Contributions to Economics

Pang Chuan · Vasil Khachidze
Ivan K.W. Lai · Yide Liu
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Innovation in the High-Tech Economy

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Contents

Development Strategy of E-health in China

Xitong Guo, Xiaofei Zhang, and Chenlei Li

Abstract As a new health care model, E-health represents the future of health care development. But there are a lot of problems during the process of construction and popularization in China. In this paper, we focus on the complex problems in the course of E-health development, develop a soft system methodology to analyze and construct models, and finally propose solutions to e-health development.

Keywords E-health • Soft system methodology • System construction

1 Brief Introduction of E-health

E-health technology is a combination of modern medical technology and information technology, and a course from one terminal to another. It ranges from the birth registration to the death registration, from the prevention and screening to periodic review, from the emergency to the take-home health care (Peng Yuhua et al. 2007). To be simple, E-health uses information transferring technology to connect every terminal and makes a combination of disease prevention, diagnosis and health care. It includes electronic patients' records, medical information storage and transmission, hospital informatization and virtualization, remote assistance medical and monitoring as well as management from medical departments.

This is an era of information which is much easier to get owing to the popularity of mobile-phones and computers. Along with the progress of biomedical technology and promotion of life quality, people begin to realize the importance of health, which makes medical treatment as rare resources as in the society (Hesse and

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Shneiderman 2007). The development of E-health based on a modern information technology and a biomedical technology revolution. As a new health care model, E-health has advantages as follows:

1. High informationization degree. People select medical information needed through all kinds of communication means (Eysenbach et al. 2001).
2. High efficiency and convenience. Hospitals improve operation efficiency by information technology, cutting costs of human resources, materials and finance. Patients receive medical information indoors, saving a lot of time. On a long view, E-health optimizes medical resource allocation (Mao Xingzhi et al. 2007).
3. Change the information asymmetry condition between doctors and patients. E-health improves the patients' initiatives to get medical information, making them not to contact just one doctor, thus promoting accuracy of information and relationship between doctors and patients.
4. Promote Reasonable Allocation of Medical Resources. E-health makes medical resources play remote effect, benefiting patients living in remote rural places.

2 Challenges of E-health Development in China

China has facilitates E-health development with communication technology and medical resources and many city hospitals have been facilitated. However, some problems exist during the course.

2.1 Common Problems

2.1.1 Privacy Protection Problem

In traditional mode, patients' information is transmitted by oral or literal means, with low speed. However, in E-health mode, the speed is much faster and information spreads more widely, making personal privacy easier to be exposed and broken. And the breaks tend to be hidden. What's more, although patients may receive more medical resources and have high cure expectations, patients may get immersed in horror because of the application of electronic patient records and widespread information transmission. So patients may refuse E-health service considering privacy (Goldman and Hudson 2000).

2.1.2 Profit Distribution Problem

E-health relates to allocation of public medical resources, involved with interests' reallocation problem. It involves benefit distribution between system builders and users, benefit distribution between hospitals and patients, and that among hospitals.

The application of E-health has a large influence on medical revolution, involving in all interest parties. Thus, it is important to build a good profit of distribution mechanism for E-health application.

2.1.3 Risk Sharing Problem

Uncertainty exists in the course of medical treatment, especially the tense of doctor-patient relationship. The probability of the problem may increase with the transmission and share of medical information in E-health. The state should make relative laws of specific responsibility mechanism and risk sharing mechanism on the basis of current situation; however, the laws should be made and perfected in the practice of E-health application. It formed an antinomy problem. So, under the condition of imperfect laws, hospitals and doctors may not accept E-health considering risks (Jacq 2007).

2.2 Problems in Process of E-health Development in China

2.2.1 Infrastructure Problem

Although there are a large number of mobile phone users, computer users and Internet users, the number is actually low once the large population of China is considered, especially that of computer and Internet users. It is essential to further develop IT industry and improve network coverage for the popularity of E-health (Mao Xingzhi et al. 2007).

2.2.2 Imbalance of Medical Development

Hospitals in China are officially classified in three levels; level III represents the top-level hospitals that are the minority but hold the majority of medical resources; level II are the medium-size hospitals; and level I includes small hospitals such as community hospitals in the cities and township hospitals in rural areas. According to statistics from Ministry of health, now 80 % of the medical resources are centered in big cities, while 20 % in rural areas. And 30 % of those in cities concentrate on top-level hospitals. As is shown, resource distribution is unequal, prone to big cities and hospitals, even with a bigger gap between hospitals. Although hospitals at the same level are active in resource integration and inter-hospital cooperation, hospitals at different levels rarely communicate to each other.

The number of patients that big hospitals can receive is limited. And patients from rural places must pay for transportation fees and accommodation expenses. These widen the gap between urban and rural resources, which leads to a problem of “hard and expensive to see a doctor”. Because of the large area of rural districts, it is difficult to solve the imbalanced resource problem in advantage of high quality medical resources (Liu Yang 2012).

2.2.3 Complexity of System Problem

China has not established uniform system standards. And most of large and medium sized hospitals have their own systems, which are incompatible. So it will be a complex program to build a nationwide E-health system. With the unsolved problem of health care for urban laid-off workers and countrymen and the problem of tense of doctor-patient relationship, the state hardly concentrates its energy and money on E-health (Checkland 2000).

3 Application of Soft System Methodology in E-health

3.1 Soft System Methodology

Soft System Methodology (SSM) was established by English scholar Peter Checkland in 1980s. It is based on Hall's systems engineering, also called Hard System Methodology (HSM), which is compared to SSM.

As is shown in Fig. 1, Professor Checkland started from the reasonable coordination of dream expectation and realistic possibility theory, coming up with the basic idea and mode framework of understanding and possessing soft problems. And the practice process includes seven steps (Checkland 2000). The specific logic

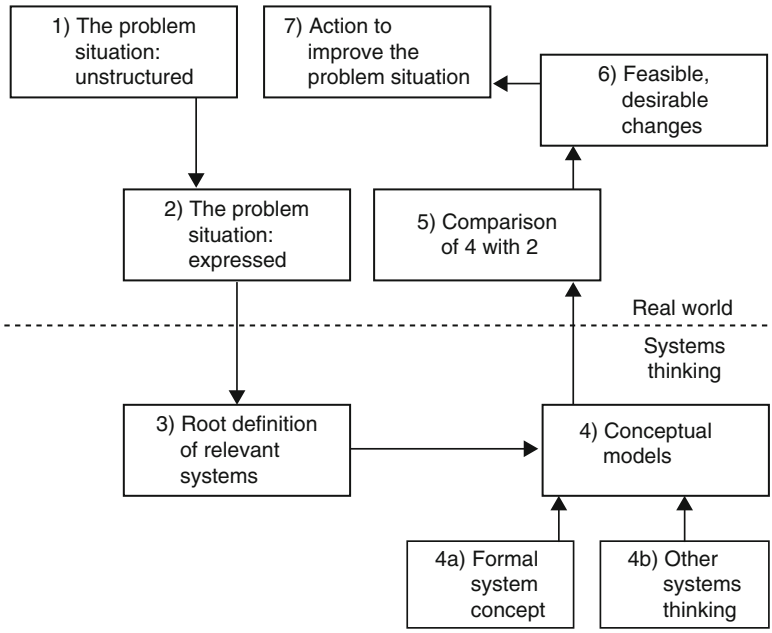

Fig. 1 Seven steps of soft systems methodology

can be analyzed as following steps: (1) recognize the problem and form a rich situation description in the way of rich picture, affinity diagram, fishbone diagram and SWOT analysis method; (2) come up with the root definition method of system by the way of CATWOE; (3) describe what the system has to do by the built of conceptual mode; (4) compare conceptual mode with realistic problem by the comparison between "what to do" in conceptual model and "how to do" in realistic problem; (5) obtain a consensus by discussion and make the satisfied feasible revolution scheme, then push the expected and feasible revolution, reaching the goal of improving the problem situation (Checkland 2000).

3.2 Applicability of Soft System Methodology in E-health Construction

E-health is a complex system, involving several interest parties whose relationship is difficult to be qualified (Silber et al. 2006). And the structure of the problem is weak, not easy to be solved by qualified math mode. The overall goal of E-health is not specific, and all stakeholders express their needs, which is hard to be met in the previous medical treatment projects. SSM is to solve such ill-structured problems which have vague aims and difficulty of building modes, from multifaceted aspects.

E-health construction is a problem not easy to be described specifically. Because of all kinds of roles' intervention, people's values and world view as well as humans' self protection awareness must be taken into consideration. Soft System Methodology can take the advantage of solving soft problems, fully considering human factor and environment factor and better solving problems in E-health construction.

4 Application of SSM in E-health Construction for China

When SSM is applied to E-health problem, the factors of national level, unit level, and personal level are considered. The research includes entering and expressing the E-health problem situation, formulating root definitions, building conceptual models, comparing the models with the real world, taking action to improve the real world situation.

4.1 Problem Situation Defined and Described

Because the system cannot be expressed clearly, it is described by soft system methodology. After reading the related literature, we firstly make problem requests

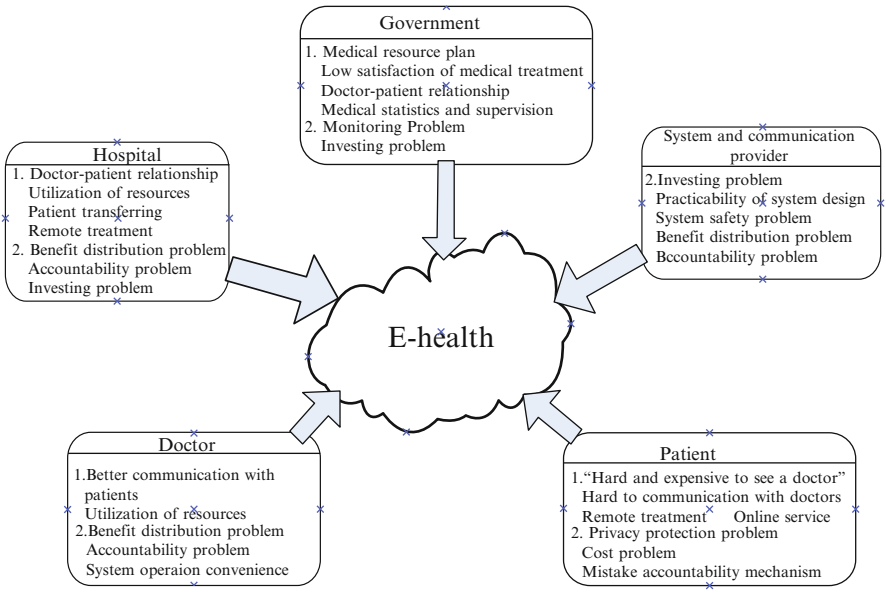

Fig. 2 Problem requests for all interest parties (Mao Xingzhi et al. 2007; Silber et al. 2006; Van Limburg and van Gemert-Pijnen 2011; Dong et al. 2012) (1. E-health problems expected to be solved 2. Considerations for E-health)

of current health care and HIS by relationship diagram, and then describe the problem by flow graph, digging out the existing problems to the largest extent.

As is shown in Fig. 2, there are E-health interest parties including governments, hospitals, doctors, patients and systems and communication equipments providers. The interest parties' question requests have both common interests and interest conflicts. The common interests are: both governments and patients consider the current benefit distribution as imbalanced; governments, hospitals, system and communication providers all care about the costs of E-health construction; hospitals, patients, communication providers all care about benefit distribution and responsibility problem. The interest conflicts are: patients complaint about the high expenses and hospitals complaint for the high costs; patients worry about the privacy protection and the fault accountability problem; responsibilities clarification and distribution of system between communication providers and doctors problem; system and communication providers could not ensure the system's practicability as the third party, while the doctors and patients make requests about the system's operation convenience.

After finishing the problem requests of all interest parties, we make a total analysis from seven aspects according to classification of requested problems. It is shown in Fig. 3, a fishbone diagram.

1. Cost Problem. The construction of E-health is a huge project which costs a large amount of money and need investing parties' joint efforts. So how to distribute costs becomes a primary problem for E-health construction.

