Control*

(1) Planning and Control: Two Emergent Tasks

As human society enters into the ternary spatial structure from the binary one, profound changes have taken place in the participants of constructing a new international order, which induces many global problems. By virtue of global governance, it is the consensus of different countries to construct a new international order. After the end of European Thirty-Year's War (1618–1648), Westphalia Peace Treaty has constructed an international politics system with relative power balance, which is the first international system in the modern history of the international relationship as well as the first international system affirming nationalism in the form of a treaty. Since it was signed, concepts such as independent and equal sovereignty, non-interference of internal affairs and balance of power have been the fundamental principles of international relations and international laws. As the entity of safeguarding the national interest, the sovereign state becomes the subject of international situation evolution. With the development of globalization, as the conflicts between national interest and global interest are turning increasingly fierce, the practice of international relations proves that no country can solve the new global issues in the pursuit of respective national interest by force. Moreover, with strengthening ties among different countries, a new situation marked by "mutual infiltration" is formed and new challenges are constantly imposed on the international order. The practice of heightening self by weakening its opponents or mutual restraint is subject to more and more queries. As the participants are diversified with each passing day, the subjects of constructing international order turn to be multiple ones from the mono sovereign state, including individuals, various interest groups, countries and international community, even men and ecology. The appeals of those interest groups should be known in international cooperative order.

As new progress is constantly made in AI, the new subjects have induced new changes in rank order of human society and generated new problems and challenges, which call for the concerted efforts from the international community to deal with them. On one hand, changes have taken place in the rank order of human society. AI will lead to "digital divide" in human intelligence, which is manifested in the fact that a minority of people (designers and operators of AI) are becoming smarter, whereas a great majority of people will be intelligently degraded, and turn to be more mediocre and become "living corpses," resulting in "dehumanization" of mankind. On the other hand, intelligent machines will be the subjects of international governance and "man-machine relationship" will become the focuses on international conflicts. As the coming AI will probably acquire independent awareness, the problem of reverse control on human beings will be generated and even obtain the ability to exercise self-remolding and to control the future world, all of which will impose huge challenges upon human beings.

(2) Vision: Promoting Common Prosperity of Human Beings

It is an irresistible trend to strengthen global governance and promote the transformation of the governance system. Based on his accurate prediction of the world's developing trend, Xi Jinping, China's president, proposes "a community with shared future for humanity," a concept for global governance. This idea stems from the profound changes in international balance of power in the traditional binary space of human society. With the rapid development of emerging market economies and developing countries, different countries should establish an international mechanism, abide by international rules, pursue international justice and construct a mutually infiltrating community of shared interests through global governance system and on the basis of friendly consultations. The advent of cyberspace has brought huge challenges to mankind, for which all the countries are positive in planning and bring forth a global governance concept marked by co-negotiation, co-construction, and shared community to deal with cyberspace troubles.

To take international security, for example, in the context of relevant ability to reconstruct national defence, the application of AI in the military field may incur a series of international issues. As technology-leading countries use unmanned weapon platform through remote command and soldiers are put in a safer place than the civilians, the ethical problem will arise. The abuse of AI will lower the threshold of the coming war. Due to falsification and virus invasion by the opponents, AI platform may indiscriminately slaughter the innocent people. It is the pressing task for mankind to keep AI from terrorists' application so as to avoid the risks of transnational attacks and erroneous judgment of war. In addition, the gene will be transformed through AI. The effective solutions of all these problems should start from the perspective of the human community with share future and depend on our analysis and judgment of international security challenge in AI age.

Therefore, with the vision of "common prosperity" and through the construction of international norms, human beings should promote AI development so as to bring benefits to the state, society, organization, and individuals. They should also make AI to motivate economic development so as to improve living quality and ensure global security. "Common prosperity" covers three implications: common interest, shared interest and prosperity, and AI free from armament race.

(1) Common Interest. AI should serve universal value. Taking the interest of human beings into consideration, we should enable as many people as possible to use AI and bring them more interest, opportunities for development and prospects rather than benefit a state, an organization, and a minority of people. To ensure AI to bring benefits to the populace, achieve safe development and maintain social stability, different countries should endeavor to construct industries and organizations responsible for relevant standards and promote the formulation of AI international norms.
(2) Shared Interest and Prosperity. Advanced AI signifies profound changes in the history of the development of human society. The economic booming achieved by AI should be universally shared and bring benefits to mankind. In addition, achieving common prosperity requires more participants in developing AI and

makes them enjoy the fruits of technical achievement. Moreover, while enjoying AI benefits, all human beings should work out planning for an exercise management over AI so as to make it to permanently serve mankind.

(3) AI Free from Armament Race. Countries should be prevented from making AI in developing automatic and deadly weapons in their armament race. If AI is used in the armament race, the competing countries will be loaded with heavy economic burdens in their military expenditure. Moreover, the armament race will bring harmful effects to the world's political ecology, endanger peace, and development. At present, AI armament race mainly focuses the development of automatic and deadly weapons, particularly armed robots. In addition, the international community should also impose relevant restrictions on civil intelligent machine companies so that governments are prohibited to order civil robot companies to produce military robots.

### *7.3.2 Drawing Lessons from Successful International Experience in Other Fields*

International community offer different countries its experiences in dealing with the proliferation of nuclear weapons, abuse of clone technology, and transgenosis security so that they may cite the reference for AI global governance and formulation of international norms.