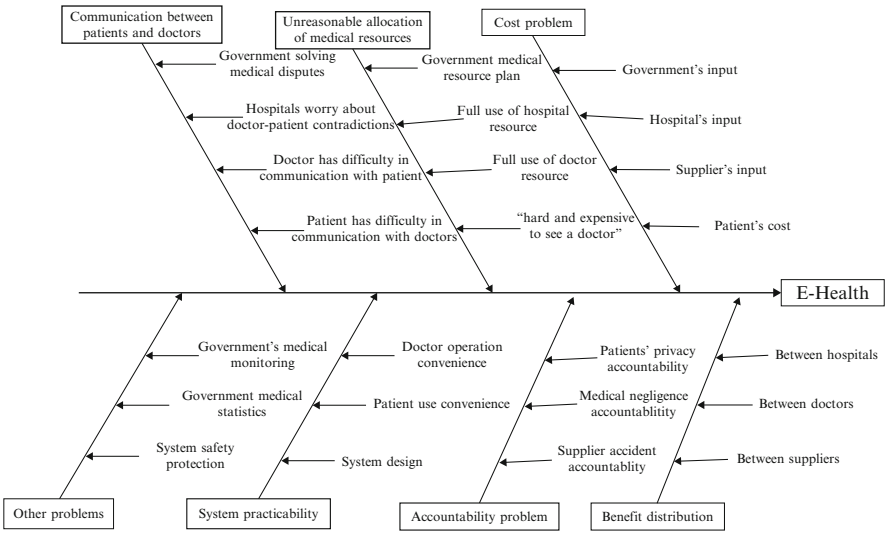

Fig. 3 Problem structure of E-health

2. Benefit Distribution Problem. Benefit distribution among hospitals, doctors, and system and communication providers affects every party's participation enthusiasm. So there must be a complete benefit distribution mechanism, guaranteeing the healthily and orderly operation of HIS.
3. The fundamental power for HIS construction is to solve the medical resources' uneven distribution and inadequate use problem. The biggest problem HIS faces is how to make good use of all districts' and hospitals' resources to solve the "hard and expensive to see a doctor" problem.
4. The major problem the hospitals face currently is the medical dispute problem, which also becomes the point governments focus on. HIS will promote the communication between doctors and patients, partly eliminating contradictions between them.
5. With emerge of E-health, there comes a new responsibility problem, based on the E-health medical negligence accountability and patients' privacy protection accountability. And these problems become more complicated with interface of the Internet factor.
6. Whether it is convenient to use the system for the frequent users, the doctors, directly affects the efficiency of the system application. As client-side users, patients have differences in culture, education and age aspects. So how to improve all kind of patients' operation convenience determines rate of utilization of E-health. As the third parties, system and communication equipment providers rarely interface with daily application of the system. What they care is how to meet the application demands in the supply process.
7. Other Problems. The system has to be in accordance with the governments' medical supervision and statistic mechanisms, escaping from hostile attacks.

4.2 Root Definition

According to the situation description of E-health, root definitions of E-health system will be made in this phrase. Based on SSM's CATWOE analysis method, root definitions are made as follows:

C (Customer): governments, hospitals, doctors and patients;
A (Actor): system and communication equipment providers, governments, hospitals, doctors and patients;
T (Transformation Process): the building, practicing, changing of HIS changing the past medical situation;
O (Owner): system and communication equipment providers;
E (Environmental Constraints): medical resources and communication equipments; law and economic constraints; expectation and hope for HIS from all interest parties.

According to the CATWOE analysis, this paper will describe HIS's root definitions as: in law and economic constraints, through the leading and coordinate of governments departments in charge, it coordinates with all interested parties, combined with information technology and medical technology to establish and popularize HIS, electronizing the medical service. To solve this phenomenon of imbalanced medical resources allocation and high cost, difficult medical problems, and make liability and interest distribution mechanism in HIS.

4.3 Establishment of the Conceptual Model

Root definition describes "what the system is", while the conceptual model describes "what system must do". Considering the complexity of HIS, we use a big system method to establish model, setting up the dynamic model in the process of "input – feedback – optimizing". HIS construction's conceptual model is shown in Fig. 4. The implementation of the system can be initially in some resource developed places as HIS pilots. Then after the summary of experience and lessons, it is promoted gradually nationwide. Each subsystem and mechanism' specific contents can be determined according to different regional economic and social environments.

1. Customer Service System: Patients get access to the system through the mobile phone or computer client sides. Patients can enjoy services such as online registration, online booking, online diagnosis, online consulting, and remote medical treatment and so on.
2. Service System with Big Hospitals as the Core: With large area hospital resources as the core, it establishes a large hospital interconnected key medical service system, providing online diagnosis, remote medical treatment and transferring patients services, supporting information transmission and medical resource sharing between hospitals, and storing peripheral patients' medical records.

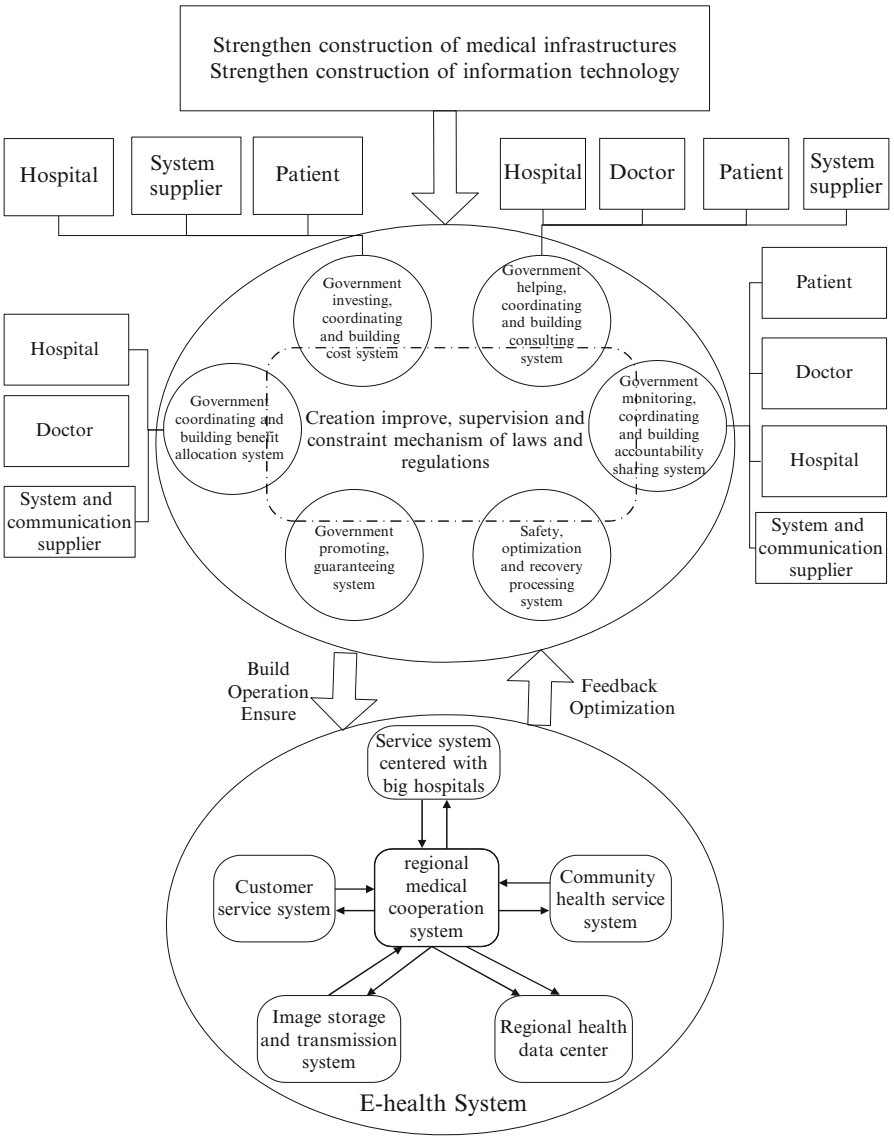

Fig. 4 HIS's conceptual model

3. Community Medical Service System: with small and medium-sized hospitals and community hospitals as the core, the basic medical service providing system is established. It provides the online registration, online booking, online diagnosis, online consulting, remote medical treatment services, supporting the information transmission and medical resource sharing between hospitals, and storing patients' medical records.

4. Regional Health Data Center: The relevant data in the system are collected, applied to the medical statistics and disease monitoring of relevant government departments and at the same time to satisfy the government's medical monitoring, in order to solve medical disputes with data supports.
5. Image Storage and Transmission System: In order to solve the long term storage of mass medical image information problem and facilitate transmission of medical images in all medical institutions, the image storage and transmission system is established. There are professional staffs responsible for uploading images and only certain people can download and watch them.
6. Regional Medical Cooperative System: It is the hub part of HIS, providing information transmission and communication among systems, transfer and carding data.

4.4 Comparison of Conceptual Model and Reality

Through the comparison of conceptual model and reality, the problems in reality which can be solved after the completion of conceptual model are determined, reflecting the meaning of the system.

Through the establishment of HIS, medical resource allocation is optimized and the utilization rate of resources is improved, to make the patients in the medical developing areas also enjoy the high quality medical service, thus improving the people's satisfaction with medical service. HIS's design process is combined with the patient and the doctor's point of view. They can express mutual communication requirement in the system design process. And then the doctor-patient communication mechanism is built.

The practicability problems from each party's view, including problems not considered in the design process but found in practice, can be solved after absorbing uses' suggestions from different angles. Cost and profit distribution problem in E-health construction and application process is the worry shared by all parties, which can be solved by establishing the stable mechanism satisfied by all parties with the government's investment and help. Liability problem can be solved by building the corresponding laws and regulations, issuing burden sharing mechanism, setting static responsibility point of division in the system, and giving responsibility clarification basis from the view of the system.

For the government, it implies medical statistics and disease control and prevention according to data from health data center, and monitors HIS timely.

4.5 Formulation and Implementation of the Plan

The planning scheme can be determined based on the present situation investigation, root definition, conceptual model and comparison of concept model with state

of the problem. The planning scheme's determination depends on the government and all interest parties' agreements. In the planning practice, it often requires discussions with the relevant departments to reach the agreements. Only in this way can the scheme have operability.

5 Conclusion

HIS construction problem is a multi-angle, complexity system problem, which involves many people and departments. It is difficult to find structured and quantitative solutions. The soft system methodology is applied to HIS construction; out of the "hard system" imprison area, making a more comprehensive analysis. This paper uses SSM to analyze various interest parties' appeal and concerns, making the analysis target diversified and providing the framework for the comprehensive solution to the problems in the construction of HIS.

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E-commerce of Eco Bags on Basis of Pareto Improvement

Qing Li

Abstract In order to build an e-commerce website of eco bags welcomed by Macau people, this research analyzes feasibility of eco bag website by questionnaire. Firstly, Pareto indicates the highest percentage of consumer interest in eco bag website among these three factors: namely online product, website design and LOHAS. Secondly, a path chart illustrates cause-effect relationships among website design, online product, LOHAS, and buying behavior. Moreover, on the basis of Pareto improvement, website design, online product, LOHAS, and buying behavior are improved. Finally, a conclusion is that, compared to online product and LOHAS, the percentage of consumer interest in website design is the highest and cause-effect relationships in variables are found. Meantime, through constant improvement, utility ratio of website is improved greatly and buyers as well as makers get benefit. The research helps building a successful eco bag website and is a valuable reference for a mutual benefit for online consumers and makers.

Keywords Buying behavior • LOHAS • Online product • Pareto improvement • Website design

1 Introduction

Macau is promoting a low-carbon society. Under such social atmosphere, all kinds of products of environmental protection, energy saving, and health are used by citizens gradually, which results in a phenomenon that lifestyles of health and sustainability (LOHAS) are embedded in citizens' life. Usage of eco bag is one of the ways to bring a low-carbon society into reality. Through an eco bag website, supplier and buyer make online transactions. E-commerce of eco bag can improve

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interaction between suppliers and consumers and will arouse resonance of a more devoted environmental protection. The theme will attract more people's attention.

Concept of LOHAS is applied to e-commerce of eco bags so as to motivate more LOHAS people online shopping and improve the utility ratio of website while benefit buyer and maker.

2 Literature Review

2.1 Website Design, Online Product, and Buying Behavior

Palmer mentions that easy to find, easy to navigate and aesthetic impression are important for consumers.

Robbins and Stylianou assert that presentation, navigation, security, speed, and tracking are regarded as the important factors of website design.

Hsu claimed that timeliness, readability, and information richness can drive consumers to buy on website (Guorui 2006).

Hengjun, Wang points out that strong buying intention attributes to website design and consumers given a good vision and useful information on website.

Chen et al. think that consumers' preference of online shopping includes convenience, comparable price, diversity of style, and demand information (Meiling 2005).

2.2 LOHAS

LOHAS (Lifestyles of Health and sustainability) is given a definition by Paul H. Ray, as a sociologist, and Sherry Ruth Anderson, as a psychologist, in a book called "The Cultural Creatives: How 50 Million People are Changing the World." The book illustrates that health means lifestyle of health, environment protection, personal growth, and health care, and sustainability means a spirit of ecological sustainability (Shih-Chun 2008).

Shih-Chun Liang concludes the cores of LOHAS including healthy life, sustainable environmental protection, and pleasure (Siyu 2009).

2.3 Pareto Improvement

Pareto chart is that according to descending order from left to right, corresponding class frequency is shown in bar (McClave and George Benson 2009).

Pareto improvement is named by Vil-fredo Pareto, an economist of Italy. It is an economic theory. It is defined that one party is not impacted when other party get a good improvement with reasonable resources allocation. It is beneficial for both of them in improvement (Ke and Qing 2008).

3 Situation of Eco Bag Website in Macau

Online shopping has become a popular way of shopping because of its convenient interaction, low-cost, and unrestricted time and place. Currently, Macau has no e-commerce of eco bag. Just of information asymmetry, citizens are not able to identify a high quality and durable eco bags.

The distribution of sales depends on traditional distribution mainly. Citizens buy most of eco bags in supermarket, retail bag shop, and stationer rather than online shopping.

Some organizations of environmental protection hold creative competition of eco bags for collection of works and activities only award prize and improve citizens' awareness in the area of their interest issues, but those creative works are seldom sold in market. Outcome of works are not retained because these works are not promoted on website.

The increase in the number of LOHAS people in recent years results from the support of a low carbon economy by each age group in the society of Macau. LOHAS people care for the earth and keep a balance development between human being and nature. E-commerce of eco bag will attract these groups. More and more citizens take eco bags to shopping. Website of eco bags expands the market for sales of eco bags and leads to a broader market. That is to say, if LOHAS people can have access to the purchase of eco bags through a good media of website, makers would enjoy bigger market shares.

4 Descriptive Statistics

On the basis of references, this research makes questionnaires and the total questionnaires are issued 275 in Macau. However, there are 251 questionnaires recycled in the investigation. The ratio of callback of valid is 91.27 %. SPSS is dealt with the valid date in the questionnaire.

4.1 Demographic Variables

In this investigation, male accounts for 40.84 % and female accounts for 59.16 %. The difference of percentages controls within 10 %.

The degrees are composed of senior high school, bachelor, master, doctor, and others. The number of people who have higher degree accounts for nearly 70 % in which 37.24 % goes to bachelor degree, 24.90 % goes to master degree, and 9.6 % goes to doctor degree. In all degrees, people who have senior high school account for 17.53 % and other is only 10.73 %.

There are five age groups and the groups are composed by categories of those who are under 20 and above 51, as well as groups of those who are from 21 to 30, 31 to 40, and 41 to 50. In all ages, people under 20 make up 16.53 % and the people in the range of 21–30, 31–40, and 41–50 years old account for 33.85 %, 25.28 %, and 14.74 %, respectively. People aged above 51 accounts for 9.6 % of all ages.

In all incomes, people who earn salary from 10,001 to 15,000 make up 30.65 %. People who acquire salary from 15,001 to 20,000 make up 19.12 %and from 20,001 to 25,000 make up 22.31 % of all incomes. People who get salary above 25,001 and under 10,000 make up 9 % and 18.92 % of all incomes, respectively.

The careers consist of teachers, employees, doctors, students, managers, government officers, and others. The percentage of employee in business is the largest with 24.3 % of all careers. In all careers, students account for 20.31 % and teachers account for 18.63 %, and doctors account for 10.1 %. Managers and government officers account for 9 % of all careers, respectively. There is a smallest percentage for those people who serve for other fields.

4.2 Factor Analysis

According to the target of research, after questionnaire collected, exploratory factor analysis classifies questionnaire by SPSS and then gets new category and validity. On the basis of principal components analysis for scale, orthogonal rotation checks the correlation of factors. Finally, there are 30 subjects in four factors. In all subjects, Cronbach's alpha is 0.836. Reliability of LOHAS is 0.845, online product is 0.825, website design is 0.779, and buying behavior is 0.773. It is proved the higher reliability. Sig. is 0.000 in KMO and Bartlett's Test. It indicates that variables are significant. Factor analysis is available.

Cumulative variance is 70.391 %, and there is a bigger factor loading in very factor. Therefore, scale is useful with a good validity (Table 1).

4.3 Pareto Chart

Website design is on the left with the highest counts in column graph. LOHAS is on the right with the lowest column. The percentage of website design is the largest and the percentage of online product is larger than the percentage of LOHAS (Fig. 1).

Table 1 Factor analysis

Factor	Component	Factor loadings	% of variance
Online product	Size	0.765	23.621
	Color	0.673	
	Pattern	0.703	
	Price	0.676	
	Hand bag	0.693	
	Single shoulder bag	0.682	
	Capacity	0.749	
	Material	0.769	
	Quantity	0.681	
Website design	Operation interface is good	0.882	21.692
	Information is searched easily	0.774	
	Information of item is detailed	0.795	
	Information is updated quickly	0.753	
	Both maker and buyer are interactive on website	0.686	
	Payment is safe	0.681	
	Privacy of online buyer is protected	0.612	
	Business information of maker is legal	0.715	
	Knowledge of eco bag is introduced on website	0.709	
	Frequent question and answer are provided on website	0.716	
LOHAS	I love nature and am afraid of nature destroyed	0.791	14.745
	I am well aware of problem of earth and try myself best to protect earth	0.667	
	I am concerned with my health and relatives' health	0.775	
	I am concerned with logo of environmental protection while buying	0.689	
	I self-prepare eco bags and avoid using plastic bags	0.835	
	I focus on my growth by further learning	0.758	
	I sort out trash according to different classification	0.631	
	I usually participate in activities of healthy life and environmental protection	0.725	
Buying behavior	Possibility of online buying is high	0.738	10.333
	I will introduce other people to buy eco bags on website	0.793	
	Online buying is very frequent	0.882	

5 Path Analysis and Pareto Improvement

There are some subjects about online product, website design, LOHAS as well as buying behavior. Scale is made on a five-point Likert Scale which is designed to let interviewees make choice of subjects, such as strongly disagree, disagree, neutral, agree, and strongly agree. (*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.*)

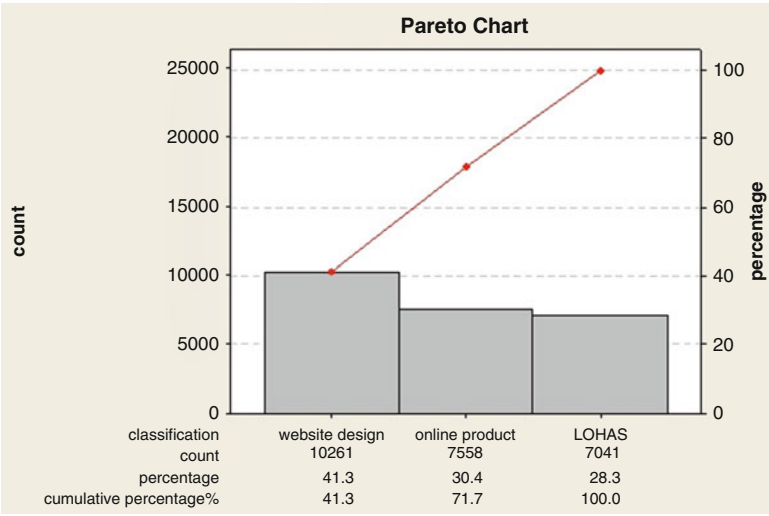

Fig. 1 Based on the result of questionnaires, Pareto chart shows factors of descending order by columns from left to right on horizontal axis. *Points* in *broken line* indicate cumulative percentage of the total counts

Table 2 Model summary

Model	R	R^2	Residual coefficient
1	0.798	0.637	0.603
2	0.676	0.457	0.737
3	0.58	0.336	0.815

5.1 Model Summary

In model one, predictors (constant) are website design, LOHAS, and online product. In model two, predictors are (constant), online product and LOHAS. In model three, predictor is (constant), LOHAS (Table 2).

5.2 ANOVA

In regression one, dependent variable is buying behavior. Predictors (constant)are website design, LOHAS, and online product. In regression two, dependent variable is website design. Predictors (constant) are LOHAS and online product. In regression three, dependent variable is online behavior. Predictor (constant) is LOHAS (Table 3).

Table 3 ANOVA

Model	F	Sig.
1 Regression	27.173	0.000
2 Regression	20.429	0.000
3 Regression	11.44	0.286

Table 4 Coefficients

Model		Standardized coefficients Beta	t	Sig.
1	LOHAS	0.178	3.196	0.011(**)
	Online product	0.151	2.549	0.002(**)
	Website design	0.477	8.014	0.000(***)
2	LOHAS	0.104	1.766	0.043(**)
	Online product	0.354	6.010	0.000(***)
3	LOHAS	0.68	1.069	0.286

**p<.05; ***p<.01

According to regression one, one can be informed, from the data, that the dependent variable – buying behavior is caused by the predictors because there is a significance level with $0.000 < 0.05$. According to regression two, one can be informed, from the data, that the dependent variable – website design is caused by the predictors because there is a significance level with $0.000 < 0.05$. In regression three, predictors have no impact on dependent variable because there is no a significance level with $0.286 > 0.05$.

5.3 Coefficients

In model one, dependent variable is buying behavior. Standardized coefficient of LOHAS as a predictor is 0.178. A path, from LOHAS to buying behavior, is significant because of $0.011 < 0.05$. Standardized coefficient of online product as a predictor is 0.151. A path, from online product to buying behavior, is significant because of $0.002 < 0.05$. Standardized coefficient of website design as a predictor is 0.477. A path, from website design to buying behavior, is significant because of $0.000 = 0.000$ (Table 4).

In model two, dependent variable is website design. Standardized coefficient of LOHAS as a predictor is 0.104. A path, from LOHAS to website design, is significant because of $0.043 < 0.05$. Standardized coefficient of online product as a predictor is 0.354. A path, from online product to website design, is significant because $0.000 = 0.000$.

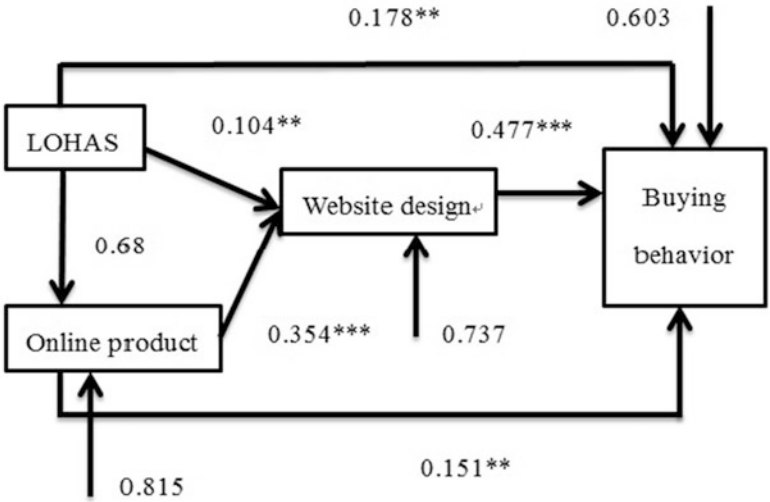

Fig. 2 Path chart

In model three, dependent variable is online product. Standardized coefficient of LOHAS as a predictor is 0.68. A path, from LOHAS to online product, is not significant because of $0.286 > 0.05$ (Fig. 2).

Five cause-effect relationships are feasible as following:

- From website design to buying behavior is feasible.
- From online product to buying behavior is feasible.
- From LOHAS to buying behavior is feasible.
- From online product to website design and then buying behavior are feasible.
- Form LOHAS to website design and then buying behavior are feasible.

There is a crosspoint in A (line of buying behavior/LOHAS and line of buying behavior/online product), B (line of buying behavior/website design and line of buying behavior/LOHAS), C (line of buying behavior/online product and line of buying behavior/website design) (Fig. 3).

These three points can be linked together to form a parabola which is a utility curve. The area inside of the parabola is where the improvement action should be targeted. Along with the increase in income, the utility will increase progressively. Therefore, we can expect that the improvements in LOHAS, online product and website design will bring about a progressive increase in the buying behavior of consumers. Furthermore, because of these three factors, LOHAS, online product and website design interact with buying behavior individually, buying behavior are encouraged if the other three are improved. The figure shows a significant increase in buying behavior/LOHAS and buying behavior/website design but a rather slight rise in buying behavior/online product.

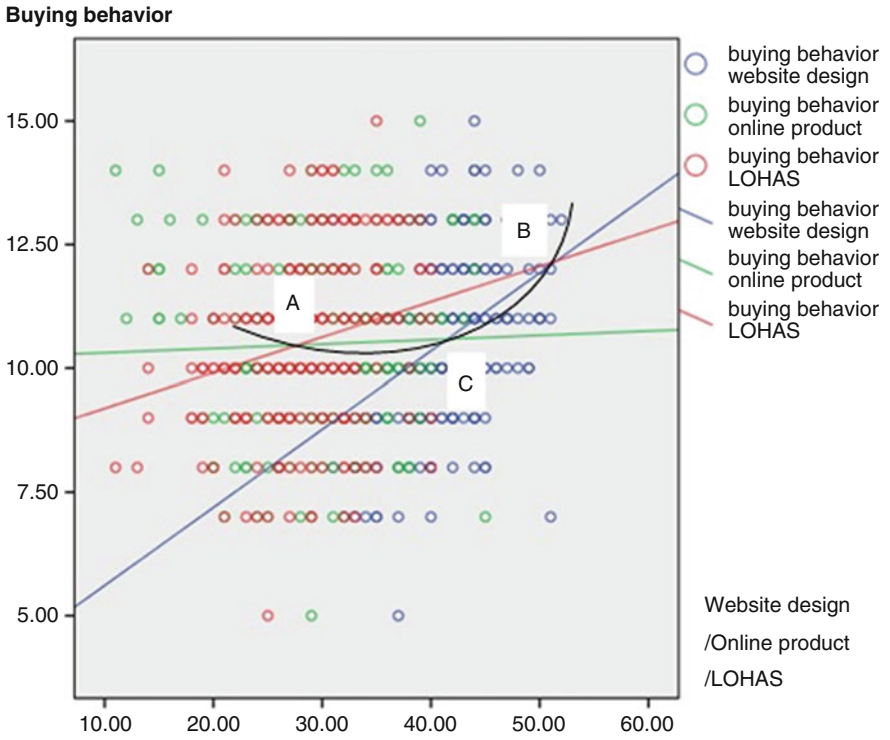

Fig. 3 Pareto improvement

6 Conclusion

Consumers pay close attention to website design. Compared to online product and LOHAS, frequency of website design is the highest. So website design is considered a priority. A good website can attract a great number of consumers. Consumers also concern about online product with a higher frequency. Therefore, online products are more important for consumers.