(1) Control of Nuclear Weapons

Nuclear weapons were invented in the 1940s, which was first used on the battlefield of the World War II. In August, 1945, the USA dropped two atom bombs in Hiroshima and Nagasaki, Japan, ending that most disastrous war in human history. It is a pity that the application of nuclear weapons killed many civilians, a consequence that aroused the objection and resistance from many physicists who participated in the research and development of the weapon. Since then, some countries have made substantial progress in their nuclear programs, among which a few are able to turn nuclear materials and technology into weapons, resulting in severe situation for people's efforts to control nuclear weapons. However, since the end of the World War II, there have been no wars of using nuclear weapons, which is due to various control strategies of nuclear weapons exercised by sovereignty countries and intergovernmental organizations. More importantly, the global governance strategy presented by "governance subject—construction of control mechanism—conceptual construction" is a cornerstone in preventing nuclear war from happening for nearly seventy years.

(1) Governance Subjects: Mutual Coordination among Multi-behavioral Entities

Governance subjects cover sovereignty countries, intergovernmental organizations, and mass associations. On the one hand, sovereignty countries, intergovernmental

organizations have made great contributions to the control of nuclear weapons, which are the global control mainstay. On the other hand, civil organizations, including specialized research institutions, organization of international celebrities, and groups of specific professionals, have also done their bits, among which non-governmental organizations play an indispensable role in controlling nuclear weapons and make up for the deficiencies in the control mechanism. For example, the Federation of American Scientists consisting of the experts of nuclear weapons has gained a deeper understanding of the perils of such weapons and thus has an authoritative right of speech. As the experts in this institution keep high independence and their studies are for benefit of human beings, their research achievements would be easily accepted by the international community, conducive to the process of global control of nuclear weapons. Greenpeace, another non-governmental organization, shows concern in the control of nuclear weapons from a specific topic, which strongly calls for ban on nuclear tests as they cause severe destruction to the environment.

(2) Governance System: To Prevent nuclear Proliferation by Treaties and Agreements

To prevent nuclear proliferation, the international community has formulated a series of international treaties, set up international institutions and organizational mechanism, all of which constitute nuclear non-proliferation mechanism, mainly supported by International Atomic Energy Agency founded in 1957 and "Treaty on the Non-Proliferation of Nuclear Weapons" signed in 1968. This mechanism not only effectively controls the growth of nuclear countries, smothers the intentions of nuclear-free countries to develop nuclear weapons and prevents the proliferation of nuclear weapons, but also promotes the process of nuclear disarmament by powers. In addition, this mechanism has also promoted the peaceful use of nuclear power in the world. "Treaty on the Non-Proliferation of Nuclear Weapons" is the most authoritative international law for peaceful sue of nuclear power, which puts the member states under strict international supervision while enabling them to use nuclear power for peaceful purpose. In fact, not only sovereignty states play their role in nuclear non-proliferation mechanism, mass organizations also promote the construction of nuclear non-proliferation mechanism. Moreover, construction of nuclear-free zones (After Latin America became nuclear-free zone in 1967, similar treaties were also signed in other parts of the world.), an innovated system, has exerted extensive demonstration effect in global governance and brought about more control regulations for nuclear proliferation.

(3) Conceptual Construction: To Enforce the Identity of Nuclear Non-proliferation Concepts and Internalize Self-Acts

The formulation of regulations for nuclear non-proliferation makes the countries concerned to consciously observe these norms and so they reach a consensus. The most important way for the norms to function is to integrate with the system. After sovereignty countries signed "Treaty on the Non-Proliferation of Nuclear Weapons," the restraint clauses urge them to consciously observe the treaty. The restraint clauses

cover "no right to nuclear power" and "peaceful use of nuclear power." With time passing, nuclear non-proliferation evolves into the authentic "universal law of morality."

(2) To Prevent Abuse of Clone Technology

Just like a double-edged sword, clone technology can bring either benefits or scourges to mankind. The abuse of clone technology (such as the attempts to use the technology to cultivate headless men as donors of organ transplantation or to make it as man's tool) is a challenge to human right and human dignity and violates the law of biological evolution. The worst case is to disturb the normal ethical order. With concerted efforts of international community, an international control mode marked by "state legislation—international conference—declaration of 8-country top leaders—participation of international organizations—international treaty" is formed, which aims at preventing abuse of clone technology.

As early as 1990, the United Kingdom released "Human Fertilisation and Embryology Act," a law for application of clone technology. It is the first country in the world that makes legislation for medical reproduction. In the same year, Germany introduced "Embryo Protection Act," which explicitly defines the scope for studying reproduction technology. In June, 2001, Japan put forth "Law on Clone Technology."

In order to standardize the development of clone technology, the World Health Organization formulated "Resolution on Clone Technology" at the conference convened in May, 1997, which definitely bans the application of clone technology on human beings. In G8 Summit Conference held in June, 1997, Jacques Ren Chirac, the French president, proposed to ban human cloning, which was admitted into "Declaration of G8 Summit Conference." In October, 1997, members of Council of Europe unanimously resolved to prohibit clone men. In December, 1997, UNESCO adopted "World Declaration on Human Genome and Human Right," appealing for the prohibition on man cloning as it infringes human dignity. At the conference of formulating "International Convention on Prohibiting Genital Clone Men" in February, 2002, the United Nations proposed the prohibition of man cloning in any form, whether reproductive or therapeutic cloning.

(3) Protection of Transgenic Technology

Since the advent of transgenic technology, the international community has initiated a number of heated discussions on the ethical issues brought by this technology. The negative impact of this technology mainly involves security in foodstuff, environment, and biology.

To deal with the challenges of transgenic technology, different countries should make concerted efforts to set up a protective system for global biology security, in which they will study and resist the invasion of alien species and stop the infection. During this process, they should draw mutual experiences and methods, update technology and management without delay.

There are two forms of legislation for biology security in the international community. One is product management-based mode in the USA, in which specific

institutions are responsible for labeling and inspecting transgenic products. Once the products are found with allergy, toxicity, and new components, the production and sales will be immediately stopped. Another one is technology management-based mode practiced in EU, in which corresponding laws and regulation are formulated for the pertinent transgenic technology and products. The products containing transgenic components bust be labeled and checked. Moreover, strict inspection and traceable and recyclable mechanism are implemented so as to ensure the traceability of genes. These two modes can effectively control the negative influence brought by transgenic technology.