There is a cause – an effect relationship between LOHAS and buying behavior. Consumers' buying behavior is impacted by LOHAS directly. LOHAS people care earth and undertake a responsibility of environmental protection to realize low-carbon society in order to promote sustainable development of human beings and nature by their consumption behavior. Eco bags website cultivates loyalty of consumers and develops more potential consumers. Thus, a number of online buyers will increase.

There is a cause – an effect relationship between online product and buying behavior. Consumers' buying behavior is impacted by online product directly. Since the components in online product, such as visual impact, color, pattern,

size of online product, are provided in Table 1, it is suggested that these factors should be put into considerations when makers desire to get good profits.

There is a cause – an effect relationship between website design and buying behavior. Consumers' buying behavior is impacted by website design directly. The features of a greatly operated interface, easily searched information, quickly updated information and conveniently provided interaction as well as frequently answered questions on website can strengthen interest of consumers and impact decision of online buying. Safety of online payment, protection of privacy of buyer, and legally administrated and operated business can assure the interests of online buyer. Furthermore, there is information about online products available which enable consumers to increase knowledge from which learns how to identify quality eco bags.

Consumers' buying behavior is impacted by LOHAS indirectly when website design is seen as an intervening variable. It is easier for an operation friendly, timely, effective and safe website to attract LOHAS people and encourage them to make purchase decision of eco-products.

Consumers' buying behavior is impacted by online product indirectly when website design is seen as an intervening variable. Various style, different prices and durable quantity satisfy individual preference of different consumers, which can lead to more online purchases.

Website design, online product, and LOHAS are improved in scope of Pareto improvement. Through better utilization of resource, one party gain great advantage while the other party never suffers loss in acceptable region. Thus, utility of eco bag website is improved by website design, online product, and LOHAS, and also provides mutual benefits to buyers and makers.

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The Impact of Technical Barriers to Trade: The Cases of Trade Between China, Japan, Korea, and the US

Ayoub Yousefi and Mengyi Liu

Abstract The purpose of this paper is to analyze the impact of Technical Barriers to Trade (TBT) from the examples of trade between China, Japan, Korea and US in the manufacturing industry. The gravity model is used to determine the effect of the TBT on trade values. The results indicate that the Technical Barriers to Trade (TBT) do have negative effects on trade in the long term, and the governments and economies should actually reduce the amount of this non-tariff barrier.

Keywords Technical Barriers to Trade • WTO • Gravity model • Non-tariff barrier • Manufacture

1 Introduction

The technical barrier to trade (TBT) is a relatively new technique raised during the last decades, which has influenced the trade flow worldwide (Bao and Qiu 2011). It is one form of the non-tariff trade barriers (NTBs), which differs from the traditional ones that it mainly includes standards and technical regulations. World Trade Organization (WTO) took it into an effect in the year of 1995. TBT varies from country to country in terms of the magnitude and product coverage. For example, it might come with the form of safety and labeling. In fact, it can be a tool to promote trade but can also be a protection as well. Additionally, the Developing Countries

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and Developed Countries have different reactions to this measure. This essay is aimed to find out the effects for both types of countries in the manufacturing area with the help of gravity model.

This essay is inspired by the article "How do technical barriers to trade influence trade flows". Instead of the general trade flows, this study collects data on one industry, which is manufacture and extends the scope of the years to 2011. At the same time, unlike the previous article chosen all members in WTO, China, Japan, Korea and US are chosen as the object countries, because they have strong connections. China and US are the biggest trade partners of each other in terms of manufactured goods. Another reason is that Japan, Korea, and China are very close geographically, and Japan is an important and the most developed country in Asia. With the analysis of the TBT notifications and the trade flows of those countries, there would be a reasonable conclusion of the impact of TBT on the developing country and the developed countries.

2 Literature Review

According to the article "How does technical barriers to trade influence trade flows" (2011), the technical barriers are widely used and significant. Not only developed countries are using them, much more developing countries are taking use of technical barriers frequently as well. Though it is hard to measure the TBT's influence, gravity model can be used to exam how TBT affects trade flows. Xiaohua Bao and Larry D. Qiu (2011) have taken 105 countries including the bilateral trade data of developing and developed countries from year 1995 to 2008 to estimate the equations. For this gravity model, the trade flow, the export flow, the GDP, the distance between two countries, the dummies such as common borders, official language, and the colonial history are included. In addition, to measure the quantity of the key variable TBT, Xiaohua Bao and Larry D. Liu (2011) used the country's total number of each country's TBT notifications to WTO in every single year for the measurement of TBT. The regression result shows that different countries are affected differently. It can be seen that a developing country's TBT does not have significant effects on developed countries' exports. However, a developed country's TBT has stronger effects on both other developed countries and developing countries. The possible reason is that the TBT causes the higher costs for every country, but is even higher for the developing countries. The developed countries already have high standards, but developing countries have to take more efforts because of their relatively low technical standards. In other words, the TBT is more like an effective tool for the Developed Countries to control their trade volumes other than the developing countries. The further direction could be decomposing bilateral trade flow into the number of goods trade and the trade value of each good. What is more, by using other TBT measures such as TBT accumulated notifications and TBT frequency index could be used to explore more about the TBT effects. Another article "Do technical barriers to trade promote or

restrict trade? Evidence from China" (Bao and Qiu 2010), stresses on finding out if the TBT promotes the trade flow using data only from China.

Based on the article "Do technical barriers to trade promote or restrict trade? Evidence from China", Xiaohua Bao and Larry D. Liu (2010) took Developing Country China as the goal to analyze the TBT effect. Actually they compared the pre-WTO and post- WTO period effects since China joined WTO in 2001. Data from year 1998 to 2006 is collected to exam the influence of TBT imposed by China on other countries' imports. Moreover, TBT affects agriculture product most heavily, and affects agriculture and manufacture products differently. For here, extended gravity model is also applied to estimate the degrees of impact on TBT of imports of China. During the quantifying process, two non-tariff methods coverage ratio and frequency index are applied, as well as the NTB measures import license and import quota. The frequency index measures the number of product items subject to TBT as a percentage of the total number of product item in a product category, but the coverage ratio indicates the value of TBT affected imports as a percentage of total imports. They conclude that the frequency index shows a negative impact on China's imports but a non-negative effect by coverage ratio. The interest situation is that, from the regression results, the TBT has contradictory impacts on agricultural and manufacturing imports. That is, the impact on agriculture is negative but is positive on manufacture in both pre and post WTO period. As a result, whether TBT can promote or restrict the trade is still premature. In fact, there are more other ways of measuring the technical barriers to trade. The following articles tell the methods in detail and give all kinds of possible models.

Author John C Beghin and Jean Christople Buraeau (2001) argued the existing methodologies to model and quantify non-tariff trade barriers in the agriculture and food sectors in the article "Quantitative Policy Analysis of Sanity, Phytosanitary and Technical Barriers to Trade". Beghin and Buraeau argued that it is necessary and important to make quantitative analyses for the government so that they could know the costs and redefine the regulations. Several different ways of definition of non-tariff barriers (NTB) are explained as well. Speaking of ways to quantify the non-tariff barriers (NTB), one is the price wedge method. According to this method, the NTB would be gauged in terms of the impact on the domestic price in comparison to a reference price. However, several limitations exist. One is the practical difficulty of the application and another is that it doesn't fit the larger scale studies. The second method is inventory-based approach. Three sources of information can be used: The data on the regulations, the data on the frequency of detentions, and the data on complains from the industry against discriminatory practice, and the notifications to international bodies about such practices. This method has restrictions as well. For example, it is not clear if there is any correlation between the number of measures and their effect on trade. In addition, measures based on the actual detention at the border are more reliable but run into the limited availability of data. If a person wants to quantify NBTs, a very useful technique considers the foregone trade that cannot be explained by tariffs. Gravity model comes up and can be used as a way to estimate the "home bias" or the "border effect" in trade.

3 Methodology

3.1 Model

The model would be used to estimate the trade flows is the gravity model. Basically, the gravity model is a statistical analyses of bilateral flows between different geographical entities (Bao and Qiu 2011). It comes from the idea of Newton's "Laws of Universal Gravitation", and the shorter geographical distance indicates more trade volume between two countries. In terms of estimation gravity equation in economics, there is a linear relationship between log trade flows and the logged economy sizes and distances. Additionally, the economic sizes of the countries are measured with gross domestic product (GDP). However, there are more variations in trade that can explain the trade flows so that the augmented gravity equation is applied here.

$$\ln\left(\mathrm{EX}_{\mathrm{ijt}}\right) = \mathrm{C} + \beta\ln\left(1 + \mathrm{TBT}_{\mathrm{jt}}\right) + \gamma_1 \mathrm{lngGDP}_{\mathrm{it}} + \gamma_2 \mathrm{lnGDP}_{\mathrm{jt}}$$

In the equation above, the dependent variable is $\ln(\mathrm{EX}_{\mathrm{ijt}})$, which is the value of the country i's export to country j in year t. The control variables include gross domestic production of country i and country j in year t, which are $\mathrm{lnGDP}_{\mathrm{it}}$ and $\mathrm{lnGDP}_{\mathrm{jt}}$ in the equation. In addition, C is described as the year fixed effect to control the determinants of trade values that only change with time. In terms of measuring key variable TBT, a country's total number of TBT notifications to WTO in every single year is taken to measure. Because the TBT might be zero for some years, then $\ln \mathrm{TBT}_{\mathrm{jt}}$ would be meaningless, so $\ln(1+\mathrm{TBT}_{\mathrm{jt}})$ is used instead of $\ln(\mathrm{TBT}_{\mathrm{jt}})$.

3.2 Sources of Data and Summary Statistics

All the data between China and US starts from the year 1984 to the year 2011. For China and Japan, the time range of data is from year 1984 to 2011 as well. For the export from China to Korea, the data is valid from year 1992 to year 2011. Data of Korea exporting to China is valid from year 1989 to year 2011.

As the part of TBT notifications, they are collected from the TBT information system of WTO and added on to get the sub number for each year.

As the control variable, real GDP (based on year of 2000 in US dollars) for China, Japan, and US are collected from the World Bank.

As mentioned above, the manufacturing trade flow of China, Japan, Korea, and U.S. should be included. In that case, the data of the manufacturing trade flow were obtained from the WTO commodity trade statistics and database from the year 1984 to the year 2011 between Japan and China, as well as US and China. The trade value of manufacture from Korea to China is collected from 1989 to 2011 since there is no historical data before 1989. At the same time, the trade value from China exports to Korea is valid from the year of 1992 to the year of 2011.

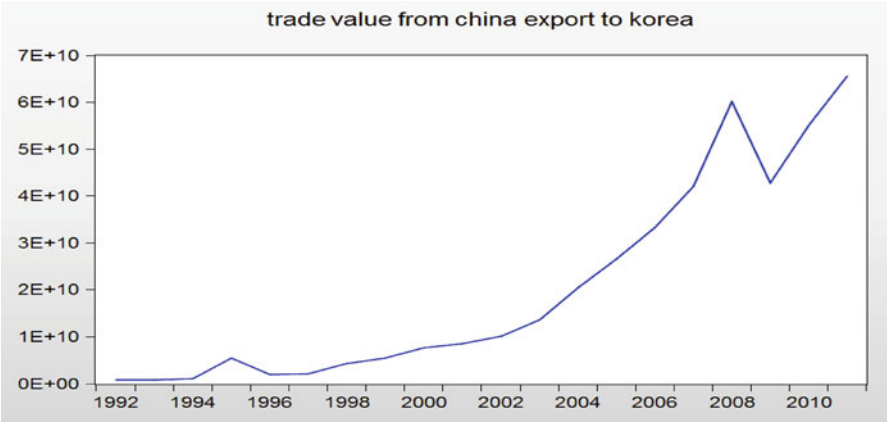

Fig. 1 The trade value from China export to Korea (1992–2010)

Table 1 The regression results of China exports to Korea

Dependent Variable: LOG(TRADE_VALUE_FROM_CHINA_E)
Method: Least Squares
Date: 03/26/13 Time: 14:00
Sample: 1992 2011
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(1+TBT__KOREA_S_)	0.305472	0.166122	1.838837	0.0846
LOG(REAL_GDP_KOREA)	4.900394	1.972563	2.484278	0.0244
LOG(REAL_GDP_CHINA)	0.056455	0.976176	0.057832	0.9546
C	−111.2833	26.67463	−4.171877	0.0007
R-squared	0.961692	Mean dependent var		22.96093
Adjusted R-squared	0.954509	S.D. dependent var		1.460424
S.E. of regression	0.311488	Akaike info criterion		0.681943
Sum squared resid	1.552393	Schwarz criterion		0.881089
Log likelihood	−2.819426	Hannan-Quinn criter.		0.720818
F-statistic	133.8888	Durbin-Watson stat		1.957077
Prob(F-statistic)	0.000000			

As is shown in Fig. 1, from 1992 to 2011, the export value from China to Korea. is increasing constantly, especially sharply after year 2000. It does fallen a bit on 2009 possibly because of the global financial crisis, but the value goes up after that (Table 1).

From the E-Views regression result showing above, the probability of log(1 +TBT_korea) is 0.0846, which means that it can be 90 % sure that the coefficient is significant, and TBT of Korea can influence the trade flow from China export to Korea. However, it is not reasonable since the coefficient is a positive number. Generally, the TBT would not stimulate other countries' export.

Fig. 2 The trade value from Korea to China (1990–2010)

Table 2 The regression results of Korea exports to China

Dependent Variable: LOG(EXPORT_VALUE_FROM_KOREA_)
Method: Least Squares
Date: 03/26/13 Time: 13:58
Sample: 1989 2011
Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REAL_GDP_CHINA)	0.758320	1.252815	0.605293	0.5521
LOG(REAL_GDP_KOREA)	5.766216	2.190006	2.632968	0.0164
LOG(1+TBT_CHINA_S_)	−0.277276	0.155373	−1.784584	0.0903
C	−153.2546	26.79880	−5.718711	0.0000
R-squared	0.959646	Mean dependent var		23.02979
Adjusted R-squared	0.953275	S.D. dependent var		2.141568
S.E. of regression	0.462921	Akaike info criterion		1.454252
Sum squared resid	4.071627	Schwarz criterion		1.651729
Log likelihood	−12.72389	Hannan-Quinn criter.		1.503917
F-statistic	150.6128	Durbin-Watson stat		1.803100
Prob(F-statistic)	0.000000			

However, the influence is positive. There are two potential reasons for this. One is that the amount of observations is not big enough, and there might be a bias. The other possible reason is that Korea's notifications can influence all of the partners that Korea has, and China might did not export the goods that were influenced by these notifications during those years (Fig. 2).

The trade value from Korea export to China also has a trend of going up, and also has a small decrease around the year of 2009. However, the absolute value is smaller than the one of China exporting to Korea. The regression table comes as following (Table 2).

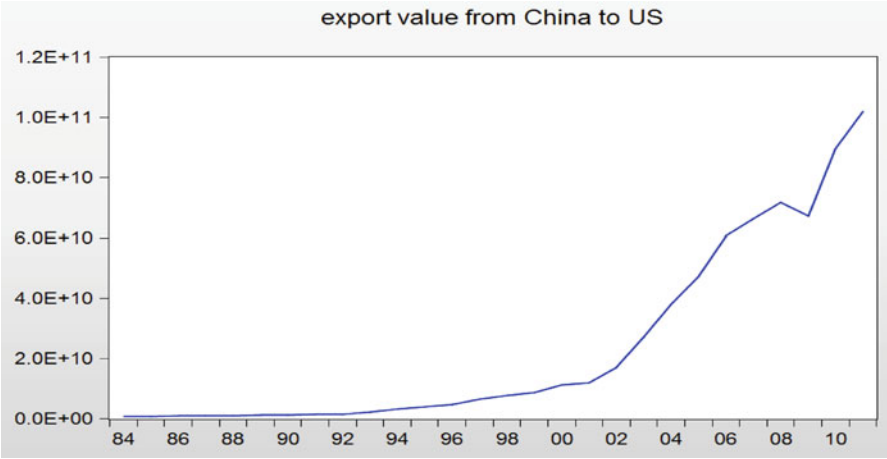

Fig. 3 The trade value from China export to US (1984–2010)

From[1] the results above, the probability of the key variable log (1+TBT_China) is 0.0903, which is smaller than 0.1. This number indicates that we can be 90 % sure that the TBT notification of China would influence the export value of Korea. Since the coefficient is −0.277276, the TBT of China does have a negative effect on the Korea's export. This result is reasonable. For[2] the variable of the real GDP of Korea, the probability is 0.0164, and we can be 95 % sure that this variable has positive influence on the export value of Korea. However, the GDP of China does not have significant influence on Korea's export value because the probability 0.5521 is bigger than 0.1. Looking at the adjusted R-squared; it is 0.953275, which argues that the model fits the data well (Fig. 3).

The value is increasing slowly before the year of 2000, and goes up quickly after that. Although there is a tiny fall in the year of 2009 because of the financial crisis, the value is increasing very fast in general (Table 3).

The probability log(1+TBT_US) is 0.0328 and the coefficient is 0.019259. This shows that there is a slightly positive effect of TBT instead of a negative one in the example of exporting from China to US. This is not supposed to be happen. One of the reasonable explanations might be that the number of the variables is not big enough to give sufficient result, and another explanation is that China has trade surplus during these years so that TBTs are not strong enough to influence the trade values. In addition, China joined WTO in the year of 2001, this benefits China exporting manufacture products to its biggest trade partner US as well (Fig. 4, Table 4).

[1] As the part of TBT notification numbers, there are two ways to calculate. However, those methods do not change the regression results.

[2] Authors tried to add other variable such as GDP per capita for China, GDP per capita for Korea, and dummy variables such as China joined WTO or not . However, the results showed that adding these variables made all original variables insignificant. Therefore other variables would not be included here.

Table 3 The regression results of China exports to US

Dependent Variable: LOG(EXPORT_VALUE_FROM_CHINA_)
Method: Least Squares
Date: 03/26/13 Time: 14:07
Sample: 1984 2011
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REAL_GDP_US)	2.955834	1.016718	2.907231	0.0077
LOG(REAL_GDP_CHINA)	1.188263	0.331031	3.589578	0.0015
LOG(1+TBT__US_S_)	0.109259	0.048227	2.265492	0.0328
C	−98.27826	21.58133	−4.553856	0.0001
R-squared	0.988017	Mean dependent var		22.68282
Adjusted R-squared	0.986519	S.D. dependent var		1.745510
S.E. of regression	0.202665	Akaike info criterion		−0.222961
Sum squared resid	0.985754	Schwarz criterion		−0.032646
Log likelihood	7.121456	Hannan-Quinn criter.		−0.164780
F-statistic	659.6208	Durbin-Watson stat		1.003821
Prob(F-statistic)	0.000000			

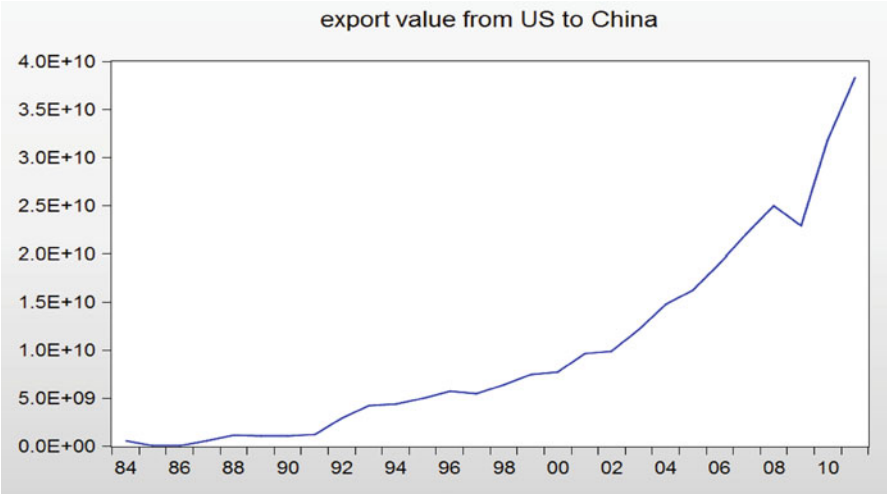

Fig. 4 The trade value from US export to China (1984–2010)

The probability of the log(1+TBT_China) is 0.0349, which means it is 95 % sure that the coefficient −0.382740 is significant. Consequently, the TBT of China has a negative influence on the export of US. The positive economy index of China would stimulate the export from US to China, whereas the US GDP does not have a significant influence. The adjusted R-squared 0.867589 is close to 1, which indicates good fitness of the model to the data (Fig. 5).

Table 4 The regression results of US exports to China

Dependent Variable: LOG(EXPORT_VALUE_FROM_US_TO_)
Method: Least Squares
Date: 03/30/13 Time: 14:20
Sample: 1984 2011
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REAL_GDP_CHINA)	2.031309	1.035027	1.962566	0.0614
LOG(REAL_GDP_US)	1.844945	3.119932	0.591341	0.5598
LOG(1+TBT__CHINA_S_)	−0.382740	0.171158	−2.236186	0.0349
C	−88.49733	65.99091	−1.341053	0.1925
R-squared	0.882302	Mean dependent var		22.16784
Adjusted R-squared	0.867589	S.D. dependent var		1.706637
S.E. of regression	0.621016	Akaike info criterion		2.016643
Sum squared resid	9.255856	Schwarz criterion		2.206958
Log likelihood	−24.23301	Hannan-Quinn criter.		2.074824
F-statistic	59.97036	Durbin-Watson stat		1.216624
Prob(F-statistic)	0.000000			

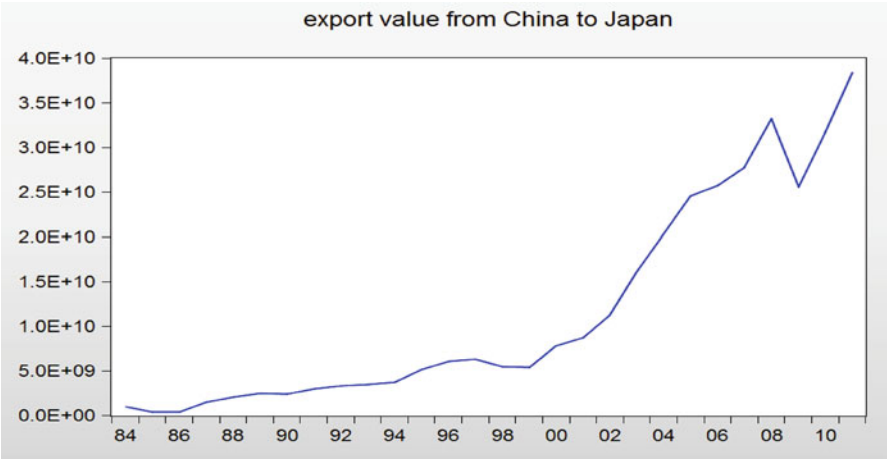

Fig. 5 The trade value from China export to Japan (1984–2010)

The export value from China to Japan is increasing slowly before 2002, and is increasing sharply after then with a tiny fall in the year 2009 (Table 5).

The probability of the log(1+TBT_Japan) is 0.3209, which shows that the coefficient is not significant. In other words, the TBT of Japan might does not have an influence on the export of China to Japan. A possible explanation is that these two countries are too close geographically and Japan needs the manufacturing goods very much so that the notifications would not be a key factor of the change of the trade value (Fig. 6).