(4) To Deal with Climate Changes

Climate change is one of the issues attracting world's attention. To deal with climate changes, the United Nations set up a special intergovernmental commission, which organized more than once international conferences and formulated a series of documents, with which a basic framework is formed to deal with climate changes, marked by "special commission—international conference—international convention—action."

On April 22nd, 2016, the leaders from over 170 countries signed "The Paris Agreement" on climate changes, committing to bring global climate warming under the control of 2 °C. This agreement is the third landmark international law, following "The United Nations Framework Convention on Climate Change" in 1992 and "Kyoto Protocol" in 1997, all of which aim at forming a global climate governance pattern after 2020. (Lv Jiang, "'The Paris Agreement': New Systematic Planning, Uncertainty and China's Option", No. 3 "A Survey of International Situation," 2016.)

"The Paris Agreement" represents the concept of harmony in diversity and gives full consideration of the national conditions and capacities of different countries and reflects the demands of different member states under the United Nations, which is generally observed by the contracting parties. For example, "The Paris Agreement" stipulates the different responsibilities of developed countries and developing countries as shown in the practice that the developed countries continue to take the lead in emission reduction and exercise absolutely quantized reduction so as to offer capital to the developing countries, while the developing countries such as China and India raise the emission reduction on the basis of their own conditions and the under-developed countries and islets may compile and notify their strategies, plans and actions for greenhouse gas emission on their specific situations.

Obviously, "The Paris Agreement" is conducive to the adoption of non-invading and non-confronting balanced mechanism by different countries, enhancement of bilateral and even multi-lateral cooperations and cultivation of global consciousness to deal with climate changes.

### *7.3.3 International Cooperation Framework for AI*

AI is developing in an accelerating way, and it is widely used in economic, military, social, and cultural fields. In addition, the negative effect of AI begins to emerge. As automation and autonomy of intelligent machines are getting increasingly powerful, automatic development of those machines has caused severe threat to human life and dignity. Confronted with these issues, people of different regions, nations, states, regions, enterprises and individuals share the same fundamental interest. If people refuse cooperation, act willfully, or develop AI with differentiation way, it will be difficult for us to make AI better serve mankind so that more people may use such technology and benefit from it. Moreover, we will be unable to avoid the risks in a timely and effective way. For this reason, while coordinating AI development, the international community must unite in a concerted effort and unfold international technical exchanges on the basis of human shared values and bottom line so as to promote legislative collaboration among different countries and regions and conclude relevant international treaties.

(1) To Conduct International Technical Exchanges and Cooperation

Although AI is growing rapidly and still has much room for development, there exist many technical loopholes and bottlenecks in the technology. Hence, different countries should frequent their mutual exchanges and cooperation in an endeavor to promote progress made in AI.

(1) To Unfold Multi-level and Multi-channel Exchanges and Cooperation.

By virtue of intergovernmental exchange visits, academic communications, consultations, technical service and license trade, decision-makers, researchers, and enterprises of different countries should strengthen their mutual exchanges and cooperation to promote AI international standardization. In the first half year of 2013, the European Commission pooled one billion Euros into "Human Brain Program," earlier than "BRAIN Program" of the USA (a nervous system project sponsored by the White House). In March, 2014, the two programs began cooperation by exercising negotiations in such issues as collaboration extent and shared data so as to cover more research items to avoid the repetitious work.

(2) To conduct technical cooperation through the establishment of joint laboratories.

In July, 2017, during the "2017 Global Submit Forum on Sustainable Development of Artificial Intelligence" jointly sponsored by Shanghai Mobile Internet Application Promotion Center, the University of California, Berkeley, "Harvard Business Review" and "Finance," "International Joint Laboratory for Artificial Intelligence, Berkeley Center" was founded in Jinqiao Hi-Tech Park of Pudong New Area, Shanghai. The joint laboratory is positioned to be "specialized technical service platform for AI industrialization and standardization, exchange and cooperation platform and service platform for international third-party public intellectual property

right for hi-tech enterprises" committing to forge "China's largest, the most influential and specialized international joint laboratory for AI." ("Forum for Innovation Exploration—Review of 2017 Global Submit Forum on Sustainable Development of Artificial Intelligence" [EB/OL]. (20170812) [20170814]. https://www.sohu.com/a/163984680_168180.) Meanwhile, Jiangsu Province, China, declared its cooperation with Massachusetts Institute of Technology in AI.

(3) To Encourage AI Enterprises to Participate in Formulating International Standards and make the Standardization Promote Internationalization of AI Products and Services.

To cite China as an example, in September, 2015, China organized the formation of the first ISO CDVS, which is adopted as ISO international standards (Standard Number: ISO/IEC 15938—13: 2015), becoming one of the international standards in the field of the visual algorithm. In March, 2017, at Berlin Conference of ISO/IEC JTC1/SC35, "Information Technology—Affective Computing User Interface—Framework" was adopted by votes and won project approval, a program that was jointly initiated by Software Institute, Chinese Academy of Sciences, Chinese Institute of Electronic Technical Standardization and Shanghai Zhizhen Smart Network Technology Co. (minor i robots). This standard is not only the China's first international standard approved project, but also the first effective algorithm standard in user interface subcommittee, filling up the domestic and international gap. (from Longhua Website, "A Further Step in AI: China's First Affective Interactive International Standard Was Approved to Be A Project") [EB/OL]. (20170328) [20170814]. http://www.cqnews.net/html/201703/28/content_41109467.htm.