Table 5 The regression results of China exports to Japan

Dependent Variable: LOG(EXPORT_VALUE_FROM_CHINA_)
Method: Least Squares
Date: 03/26/13 Time: 14:04
Sample: 1984 2011
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REAL_GDP_CHINA)	1.111624	1.168288	6.605467	0.0000
LOG(REAL_GDP_JAPAN)	3.328278	0.960872	3.463811	0.0020
LOG(1+TBT__JAPAN_S_)	−0.081827	0.080727	−1.013629	0.3209
C	−105.0114	24.16029	−4.346446	0.0002
R-squared	0.951298	Mean dependent var		22.52554
Adjusted R-squared	0.945210	S.D. dependent var		1.295777
S.E. of regression	0.303307	Akaike info criterion		0.583419
Sum squared resid	2.207879	Schwarz criterion		0.773734
Log likelihood	−4.167869	Hannan-Quinn criter.		0.641600
F-statistic	156.2628	Durbin-Watson stat		1.573004
Prob(F-statistic)	0.000000			

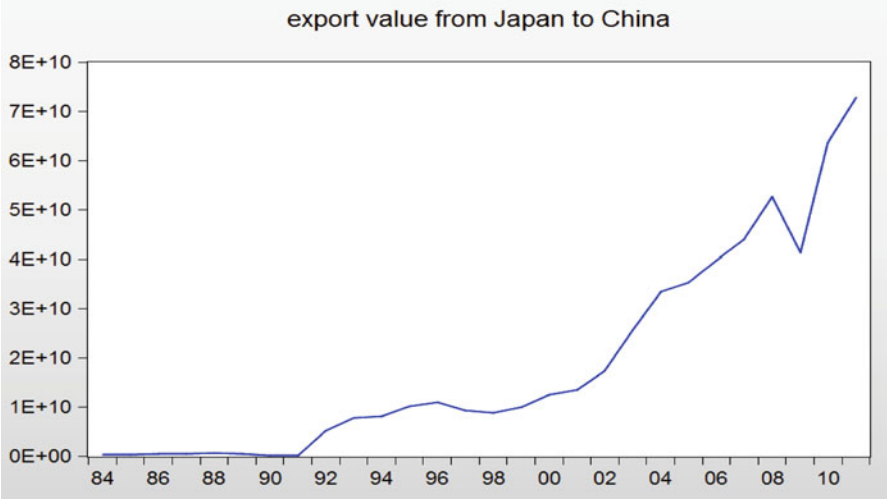

Fig. 6 The trade value from Japan export to China (1984–2010)

The value is very small before year 1991 and goes up lightly and fluctuates between the year 1992 and 2002. Then the value goes up quickly except the fall on 2009 because of the financial crisis (Table 6).

The probability of the log (1+TBT_China) is 0.0926, which shows that the coefficient is significant. Therefore it is safe to say that the TBT of China has a negative influence on the export of Japan to China. This result is reasonable.

Table 6 The regression results of Japan exports to China

Dependent Variable: LOG(EXPORT_VALUE_FROM_JAPAN_)
Method: Least Squares
Date: 03/26/13 Time: 14:02
Sample: 1984 2011
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(REAL_GDP_CHINA)	6.280805	1.838254	3.416724	0.0023
LOG(REAL_GDP_JAPAN)	−10.96523	6.997935	−1.566923	0.1302
LOG(1+TBT__CHINA_S_)	−1.056877	0.603299	−1.751830	0.0926
C	169.1204	161.3631	1.048074	0.3050
R-squared	0.638491	Mean dependent var		22.09189
Adjusted R-squared	0.593302	S.D. dependent var		3.016809
S.E. of regression	1.923906	Akaike info criterion		4.278155
Sum squared resid	88.83391	Schwarz criterion		4.468470
Log likelihood	−55.89417	Hannan-Quinn criter.		4.336336
F-statistic	14.12944	Durbin-Watson stat		1.217567
Prob(F-statistic)	0.000016			

4 Policy Implications

As we can see from the example of US exporting to China, Japan exporting to China, along with Korea exporting to China, the Technical Barriers to Trade (TBT) has a negative influence on the exporting trade values. As a huge economy playing a crucial part in the bilateral trade of manufacture, China definitely should be care of the policies which it is implementing. There is opposite results too as which have been showed above. The most possible reason for all of them is that the numbers of the variables are not big enough, which can influence the regression result. Additionally, the industry and the countries have been picked are very special. Bilateral trades of manufacturing trades between China and the other three countries are of great importance and particular enough so that the manufacturing industry cannot stand for the other industries. Though we see opposite examples, the opposite results also come with the imperfect fits between the model and the data, which means we should pay more attention on the ones that proving the negative influence on the importing countries' TBT notifications on its partner. The time period in this paper is not that long, but the long-term effect of the TBT can be somehow predicted from the results. As a consequence, as a non-tariff trade barrier, it should be reduced in rising up in order to avoid more negative on the trade values as well as other potential bad effects for all the governments trading in the international markets. Of course, this paper is by no means complete. Further researches should be extended with more industries and countries along with a longer time period.

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An Appraisal of Internet Business Models as a Research Paradigm

Ruchi Sharma

Abstract This paper attempts to provide a multidimensional view of the existing research in the area of Business Model for Internet companies (E Business Models). The paper highlights the emerging themes prevalent among researchers in the area of E Business Model research. The paper proposes a grouping framework to promote structure to the reviewed literature. The review presents that research in the domain of E Business Model exists in silos. There are gaps across the research themes that can be a subject of detailed investigation. There is a strong need to synergize the findings across different research themes. The paper presents the need for a holistic and a synthesis based approach in the knowledge assimilation mechanism.

Keywords Business model • Internet business model • Elements of an E business model • Taxonomies • Value generation and firm performance

1 Introduction

The advancement in information technology has given a way to a new genre of business opportunities and thereby expanded the horizon for companies to explore new business models. The twentieth century presents strong propulsion for companies to adopt Internet as a medium to a conduct business (e- Business). Companies are leveraging the efficiency and novelty (Zott and Amit 2007) promoted by Internet and moving towards to the new breed of "Internet based Business Models". The advent of E business forms have transformed the dynamics of competition in the market bringing in the concept of "redundancy" into the game with newer, quicker and dynamic business models coming into play. Hence, the established

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firms are engaging in actively to design their businesses in order to compete with the market forces. Likewise, starts up ventures are also exploring innovative business opportunities as strategic market entry options. Hence, the study of existing and exploring innovative Business Models has become a topic of growing interest among both the academia and the practitioners (Zott et al. 2011; Teece 2010). As cited by researchers, a holistic understanding of a Business Model can create a full understanding of a business (Osterwalder and Pigneur 2002) and an explicit Business Model can make it easy to communicate the understanding of a business (Gordijn and Akkermans 2001a, b, c).

The earliest mention of "Business Model" as a concept can be traced back to the early fifties through its association with the trade and economics (Teece 2010). The evolution of the internet during the nineties (1990s) spear headed the dominance of Business Model as a concept among enterprises. Since then, academicians and business practitioners have documented articled eliciting the business model as a concept. Subsequently, some common themes and definitions have emerged from the scholarly discussion among the academia. Common catalyst to the study on "Business Model" as a concept has been the emerging Internet technologies as cited by some scholars for e.g. (Amit and Zott 2001).

In this paper we present a review analysis of the existing research work done in the area of E Business Models and attempt to map the work done under a classification framework that can be used as a guiding vehicle for future research in the area. As an attempt to explore the research area of business models and identify the research, a theme based classifying mechanism can help organize the vast amount of research results presented by academicians.

2 Business Models

Several academicians have articulated and published literature on Business Models. Apparently, there is no general consensus on the meaning of the term Business Model (Jansen et al. 2007). Some authors have defined the term Business Model as a statement (Stewart and Zhao 2000), a description (Applegate 2000; Weill and Vitale 2001), a representation (Morris et al. 2005; Shafer et al. 2005), an architecture (Dubosson-Torbay et al. 2002; Timmers 1998), a conceptual tool or model (Osterwalder 2004; Osterwalder et al. 2005), a structural template (Amit and Zott 2001), a method (Afuah and Tucci 2001), a frame- work (Afuah 2004), a pattern, and a set (Seelos and Mair 2007). Linder and Cantrell (2000) define a business model as "the organization's core logic for creating value". Magretta (2002) views it as a "story that explains how an enterprise works". Eliciting the scope of a business model and contrasting it with the strategy concept, the researcher presents that "that business models describe, as a system, how the pieces of a business fit together", but a "business model" does not consider the critical dimension of performance, usually competition, unlike in business strategy. Other researchers

adopt the approach of defining business models by specifying their primary elements, and possibly their interrelationships. Laudon and Traver (2008) define "a business model is a set of planned activities (sometimes referred to as business processes) designed to result in a profit in a marketplace". Osterwalder et al. (2005) defines Business Model as "the firm's logic for creating and commercializing value". Applegate (2001) presents Business Model as "a description of a complex business that enables study of its structure, the relationships among structural elements, and how it will respond in the real world". The author highlights the importance of macro setting in which the target firm operates and is susceptible to the any change(s) in the business environment. Osterwalder and Pigneur (2002) when defining a Business Model, focus on the value proposition "the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams". Extending the concept of a value proposition, Seddon et al. (2004) investigate the link between the concepts 'strategy' and 'Business Models', "a Business model may be defined as an abstract representation of some aspect of a firm's strategy." Business model is often used to describe the unique competitive strategies of a given business (Afuah and Tucci 2001), a logical story explaining who your customers are, what they value, and how you'll make money providing them that value (Magretta 2002). It is also explained as an abstraction of how to generate revenue from business and the blend with the value stream, the revenue stream, and the logistical stream for the business (Betz 2002; Mahadevan 2000), business model can also become a product in and of itself (Hawkins 2004). A business model can also be patented under business method category if it can demonstrate the invention is useful, non obvious, and novel. The reverse auction model adopted by Priceline.com has earned itself a business method patent.

Hence, it is interesting for organizations to investigate how other organizations create and commercialize value by employing the "Right Business Model" for harnessing the "Right Business Opportunity" in the "Right Business Environment".

3 E Business Model – A Concept

E-business conceptually refers to "performing business electronically". It includes e-commerce, e-markets, and Internet-based business. In other words, it involves that business transactions conducted via open networks using the fixed and wireless Internet infrastructure to help the firms' bridge commercial transactions with their business partners and buyers (e.g., Mahadevan 2000). Some key features of Internet

based markets are high connectivity (Dutta and Segev 1999), concept of transactions (Balakrishnan et al. 1999), the importance of information goods and networks (Shapiro and Varian 1999), high reach and richness of information (Evans and Wurster 1999). Afuah and Tucci (2001) propose the Internet Value Network namely as: Users, Communication Service Providers and Suppliers by associating the largest players in the industry with each of the components of the Internet technology platform.

The technological developments in the Information technology systems have successfully added new ways to generate value from the traditional business model by revamping them, creating unconventional exchange mechanisms and transaction architectures (Amit and Zott 2001) and design of new boundary-spanning organizational forms (Daft and Lewin 1993; Dunbar and Starbuck 2006) both within and across firm and industry boundaries (Mendelson 2000). According to Brynjolfsson and Hitt (2004), these exchanges include the supplier and customer relationships.

4 Impact of Internet on a Firm's Business Model

There is a very significant role played by the technological developments manifested through the principal activities in the realization of digitally intensive goods and services. It is essential to identify the role and activities in order to elucidate the major dimensions of digital business models. This would further help in segregating business models, in line with the relevant characteristics. Under the gamut of technological advancements, Information technology has successfully fostered the digitization of value proposition, production of the digital services, strategic bundling of the services and distribution of the services for final consumption. Further on, with the standardization of interfaces, interoperability issues related to the activities of production, assembling and distribution of services and the subsequent economics of digitally intensive businesses have been highly rationalized. Hence, the key emphasis of a digital business model lies in the concept of digital services realized through functionalities. The functionalities when bundled form the module(s), which are distributed through packages to the service community. As a matter of caution, the packages have to be targeted to the specific customer needs. The software will deem to be redundant if not directed at meeting customer requirements in a prescribed fashion. The differentiating feature of the digital business model lies in the unique and novel ways of presenting the assortment of services. Backed by the case study results from 59 E-Business firms, Amit and Zott (2001) propose four major value drivers in any e-Business as – efficiency, complementarities, lock-in, and novelty and use these to create a Business Model construct for analysis of value creation in E-firms. They propose that "a business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities".

Hence, the major stakeholders being the producers and assemblers need to very cautiously sketch out their business model to optimize the novelty and efficiency quotients (Zott and Amit 2007) in the value offering. Many of the Internet success stories – E-Bay, Amazon, Google, Yahoo, Autobytel – have developed business models based on the concept of platforms assembling components, then bundling them into packages that matching them to consumers' complex and specific needs.

A critical appreciation of an E business model lies in understanding aspects related to how the providers frame the cost and revenue streams for the value proposition, what are their incentives in providing alternative intermediation services (that is, are these alternative models characterized by contrasted levels of pay-off?), how these models compete with each other, what is the value added by these intermediaries, etc.?

5 Definitions, Concepts and Elements of an E Business Model

Business model is a term that has received considerable attention in the area of e-business (Timmers 1998; Afuah and Tucci 2001; Amit and Zott 2001; Applegate 2001; Cheng et al. 2001; Weill and Vitale 2001; Hedman and Kalling 2003). Researches in the area of E-Business Models have been typically done with the following objectives:

- Understanding an E-Business Model, concepts, elements, activities and participants – (Gordijn and Akkermans 2001c)
- Eliciting the elements of a specific business model in a specific domain-(Osterwalder and Pigneur 2002)
- Viewing E Business Models in the light of the technological enhancements and requirements needed (Eriksson and Penker 2000)
- Critical assessment of existing business models and redesigning innovative business models (Eriksson and Penker 2000; Osterwalder and Pigneur 2002; Weill and Vitale 2001)

We propose a classification theme to organize the research work done in the area of E Business Models. The underlying thought for arranging the literature is to group the literature according to the primary objective of the research study. The review of the work on E Business Models presented in book chapters, academic publications, articles, and reports that discuss business models have been considered for the study. Based on the study, the classification scheme attempts to collate the work under the following sections.

5.1 Conceptual Knowledge Block

This block includes E Business research pertaining to the concept of E Business Model, its scope, components of an E Business Model arising from a detailed ontological analysis. Definitions comprise an important research phase in the area of E Business Model and its applications and form the platform for subsequent research concepts.

5.2 Applied Knowledge Block

This block includes the research related to the classification models, typologies and taxonomies developed based on various criteria, representations for assessing the linkages between E Business Models and strategy, and innovation, models assessing the feasibility and profitability of E Business Models and illustrative examples of successful E Business Models.

Researchers have proposed several definitions that give a conceptual understanding of an E Business Model and the possible purposes and elements of a business model. Some researchers provide a concise definition of a business model (Hedman and Kalling 2003) and while some others identify the components a business model should consist (Mahadevan 2000). The initial and perhaps most often cited definition is provided by Timmers (1998). In an attempt to create a classification model for Business Models for Electronic Markets, Timmers (1998) defines a business model as "an architecture for the product, service and information flows, including a description of the various business actors and their roles; and a description of the potential benefits for the various actors; and description of the sources of revenues". He creates a subtle association between Business Models and Marketing Models, leveraging the importance of Marketing Models in determining the commercial viability of a Business Plan. Being primarily influenced by Timmers, and deriving conclusions from industry illustrations (through case facts), Weill and Vitale (2001) define a business model as "a description of the roles and relationships among a firm's consumers, customers, allies and suppliers that identifies the major flow of product, information, and money, and the major benefits to participants". Osterwalder and Pigneur (2002), view the business model as the missing link between strategy and business processes. They suggest that a business model is a conceptual and architectural implementation (blueprint) of a business strategy (that) represents the foundation for the implementation of business processes and information systems. Their working definition of business model is "A business model is nothing else than a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenues streams." Tapscott et al. (1998) present "business models as structures that

encompass "fellow travellers" along with the target company". The authors indicate the transition from an "M-form" to the "E-Form" in the business eco system fostered by the robust network technologies. The proponents of an E-form organization are: customers, markets, products, processes, organizations (structures and relationships), shareholders and financing, social values, and government policy. Mahadevan (2000) defines a business model as a "blend of three different streams including value stream, revenue stream, and logistic stream".

Researchers have gradually shifted focus to conceptualizing the components that can better explain the Business Model structures. Afuah and Tucci (2001) present a list of business model components including customer value (distinctive offering or low cost), scope (customers and products/services), price, revenue sources, connected activities, implementation (required resources), capabilities (required skills), and sustainability. Dai and Kauffman (2002) theorize three dimensions of business model including market functions, management needs, and technological adaptation. A generic business model proposed by Hedman and Kalling (2003) includes several causally related but cross-sectional components: customer, competitor, offering, activities and organization, resources, supply of factor and production inputs, and process. Researchers use different terminologies to address the same case as decomposing the E Business Model into their "atomic" elements, "components", "functions", "attributes", or "pillars" of business models (Afuah and Tucci 2001; Hamel 2000; Peterovic et al. 2001; Weill and Vitale 2001; Rayport and Jaworski 2001). Unfortunately, the differences in terms used only suggest an increased number of component structure with little genesis across the multiple approaches and thus do not contribute to an overall synthesis in the knowledge aggregation mechanism.

Researchers working on E business model highlight value generation as the core of any business model. Amit and Zott (2001) propose that "a business model depicts the content, structure and governance of transactions designed so as to create value through the exploitation of business opportunities". Presenting the inter connectivity across transactions evolve from their previous definition to state that "a business model is a system of interdependent activities that transcends the focal firm and spans its boundaries". Teece (2010, p. 179) proposes that "A business model articulates the logic, the data and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value". Chesbrough and Rosenbloom (2002) view business model as "a heuristic logic that connects technical potential with the realization of economic value". The general pattern in E Business Model research shifts gradually from the more general to the more specific (i.e. internet business options to atomic business models), and identifying primary components for each analysis level (Weill and Vitale 2001) and mapping strategic goals to a business model. Some researchers have created a relational pattern linking the sub models to an overall business model (Peterovic et al. 2001; Linder and Cantrell 2000). There is also work done by researchers towards conceptualizing the prime components and sub components of a Business Model (Hamel 2000; Osterwalder and Pigneur 2002) or classifying the Business Models across on a 2 dimension scale (Alt and Zimmermann 2001).

6 Taxonomies

Several researchers use the concept of taxonomy to describe their classification of Business Models (Bambury 1998; Tapscott, et al. 2000; Rappa 2001). The underlying principle used by researchers is that business models can be clubbed together based on the common set of characteristics that they may share for (sourcing model, customer relationship model, revenue model etc.). There are two main features in any taxonomy: **Classification Theme** and **Classification List**. Listed below are some common themes used by researchers have been summarized in the list below (Table 1).

Some researchers identify business models using a Classification theme (variable based) approach. Researchers are also found to use the first and second order component system to determine the classification lists (Mahadevan 2000; Stewart and Zhao 2000; Afuah and Tucci 2001; Alt and Zimmermann 2001; Applegate 2001; Osterwalder 2004; Bonaccorsi et al. 2006; Brousseau and Penard 2006). For example, two variable approaches employed to establish the business models (Timmers 1998; Linder and Cantrell 2000; Tapscott et al. 2000) and four variables used (Weill and Vitale 2001; Betz 2002).

Harnessing the connectivity and open platform provided Internet infrastructure, Timmers (1998) uses his conceptual understanding of Business Models to identify 11 forms of Internet Business Models with best of the breed industry illustrations. Timmers depicts a qualitative mapping of the identified Business models across two dimensions. The first dimension is degree of innovation and second dimension is the degree of integration of functions, ranging from single function business models (e.g. e-shops that only provide the marketing function over the Internet), to fully integrated functionality, e.g. value chain integration. Afuah and Tucci (2001) provide an analysis of the business model classifications of Timmers (1998), Rappa (2001) and Eisenmann (2002) based on four variables; profit site, revenue model, commerce strategy and pricing model. The analysis provides valuable results by highlighting the similarities and differences between typologies through their taxonomy.

There has been yet another stream of research in the area of E Business Models focusing on the specific e business models and its specificity in the business horizon (Timmers 1998; Cherian 2001; Applegate 2001). For example, Timmers (1998) mentions 11 e-business models such as e-shop, e-auction, e-procurement, e-mall, third party marketplace, virtual communities, value chain service provider, value chain integrators, collaboration platform, information brokerage, trust services etc. Based on generic market roles (suppliers, producers, distributors, customers), digital business (online or not), and platform, Applegate (2001) presents six general business models and 22 specific e-business models. Rappa (2001) segregates the different models into nine categories based on how each model can generate value and specific revenue stream. Tapscott et al. (2000) propose a network of b-webs (business webs). The central theme in coining the b-webs has been the degree of economic control and value integration among the networks.

Table 1 Taxonomy of business models

Author(Year)	Typology referred	Classification theme	Classification list
Timmers (1998)	Current business models	Degree of innovation Degree of integration	11 categories • E-shop • E-procurement • E-malls • E-auctions • Virtual communities • Collaboration platforms • Third-party marketplaces • Value-chain integrators • Value-chain service provider • Information brokerage • Trust services
Bambury (1998)	Taxonomy	Not defined explicitly	2 categories/15 subcategories • Translated real-world business models • Native internet business models
Lindell and Cantrell (2000)	Overview of Operating Business Models	Core profit making activity Relative position on the price/value continuum	8 categories/34 sub-categories • Price model • Convenience model • Commodity-plus model • Experience model • Channel model • Intermediary model • Trust model • Innovation model
Tapscott et al. (2000)	B-Web taxonomy	Degree of economic control Degree of value integration	5 categories • Agora • Aggregation • Value chain • Alliance • Distributive network
Applegate (2001)	None given	Not defined explicitly	6 categories • Focused distributor models • Portal models • Producer models • Infrastructure distributors • Infrastructure portals • Infrastructure producers
Weill and Vitale (2001)	Typology of atomic e-business models	Strategic objectives Source of value Critical success factors	8 categories • Content provider • Direct to customer

(continued)

Table 1 (continued)

Author(Year)	Typology referred	Classification theme	Classification list
		Core competencies	• Full-service provider • Intermediary • Shared infrastructure • Value net integrator • Virtual community • Whole-of enterprise/ Govt
Eisenmann (2002)	Generic internet business models	Not defined explicitly	8 categories • Internet access providers • Online portals • Online content providers • Online retailers • Online brokers • Online market makers • Networked utility providers • Application service providers
Betz (2002)	Generic business models	Resources Sales Profit Capital	6 categories • Strategic finance • Strategic enterprise • Strategic response • Strategic learning • Strategic innovation • Strategic firm
Rappa (2001)	Taxonomy of business models observable on The web	Not defined explicitly	9 categories/41 subcategories • Brokerage • Advertising model • Infomediary model • Merchant model • Manufacturer model • Affiliate model • Community model • Subscription model • Utility model
Laudon and Traver (2008)	Major business models	Not defined explicitly	7 categories • Portal • E-tailer • Content provider • Transaction broker • Market creator • Service provider • Community provider

(continued)

Table 1 (continued)

Author(Year)	Typology referred	Classification theme	Classification list
Afuah- Tucci (2001)	Internet business model taxonomy	Based on the revenue model	7 categories • Commission • Advertising • Markup • Production • Referral • Subscription • Fee-for-service
Weijun Zheng (2006)	Business models for electronic market place	Network role based	4 categories • Communicator model • Transaction facilitator model • Valued chain coordinator model • Collaboration enabler model

Weill and Vitale (2001) use the concept of "atomic business models", which can be used to describe a business activity by considering any one or more of these "8 sub atomic models". These atomic business models are characterized by "strategic objectives, sources of revenue, critical success factors and core competencies required" (Weill and Vitale 2001, p. 25). The characteristics of the e-business model include "the roles and relationships among a firm's customers, allies, and suppliers, the major flows of products, information, and money, and the major benefits to the participants" (Weill and Vitale 2001, p. 25).

Bienstock et al. (2002) use the concept of exchange mechanisms to create the classification scheme based on the number of potential buyers and sellers involved in the transaction, the types of sellers involved in the transaction, the price mechanism, nature of product being exchanged and frequency of the offering. The author formulates a hierarchical decision tree resulting in a typology of 40 potential B2C categories and 52 potential B2B categories. However, there is no evidence to suggest that this typology has been evaluated either analytically or through deductive, empirical research.

Dubosson-Torbay et al. (2002) create a matrix based on six dimensions to classify the business models as follows:

- user's role
- nature of the offering
- pricing system
- interaction pattern
- level of customization
- economic control.

Following the same approach Osterwalder et al. (2005) propose three tiered hierarchical business model ontology. The top layer of the business model ontology

consists of four pillars namely: product, customer interface, infrastructure management and financial aspects of the business. The pillars serve to explain the business model. At the second layer, the four pillars are composed of nine elements, referred to as "business model building blocks". The third layer captures instances (view of a company) of the nine elements. Potentially, the nine business model elements could form the basis of business model in taxonomic research.

Some researchers have also successfully created an e business classification using the actor and roles analysis. Using the same, Timmers (1998, p. 4) defines an e-business model as: "An architecture for the products, service and information flows, including a description of the various business **activities** and their **roles**". Alongside Weill and Vitale (2001) presents that a definition of a Business Model as a description of **the roles** and relationship among a firm's consumers, customers, allies, and suppliers that identifies the major flows of product, information, and money, and the major benefits to participants." Another arena presented in the E business model research has been in outlining the specific roles carried out the E Businesses. **Weijun Zheng** (2006) presents on the specific roles that Electronic Markets play, as identified by researchers and builds a taxonomy based on the specific role exhibited by EM business model in its economic network.

To summarize, there are numerous taxonomies created in an attempt to classify the E Business Models. Still, it can sometimes be impossible to segregate a given business model conclusively into identified E- Business Model patterns, for example E-Malls encouraging E-auctions. This could be attributed to the complex nature of the business needs being addressed by the E business providers and assemblers. This calls for a more rigorous approach in determining the business models targeted at identifying the bridge networks existent in the real world.

7 Business Model Representation

Researchers have represented Business Models using informal texts, verbal descriptions, ontologies and ad hoc graphical representations. In an attempt to depict the mechanics of a business model, Tapscott et al. (2000) represents the b-webs participants (partners, customers, suppliers) and value exchange mechanism (tangible and intangible benefits, knowledge) using the "Value Map" representation. Weill and Vitale (2001) introduce the tool called "e-business model schematics" for the analysis and design of e-business initiatives. The tool is based on three classes of objects: participants (firm of interest, customers, suppliers, and allies), relationships, and flows (money, information, product, or service). Gordijn and Akkermans (2001a, b, c) represent an e-business value model using a e3-value ontology based on the "value viewpoint". They create the ontology using a scenario technique, called Use Case Maps (Gordijn and Akkermans 2001a). The e3-value ontology includes the following concepts: Actor, Value Object, Value Port, Value Interface, Value Exchange, Value Offering, Market Segment, Composite Actor, and Value Activity. Osterwalder and Pigneur (2002) introduce the concept of an "e-Business Model Ontology", that is

the conceptualization and formalization into elements, relationships, vocabulary, and semantics of the essential subjects in the e-business model domain. Tankhiwale (2009) employs the same ontology. The researcher conducts a longitudinal case study in order to trace the evolution of a telecommunication firm's business model and its impact on the firm's business process architecture. Summarizing, the majority business model representation tools take into account the relationships between business functions and business flows, stakeholders (actors) intertwined with the processes – activities.