(2) To Strengthen International Legislation Cooperation

AI poses huge challenges to social governance, legal system, and governmental supervision. To ensure the orderly development of AI, we should make laws to normalize the operation. As legislation for AI is a new issue, different countries should enforce the legislative collaboration among them, make concerted efforts to lower and control the risks in AI development so as to ensure AI rapid development in Institutional way.

(1) Realistic Foundation for AI International Legislation Cooperation—Legislation Practices in Different Countries.

Governments and public institutions in different countries show great concern on AI laws and social influences and have conducted much research in it, which provides theoretical support for the formulation of laws and ethical construction of AI. In terms of research in AI law and ethics, the United Nations and IEEE have reaped substantial achievement. Meanwhile, European countries and the United States have also made trials in AI legislation and thus laid a foundation for international legislation cooperation.

(A) AI legislation practice in the United States. Since January, 2017, the U.S Congress has formulated three acts for AI, among which "2017 National Computer Science Act" and "2017 Computer Science Act in Technical Engineering and Mathematics" focus AI improvement of living quality for Americans and possible replacement of part jobs and calls for intensification of occupational training by commercial and educational departments and of computer competence acquisition for middle school students.

(B) AI legislation practice in the European Union. As early as January, 2015, Legal Affairs Commission of European Parliament decided to set up a working panel, specialized in studying the relevant legal issues in robots and AI development. In May, 2016, the said Commission released "Draft Report to European Commission on Legislation Proposal Concerning Robot Civil Regulations". In October, 2017, it published research result "Regulations of Eruopean Commission on Robot Civil Law". On February 16th, 2017, a resolution was adopted by European Union (driven by Legal Affairs Commission of European Parliament), requiring European Commission to make legislative motion on robot and AI which covers ten proposals, including AI ethical norms, reconstruction of responsibility rules, compulsory insurance mechanism and compensation funds, conferment of possible legal status to complicated independent robots and independent intellectual creation.

(C) Conditions in other countries. In recent years, in order to effectively cope with the rapid AI progress made by the Unites States and China, Japan has laid particular importance in its AI development and brought forth some measures. For example, it brings the products made by AI into the protection mechanism of—intellectual property rights through legislation. The specific practice is to amend "Anti-Unfair Competition Law." Japanese Ministry of Transportation promulgated the policy for intelligent automobiles. Ministry of Health, Labor and Welfare amended security and health rules, specifying the industrial robots may be free from protective means to work with man. In pilotless driving, as early as 2015, Japanese Government was planning to initiate the legislation for pilotless automobiles. In the following year, it worked out popular roadmaps for pilotless driving, intending to relax the restrictions on pilotless automobiles and unmanned aerial vehicles in the relevant laws and regulations. In 2017, Japan allowed the tests of pilotless automobiles on highways.

(2) Major Fields and Basic Paths for AI International Legislation Cooperation

In the future, there several major fields for AI international legislation cooperation among different countries, covering AI legal dominating position, AI "independent intellectual creation," construction of AI ethical norms, AI responsibility reconstruction, AI supervision, etc. The basic paths for AI are as follows.

(A) To try and implement first. As there exists uneven development in AI among different countries, resulting in disparities of actual issues they are confronted with. For example, Japan acquires comparative advantages in robot, novels and cartoon while the United States and China are strong in pilotless driving,

computer vision and speech recognition, etc. Every country should be based on its own specific conditions and formulate legal norms and ethical system in its leading fields.

(B) To explore the cooperative path on universal issues for AI. International legislation cooperation covers mutual exchanges of legislation institutions among different countries, discussions on universal issues and collaborations between the legislation institution and ethical institutes in universities.

(C) To amend relevant international agreement and jointly explore AI international standards and norms. With incessant development of pilotless driving, such international agreements as "Vienna Convention for Road Traffic (Geneva)" and "Convention on the Law Applicable to Traffic Accidents" should be accordingly amended. In addition, all the countries should seek for and establish international standards through legislation among them so as to bring the risks caused by AI extensive application under control.

(3) International Treaties in Relevant Fields

As AI brings enormous convenience and benefits to mankind, more and more companies pool increasing funds in exploring and developing this technology and it has also become the focus in formulating public policy worldwide. For the sake of human common interest and security, it is imperative to impose restricts on AI development through international treaties.

(1) Necessities of Formulating International Treaties for AI Development

AI development evokes mankind's anxiety for their survival. Elon Musk holds "AI endangers human civilization and it will do harms to the whole society." and "We must be highly alert of AI as it may be more perilous than nuclear weapons.", whose views are shared by other celebrities as Bill Gates and Stephen King, etc.

AI is extensively used for military purposes as shown in incessant smart automatic weapons, e.g. unmanned vehicles and vessels and UAVs, all of which evoke people's panic on the possible accidents caused by "large-scale war" and "uncontrolled robots", etc. In the opening ceremony at "2017 International Joint Conference on Artificial Intelligence" on August 21st, 2017, Elon Musk, together with Mustafa Suleyman founder of DeepMind and CEOs of 116 robot and AI companies from 26 countries, delivered an open letter to the United Nations, appealing this largest international organization to adopt pertinent measures to curb the armament races on "intelligent weapons" and describing the application of AI in military areas as "the third revolution of human war forms after gunpowder and nuclear weapon." (Ariel Conn. Leaders Of Top Robotics And AI Companies Call For Ban On Killer Robots [EB/OL]. (20170821) [20171124]. https://www.huffingtonpost.com/entry/leadersoftoproboticsandaicompaniescallforban_us_59998ef3e4b03b5e472cf08f.)

(2) Possible Orientation of International Treaty for AI Development

The massive application of AI weapons and potential use of "smart combat robots" will greatly lower the threshold of wars. Therefore, international treaties on AI development should start from military fields and be amended or reformulated within the

framework of existing international treaties. Apart from "Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons", a treaty that aims at restricting and banning the application of inhuman conventional weapons, the United Nations has begun to focus and discuss the control of lethal automatic machines (also called homicidal robots) in 2014 and set up in 2016 "Group of Governmental Experts on Lethal Autonomous Weapon Systems," which is specialized in discussing the issues of controlling and banning lethal automatic weapons and which is expected to put forth a dealing program.

### *7.3.4 Establishment of AI International Organization*

Based on full exchanges and cooperation between countries, international community should set up global control organizations for AI, responsible for concluding and implementing international norms as well global governance affairs.

(1) Existing Organizations

The existing organizations involving AI control areas cover intergovernmental and non-governmental organizations

(1) Intergovernmental organizations mainly include the United Nations, the European Commission, the Organization for Economic Cooperation and Development, etc.

(A) The United Nations. As a representative international organization, it is also a core institution in contemporary international system, which has played a leading role in AI control and has contributed particularly to the legal and ethical research of AI. The international institutions for AI development set up by the United Nations set foot on human interest, formulate AI policies and focus ethical security issues. In August, 2016, UNESCO and the World Council on Science Knowledge & Technology Ethics jointly released "Preliminary Draft Report on Robot Ethics," which holds that robots should respect the ethical norms of human society, for the purpose of which we should input the special ethical norms into robots.

(B) European Union. EU has reaped critical achievement in civil legislation for AI. In addition to publishing civil law for robot and AI, EU also formulates ethical principles for AI researchers and examiners, which manifest human values in the entire developing and examining links so that they may conform to human interest, such as its "Human Brain Project" listed in the emerging technology programs in January, 2013, "SPARC Project" jointly completed with European Robot Association in December, 2013, initiation of legislation motion for AI in June, 2016, etc.

(C) Organization for Economic Cooperation and Development (OECD for short). OECD is an intergovernmental organization whose responsibilities are to deal with the challenges in economy, society and government control brought by

globalization and to seize the opportunities by the said trend. In recent years, OECD has brought forth "Going Digital Project," providing governmental decision-makers with an indispensable tools and assisting them in achieving economic and social prosperity driven by digitalization. With the in-depth amalgamation of intelligent machines and human life, AI development problems have attracted the attention from OECD. In 2017, it named the theme of annual conference "Artificial Intelligence: Smart Machines and Policy for Intelligence," which aims at studying the opportunities, challenges and roles in governmental policy and intergovernmental cooperation.

(D) Summit Conference of BRICS. BRICS consists of Brazil, Russia, India, China and South Africa. In the context of great changes in international balance of power, BRICS represents the interests of emerging economies, following the principles of "open, transparency, unity, mutual assistance, deepening cooperation and common development" and BRICS spirit marked by "open, tolerance, cooperation and win-win", and dedicated to constructing a closer, more solid and all-inclusive partnership. The summit conference of BRICS has gradually formed the cooperation mechanism among its member states. As more emerging economies become its members, the conference will play a critical role in international political and economic affairs. This organization and its summit conferences will serve the platforms for new emerging economies to develop their AI and BRICS members will further deepen the international exchange and cooperation in AI technology.

(E) International Monetary Fund. As one of the world's two major financial institutions set up in 1945, IMF is mainly responsible for supervising currency rates and trades of different countries, providing technical and capital assistance so as to ensure the normal operation of global financial systems. Highly valuing the revolution induced by AI, IMF initiated the themes on AI and mega-data in the forums sponsored by it in 2017, touching upon the relationship between AI and employment, virtual currency, new modes of financial intermediaries and influence brought by AI.

(2) Non-governmental organizations cover international associations and international conference organizations.

(A) Institute of Electrical and Electronics Engineers. As the world's largest non-profit professional technology society, IEEE has made tremendous contributions to legal and ethical studies on AI. In addition to "Ethical Design: Vision of Making Artificial Intelligence and Automatic System to Maximize Benefits for Mankind (the First Edition)," released in December, 2016, the Institute published the world's first "Draft Design on Ethical Norms for Artificial Intelligence," which proposes ethical problem for robot manufacturing and deployment of AI system, and burden sharing mechanism, pointing out that liability traceability, robot's act and decision-making should be under supervision.

(B) International Association for AI. This association is an international non-profit scientific association which commits itself to AI research and application liability. It aims at elevating public understanding of AI, improving teaching and training conditions for AI jobholders and provides planers and sponsors with

direction to AI developing trends. Established in 1979, the former of this organization was called "American Association for Artificial Intelligence" and it was renamed "International Association for Artificial Intelligence" in 2007, with 4000 members around the world.

(C) European Association for Artificial Intelligence Association. It is an agent association in European AI community, aiming at promoting learning, research and application of AI. The former name of this organization was "European Coordinating Committee for Artificial Intelligence," set up in 1982. Every year of even number, this association will team up its members to hold European AI conference, which has become the leading conference in Europe.

(D) Society for the Study of Artificial Intelligence and the Simulation of Behavior. Established in 1964, Society for the Study of Artificial Intelligence and the Simulation of Behavior is the earliest AI association in AI and the largest AI association in Britain as well. As a non-profit research association, this association dedicates to promoting scientific understanding of concept and intelligent behavior and simulation of behavior in machines. In addition this organization also endeavors to propel AI research, behavior simulation, coordination and communication among the scientists interested in AI system design. The association consists of the members form European Association for Artificial Intelligence Association and international members from academic and industrial sectors.

(E) European Neural Network Association. As a non-profit organization, it aims at unfolding cooperation among neural network organizations in different European countries so as to deepen people's understanding of AI neural network, and promoting scientific research in neural network. The research fields of this organization cover remolding of behavioral activities and brain activities, development of neural network algorithm and the application neural remolding in different fields. Since its inception on 1991, this association has organized several international conferences on neural network and sponsored the participants of the conferences.

(F) European Robotics Association. Established in September, 2012 at the joint proposal of 35 institutions, this association is composed of 250 companies, universities and research institutions, among which there are traditional robot manufacturers, agricultural machinery producers and operators of innovative hospitals, with its headquarters in Brussels.

(G) International Conference on Artificial Intelligence and Law. This conference mainly focuses on studying AI and legal science. It was initiated by International Association on Artificial Intelligence and Law in 1987 and it is biennial conference, which aims at inter-disciplinary research and application of AI and law. The conference offers a platform for scientists to present updated achievement and practical application on AI, a beneficial venue for international interdisciplinary cooperation.

(H) International Joint Conference on Artificial Intelligence. The conference is one of the most influential academic conference on AI, convened in the year of odd number. The top researchers and outstanding professionals may share

the updated theories, technical progress and application fruits on AI at the conference.

(2) Ideas for Global Governance on AI

The challenge brought by rapid AI development is a common issue for different countries to deal with. As AI involves the benefits of human beings, this issue is addressed on the basis of analytical framework of global control.

(1) A diversified global governance body dominated by sovereign states and intergovernmental international organizations

Global AI governance requires the leading role of sovereign states and intergovernmental international organizations, responsible for coordination of affairs concerning national defense, security and development for human future. In addition to emphasis on the function of civil societies, they should give full play to the role of global residents represented by non-governmental organizations. This is due to the fact that civil societies free themselves from the boundaries of national interests and endeavor to bring the negative effect brought by AI from the perspective of the common interests of human beings, as against the sovereign countries. The major forces and motivation on coming global control on AI mainly come from intellectual and social elites.

(2) To Strengthen System Construction on AI Global Governance and Conclude the Treaties and Agreements Concerning AI Global Governance Sonner

On one hand, we should set up organizations or institutions on AI global governance, e.g. AI international coordinating and supervising institutions which are responsible for the control of key and sensitive AI development. On the other hand, we should also give full play to non-governmental organizations, strengthen construction of AI ethical norms, strive to conclude systematic international treaties and agreements around the world and standardize AI development in sovereign countries. Moreover, the international community should intensify the studies on the issues of robot ethics, security and risks that different countries are confronted with deepen the research on international laws on AI and propel the formulation of international standards on AI development and security.

(3) To Intensify Concept Construction and Form Inter-subject Consensus Transcending National Interest

We should give full play to the role of global civil societies to reach inter-subject consensus on global governance. Civil societies on AI cover the scientists who participate in AI theoretical studies and understand AI efficiency and the elites who can commercialize AI. Through their efforts, the discussions on AI evolve from technical to security and ethical fields. Those scientists and elites can help common people to raise their moral recognition of AI on special application and enable them to be aware that AI may bring enormous challenge to human survival. Moreover, those scientists and business elites may exert certain pressure upon the relevant decision made by politicians, restrict politicians from resorting to AI weapons at extreme situations.

Based on concept identity and normalization of AI global governance, we may further conclude inter-subject consensus which transcends national interests. After such consensus is globally acknowledged, it may be elevated to be both explicit or invisible norms or ethical principles, even to be global culture, which will fundamentally change the passive situation of AI global governance at eventually.

## Bibliography

Abellannebot, J.V., and F.R. Subirón. 2010. A review of machining monitoring systems based on artificial intelligence process models. *International Journal of Advanced Manufacturing Technology* 47 (14).

Allen, C., W. Wallach, and L. Smit. 2006. Why machine ethics? *IEEE Intelligent* Systems 21 (4).

Armstrong, S., N. Bostrom, and C. Shulman. 2016. Racing to the precipice: A model of artificial intelligence development. *Ai & Society* 31 (2).

Bostrom, N., and E. Yudkowsky. 2014. The ethics of artificial intelligence. In *The Cambridge Handbook of Artificial Intelligence*, ed. W. Ramsey and K. Frankish. Cambridge: Cambridge University Press.

Brady, M. 1984. Artificial intelligence and robotics. *Artificial Intelligence* 26 (1).

Buchanan, B.G., and T.E. Headrick. 1970. Some speculation about artificial intelligence and legal reasoning. *Stanford Law Review* 23 (1).

Cao Jian Feng. 2017. *10 Da Jian Yi ! Kan Ou Meng Ru He Yu Ce AI Li Fa Xin Qu Shi* (*Top 10 tips! How does the eu predict new trends in AI legislation*). *Robot Industry* (2).

Chen Jin. 2016. *Ren Gong Zhi Neng Ji Shu Fa Zhan De Lun Li Kun Jing Yan Jiu* (*Research on the ethical dilemma of the development of artificial intelligence technology*). Changchun: Jilin University.

Conitzer, V., W. Sinnottarmstrong, and J.S. Borg, et al. 2017. Moral decision making frameworks for artificial intelligence. In *Association for the Advancement of Artificial Intelligence. Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence Senior Member/Blue Sky Track*. February 29, 2017, San Francisco, CA, USA.

Daisuke, Yoshida. 2016. The right of creation by artificial intelligence (AI). *Published News* (2424).

Daniel, E.O. 2013. Artificial intelligence and big data. *IEEE Intelligent Systems* 28 (2).

Du Yan Yong. *Ren Gong Zhi Neng An Quan Wen Ti Ji Qi Jie Jue Jin Lu* (*Artificial intelligence security problem and its solution approach*). *Philosophical Trends* (9).

Froese, T., and T. Ziemke. 2009. Enactive artificial intelligence: Investigating the systemic organization of life and mind. *Artificial Intelligence* 173 (34).

Gonzalez, L.F., G.A. Montes, and E. Puig, et al. 2016. Unmanned aerial vehicles (UAVs) and artificial intelligence revolutionizing wildlife monitoring and conservation. *Sensors* 16.

Guo Wu Yuan. 2017. *Xin Yi Dai Ren Gong Zhi Neng Fa Zhan Gui Hua* (*A new generation of artificial intelligence development planning*) (Guo Fa [2017] 35 Hao). (20170824) [20171005]. http://guoqing.china.com.cn/201708/24/content_41468301.htm.

Hajime, Ideoi. 2016. The problems of copyright law concerning AI creations and their countermeasures. *Patent* 69 (15).

Hassabis, D. (2017) Artificial intelligence: Chess match of the century. *Nature* 544 (7651).

He, Bo. 2017. Ren Gong Zhi Neng Fa Zhan Ji Qi Fa Lü Wen Ti Chu Kui (The development of artificial intelligence and its legal problems). *China Telecommunications Trade* (4).

Huan, Qiu Wang. *Ri Ou Zheng He Zuo Zhi Ding Zi Dong Jia Shi Gong Tong Biao Zhun* (*Japan and Europe are working together to develop common standards for autonomous driving*). (20160712) [20170712]. http://auto.huanqiu.com/globalnews/201607/9159210.html.

*IEEE Shou Fen AI Bao Gao: Li Yong Ren Gong Zhi Neng He Zi Zhu Xi Tong (AI/AS) Zui Da Hua Ren Lei Fu Zhi De Yuan Jing* (*IEEE's first AI report: the vision of using artificial intelligence*

*and autonomous systems (AI/AS) to maximize human well-being*). (20170109) [20171009]. http://www.ciiip.com/news10466511.html.

Ingrand, F., and M. Ghallab. 2014. Deliberation for autonomous robots: A survey. *Artificial Intelligence* 247.

Jennifer, Nesbitt. 4 ways artificial intelligence is transforming trade. (20170518) [20170814]. http://www.tradeready.ca/2017/topics/import-export-trade-management/4ways-artificial-intelligence-transforming-trade.

《Ji Qi Ren Ji Shu Yu Ying Yong》 2016. Bian Ji Bu. Jie Du《Zhong Guo " Hu Lian Wang +" Ren Gong Zhi Neng San Nian Shi Shi Fang An》(Interpretation of the three-year implementation plan of "Internet +" artificial intelligence in China). *Robot Technique and Application* (3).

Katsuyuki Izumi Theme. 2017. (The Future of Copyright is a Utopia?: Kyoto Women's University Faculty of Law Open Lecture: 2016). *Kyoto Women's Law* (11).

Michael, Irving. A Xi Luo Ma 23 Yuan Ze Shi AI Geng An Quan He Dao De (Asilomar 23 makes AI safer and more ethical). Chen Liang, Bian Yi. *Robot Industry* (2).

Kayser, D. 1991. Artificial intelligence and cognitive science. *Applied Artificial Intelligence* 5 (2).

Ke Ji Xun. *Ren Gong Zhi Neng De Shi Kong Feng Xian*. (*The risk of losing control of artificial intelligence*). (20170905) [20171122]. http://news.kejixun.com/article/yMLRfxWXAdYUm7qn/.

Klopman, G. 1984. Artificial intelligence approach to structure-activity studies. Computer automated structure evaluation of biological activity of organic molecules. *Journal of the American Chemical Society* 106 (24).

Koji, Okuji. 2017. Artificial Intelligence and copyright: Focusing on the copyrighted material. *Patents* 70 (2).

Kow, K.W., Y.W. Wong, and R.K. Rajkumar, et al. 2016. A review on performance of artificial intelligence and conventional method in mitigating PV grid-tied related power quality events. *Renewable & Sustainable Energy Reviews* 56.

Lachat, M.R. 1986. Artificial intelligence and ethics: An exercise in the moral imagination. *Ai* Magazine 7 (2).

Lemaignan, S., M. Warnier, and E.A. Sisbot, et al. Artificial cognition for social human-robot interaction: An implementation. *Artificial Intelligence* 247.

Li Yi Meng. Ren Gong Zhi Neng Ji Shu De Wei Lai Fa Zhan Qu Shi (The future development trend of artificial intelligence technology). *Electronic Technology & Software Engineering* (11).

Li, Jun Ping. 2013. *Ren Gong Zhi Neng De Lun Li Wen Ti Ji Qi Dui Ce Yan Jiu* (*Research on the ethical problems and countermeasures of artificial intelligence*). Wuhan: Wuhan University.

Li, Zheng Zuo. 2016. Lun Ren Gong Zhi Neng Chan Pin Qin Quan Xing Wei Ze Ren Ren Ding–Yi Ren Gong Zhi Neng Qi Che Wei Li (On the identification of liability for infringement of artificial intelligence products—A case study of artificial intelligence vehicles). *Business* (33).

Ling Yan Ping, Hou Jun Jun. 2009. Wo Guo Can Yu Guo Ji Biao Zhun Jing Zheng Zhong De Da Guo Xiao Ying (The great power effect of China's participation in international standard competition). *Social Science in Hunan* (4).

Liu, Dong Guo. 2005. Quan Qiu Zhi Li Zhong De Guan Nian Jian Gou (Conceptual construction in global governance). *Teaching & Research* (4).

Liu Xue Ting. 2016. Ren Gong Zhi Neng Ji Shu Dui Min Fa De Ying Xiang (The influence of artificial intelligence technology on civil law). *Legality Vision* (14).

Liu Yang, Xu Xiao Lei. *Mei Jun Yao Feng Sha Da Jiang, Ke Zhi " Zhong Guo Zhi Zao" Zao Yi " Fang Bu Sheng Fang"?* (*Do you know that "made in China" has become "impossible to prevent" when the US military wants to ban dji?*). (20170810) [20171010]. http://www.sohu.com/a/163518642_117351.

Luck, Michael, and Ruth Aylett. 2000. Applying artificial intelligence to virtual reality: Intelligent virtual environments. *Applied Artificial Intelligence* 14 (1).

Pan, Y. (2016). Heading toward artificial intelligence 2.0. *Engineering* 2 (4).

Pomerol, J.C. (1997). Artificial intelligence and human decision making. *European Journal of Operational Research* 99 (1).

Price, S., and P.A. Flach. 2017. Computational support for academic peer review: A perspective from artificial intelligence. *Communications of the ACM* 60 (3).

Qadir, J., K.A. Yau, and M.A. Imran, et al. 2015. IEEE Access special section editorial: Artificial intelligence enabled networking. *Access IEEE* (3).

Raedt, L.D., K. Kersting, and S. Natarajan, et al. 2016. *Statistical relational artificial intelligence: Logic, probability, and computation*. Morgan & Claypool.

Ramchurn, S.D., P. Vytelingum, and A. Rogers, et al. 2015. Putting the "smarts" into the smart grid: A grand challenge for artificial intelligence. *Communications of the ACM* 55 (4).

Ramos, C., J.C. Augusto, and D. Shapiro. 2008. Ambient intelligence—The next step for artificial intelligence. *IEEE Intelligent Systems* 23 (2).

Sun Ye, Wu Fei Yang. Ren Gong Zhi Neng De Yan Jiu Xian Zhuang Ji Fa Zhan Qu Shi (Research status and development trend of artificial intelligence). *Value Engineering* (28).

Schaeffer, J., and H.J.V.D. Herik. 2002. Games, computers, and artificial intelligence. *Artificial Intelligence* 134 (1).

Simon, H.A. 1995. *Artificial intelligence: An empirical science* vol. 77, no. 1. Elsevier Science Publishers Ltd.

Sloman, A. 1971. Interactions between philosophy and artificial intelligence: The role of intuition and non-logical reasoning in intelligence. *Artificial Intelligence* 2 (3).

Suzuki, Kenbun. What is copyright protection in AI?. [20170904]. http://wedge.ismedia.jp/articles//7943.

Teng Xun Ke Ji. *Ren Gong Zhi Neng De 23 Tiao "Jun Gui", Ma Si Ke, Huo Jin Deng Lian He Bei Shu* (*Artificial intelligence 23 "military regulations", musk, hawking and other joint endorsement*). (20170711) [20171122]. http://www.myzaker.com/article/589995291bc8e0bc42000002/.

Theodorou, A., R.H. Wortham, and J.J. Bryson. 2017. Designing and implementing transparency for real time inspection of autonomous robots. *Connection Science* 29 (3).

*Thinking about the copyright of AI era*. [20170904]. https://Www.nikkei.com/article/DGXKZO03254220W6A600C1PE8000/.

Uraikul, V., C.W. Chan, and P. Tontiwachwuthikul. 2007. Artificial intelligence for monitoring and supervisory control of process systems. *Engineering Applications of Artificial Intelligence* 20 (2).

Wei, Da Peng, and Wen Juan Mao. 2006. Wo Guo Can Yu Guo Ji Biao Zhun Jing Zheng De Qian Ti, Zhang Ai He Dui Ce Fen Xi (The precondition, obstacle and countermeasure analysis of China's participation in international standard competition) In *Tian Jin Shi She Hui Ke Xue Jie Di Er Jie Xue Shu Nian Hui Lun Wen Ji*.

*Wu, Ren. Jia Shi Qi Che Ye Yao Zun Shou Jiao Tong Gui Ze Ri De Fa Zhi Ding Tong Yi Biao Zhun* (*Driverless cars should also abide by the traffic rules and make unified standards in Japan, Germany and France*). (20160720) [20171020]. http://www.huahuo.com/car/201607/14899.html.

Weng, J., J. Mcclelland, and A. Pentland, et al. 2001. Artificial intelligence. Autonomous mental development by robots and animals. *Science* 291 (5504).

Wipke, W.T., G.I. Ouchi, and S. Krishnan. 1978. Simulation and evaluation of chemical synthesis—SECS: An application of artificial intelligence techniques. *Artificial Intelligence* 11 (1).

Yampolskiy, R.V. 2013. Artificial intelligence safety engineering: Why machine ethics is a wrong approach. In *Philosophy and Theory of Artificial Intelligence*. Berlin: Springer Berlin Heidelberg.

Yan, Zhi Ming, Xia Xia, Tang, and Deng Qin Xuan. 2017. Jiao Yu Ren Gong Zhi Neng (EAI) De Nei Han, Guan Jian Ji Shu Yu Ying Yong Qu Shi—Mei Guo《 Wei Ren Gong Zhi Neng De Wei Lai Zuo Hao Zhun Bei 》He《 Guo Jia Ren Gong Zhi Neng Yan Fa Zhan Lüe Gui Hua 》Bao Gao Jie Xi (Education artificial intelligence (EAI) connotation, key technologies and application trends—Analysis of the report "preparing for the future of artificial intelligence" and "national strategic planning for artificial intelligence research and development" in the United States). *Journal of Distance Education* (1).

Yanco, H. 1998. Artificial intelligence and mobile robots: Case studies of successful robot systems. *Artificial Life* 6 (2).

Yudkowsky, E. 2006. Artificial intelligence as a positive and negative factor in global risk. *Global Catastrophic Risks*.

Zhang, Yi Nan. 2016. Ren Gong Zhi Neng Ji Shu De Lun Li Wen Ti Ji Qi Dui Ce Yan Jiu (Research on the ethical problems and countermeasures of artificial intelligence technology). *Journal of Jilin TV & Radio University* (11).