8 Business Model, Value, Firm Performance and Innovation

The digital economy has modified the relationship between the market actors by giving rise to networked economies. There are all new channels available for business transactions for firms and opportunities for novel ways of value creation.

Management scholars have employed the concept of the business model in their attempts to explain value creation in networked markets (e.g., Zott and Amit 2010). Amit and Zott 2001, propose four potential sources of value creation through business models: (1) novelty, (2) lock-in, (3) complementarities, and (4) efficiency, and empirically validate the value drivers on a sample of 150 firms. The authors propose that these value drivers can be mutually reinforcing; i.e. the presence of each value driver can enhance the effectiveness of any other value driver. Researchers have also highlighted the value of monetization of E-Businesses. Pauwels and Weiss (2008) examine "fee and free" business models for providing digital content on the Internet. They investigate the impact on a firm's performance as the firm moves from the "free" to "fee" model and empirically analyze the role that marketing actions can play in accommodating this shift. In the given business eco systems firms compete through their business models (Casadesus-Masanell and Ricart 2010). In this respect, the business model, then, represents a potential source of competitive advantage (Markides and Charitou 2004). Hence, business models can explain a firm performance. Afuah and Tucci (2001) employ the business model construct for explaining competitive advantage and firm performance and define it as "the method by which a firm builds and uses its resources to offer its customer better value and to make money in doing so". Afuah (2004) introduces a framework wherein a business model is formulated as a set of components that define a firm's profitability. Some researchers (e.g. Zott and Amit (2007) have analyzed the performance implications of business model design in entrepreneurial firms. The authors conceptualize a business model as the design of a focal firm's set of boundary-spanning transactions with external parties. They identify two design themes around which the business model can be formulated: efficiency and novelty. In their empirical work, Zott and Amit construct business model as the independent variable, and link it to firm performance, moderated by the environment.

Giesen et al. (2007), also examine the relationship between business model innovation and firm performance and propose three innovative business models namely : industry models (innovations in industry supply chain), revenue models (innovations in how companies generate value), and enterprise models (innovations in the role the structure of an enterprise plays in new or existing value chains). Their studies reveal two interesting insights (1) each type of business model innovation can generate success, and (2) innovation in enterprise models that focuses on external collaboration and partnerships is particularly effective in older companies as compared to younger ones.

Researchers have also explored the concept of business model in the light of innovation and technology management. In this area, research seems to suggest a bilateral link between the two above concepts. For a given firm, a novel business model is the source of innovation and innovative business model ideas can be monetized to generate revenue. The case study on Xerox Corporation by Chesbrough and Rosenbloom (2002) is a classic example, wherein by employing an effective business model, the company was able to commercialize a technology that was being rejected by other leading companies. On a complementary path, Calia et al. (2007) present how technological innovation can transform business activities in a firm, and thereby the business model itself. Chesbrough (2003) introduced the notion of "open innovation" as a mode of innovation. The author promotes firms to seek for innovative ideas across boundaries of the given firm.

9 Discussion and Future Scope

A Business Model in a digital and highly networked economy can be viewed is a holistic concept and a subject of progressive innovation. The major proponents of an effective business model include value proposition, customer base, network externalities, revenue streams and cost lines and the mechanism to roll out the business model involved therein. Hence Business Model promotes Innovation and Business Model is promoted by Innovation.

Scholars researching on the theme of E business model have been interested in assimilating the knowledge about how firms engage in Internet based business, understand the Internet based business environment, explore the business re-alignment involved and role of Internet technology in revamping existing business mechanisms, user roles, activities and relations with the stakeholders impacted herein. To achieve the objective scholars have (1) defined and represented generic E business models, (2) developed typologies and taxonomies, (3) observed the business landscape to understand the linkages in the business ecosystem as Information Technology influences activities of a player in the value system. The concepts discussed in the article including Business Model definitions, components and taxonomies add novelty to the existing business model knowledge base. The existing research highlights include the notion of value (e.g., value stream, customer value, value proposition), commercial concepts of revenue streams and cost structures aspects, and architecture of the network system the firm and its partners and its exchange mechanisms (e.g., delivery channels,

network relationships, logistical streams, infrastructure). Each of these components may constitute part of a generic business model, and it could be a source of differentiation among business model types. At a conceptual level business model binds together the various aforementioned elements. As a scope of further research the links between each of the components/elements if scanned will be able to present valuable insights into Meta relationships between the same and a better clarity and consequences of business model prediction can be facilitated. Effective control mechanisms can be devised based on these bridges that link the elements. Also, the scope of unearthing other constructs and dependencies can add valuable knowledge to the existing plethora of the E-Business Model knowledge pool.

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The Study of Usability Performance in the E-commerce Websites

Chyong-Ling Lin, Jin-Tsann Yeh, and Chuen-Chieh Kao

Abstract Successful e-commerce websites must possess high traffic and conversion rate. A high conversion rate must be realized through the usability of website. In this study, what is its usability performance and whether the usability conformed to the customers' expectations of the present e-commerce websites were discussed. This research discovered the website usability across three types of the e-commerce websites: shopping, financial, and tourism services. A Web-based survey questionnaire was assembled, based on previously research instruments for measuring three parameters of usability – content, navigation and interactivity. Two hundred and seventy respondents used the survey questionnaire to rate 12 popular websites on three types of the e-commerce websites. The finding revealed that the financial services sites are the lowest rated and online shopping and tourism services sites could serve as models for Website professionals. The performances of content, navigation and interactivity were positively related to the usability of the websites.

Keyword Usability • Content • Navigation • Interactivity

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1 Introduction

As the information technology matures, Internet has substituted the traditional information acquisition channel gradually. The report of the "Internet surfing population in Taiwan" by the Ministry of Economic Affairs indicated that, until the end of March 2011, the Internet popularity rate was 75.69 %, where the utilization rates of "online community services" and "shopping online" were 56.30 and 61.23 %, indicating that relevant application services have large growth potentials (Institute for Information Industry 2011). Online shopping creates considerable business opportunity, where enterprises could achieve more effective business through the Internet to obtain higher returns (Wan et al. 2012; Ozok and Wei 2010; Bishop 1998). However, indicated by an investigation on the usability of the top 20 shopping websites in UK in 2010 by Web credible, a usability consulting company in the UK, 83 % customers would leave the shopping websites once they failed to find the goods or services they wanted, thus to cause customer defection (Webcredible 2010). As a result, how to enable the customers willing to purchase goods or services had become one of the main issues.

Many researchers found out that successful e-commerce websites must possess high traffic and conversion rate (Younas et al. 2008; Nielsen and Norman 2000). A high conversion rate must be realized through the usability of website. The usability enabled the customers to have a high learnability and a high effectiveness in operation, a high memorability in website interface, low errors and high satisfaction (Jeng 2005; Green and Pearson 2011). In the majority's mind, a website was established by the webpage and artistic designers. But to the customers, an easy-to-use website was the most valuable. In this study, what is its usability performance and whether the usability conformed to the customers' expectations of the present e-commerce websites were discussed, expecting to provide a basis for the e-commerce companies put into or to be put into production, so that the companies could evaluate the usability of their own website, thus to make the current e-commerce websites closer to the customers' requirements.

Many authors indicated that e-commerce was a method to deal with the communication and trade between enterprises through computer and Internet, so as to achieve the goals of cost reduction, product quality promotion and service efficiency enhancement to meet the enterprises' and personal requirements (Gökmen 2011; Ramanathan 2011; Vaithianathan 2010). Therefore, e-commerce was a method for enterprises to take up the business activities such as marketing, trade, services and payment through the two-way communication of Internet. The e-commerce was divided into three applications (Rajaraman 2005; Kalakota and Whinston 1997): (1) Inter-organizational Electronic Commerce (B2B); (2) Intra-organizational Electronic Commerce (Intranet); and (3) Consumer-to-Business Electronic Commerce (B2C). Shopping online was derived from the concept of Interactive Home Shopping. Online Shop was defined as the shops to provide goods or services online, have windows for On-line Take Order and complete real-time trade. For customers, to enter the online shops, look through and purchase the goods or enjoy services through Internet was called shopping online.

After the prevalence of shopping online, many designers proposed the concept of Customer Friendly, which emphasized that the product design and development should be customer-oriented. However, Customer Friendly was gradually substituted by Usability as time went by (Ozok and Wei 2010; Green and Pearson 2011; Bevan 1999). Usability included system function, organizational structure and operation mode. To customers, usability would influence the learnability, provision of the expected functions, operability and system response. Jeng (2005), Nathan and Yeow (2011), and Nielsen (1995) pointed out that the usability of systems or tools is their capability to provide the special customers with its functions, thus they could be used simply and effectively after the customers receiving trainings and accomplish the tasks under special environment and conditions. Moreover, they also proposed the indicators such as effectiveness, learnability, flexibility, high satisfaction, memorability and low errors for evaluation. Nielsen and Tahir (2001) filtered 50 webpage usability design principles according to the characteristics of the e-commerce websites and classified them into three types according to the webpage arrangement and display modes: webpage structure, webpage content and navigation. Benbunan-Fich (2001) indicated the three dimensions to evaluate the website usability: content, navigation and interactivity, when took on relevant studies on the usability of e-card websites.

The main purposes of this study:

1. To understand the overall usability and the performances of content, navigation and interactivity of the e-commerce websites (three popular types: Shopping websites, tourism services websites, and financial services websites);
2. To understand whether there was any difference in the usability and the performances of content, navigation and interactivity of the shopping websites, financial services websites and tourism services websites;
3. Whether the performances of content, navigation and interactivity were positively related to the usability of the website.

2 Research Method

After the studies on the usability of four e-commerce websites, Tilson et al. (1998) proposed 15 items to evaluate the usability effectively, which were: simple product catalogue, effective classification function, filterable product catalogue function, provision of product photos, provision of product information, obvious push-button placement positions, obvious interlinkage placement positions, description on ordering procedures, appropriate customers' feedback function, effective safety notice, momentarily cancellable trading, returnable trading process, multiple trading procedures, provision of continuous purchasing function for the customers had purchased and provision of the products comparison function. Moreover, Nielsen (1993), Jeng (2005), Nathan and Yeow (2011), proposed many research and evaluation methods, such as heuristic evaluation, think-loud, coaching, observational method, computer record method, focus group method, user feedback

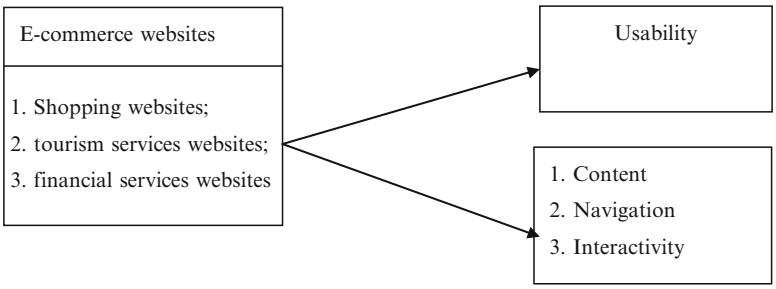

Fig. 1 Research framework

method, performance measurement and questionnaire method in the book Usability Engineering, where, questionnaire method was the most common one. Questionnaires frequently used by researchers were as following (Fig. 1):

1. System Usability Scale (SUS): proposed by Brooke in 1996, which used the questionnaires in the form of Likert 5-point scale with 10 items, with the highest credibility as verified by Tullis and Stetson (2004);
2. The Questionnaire for Customer Interaction Satisfaction (QUIS): proposed and developed by University of Maryland, USA in 1988, which used the questionnaires in the form of nine-point scale with 27 items;
3. Computer System Usability Questionnaire (CSUQ): proposed by IBM, USA in 1995, which used the questionnaires in the form of seven-point scale with 19 items.

2.1 Definition and Evaluation of Variables

Questionnaire in this study was divided into five parts, i.e. personal data, SUS, content, navigation and interactivity. SUS was consisted in the form of Likert 5-point scale, which measured the customers' subjective feeling after system operation in multiple dimensions, including ten standard narration items. The items were arranged in the form of front-back crisscross narration, the scores of which were calculated as following:

$$\{[(Q1 + Q3 + Q5 + Q7 + Q9) - 5] + [25 - (Q2 + Q4 + Q6 + Q8 + Q10)]\} * 2.5$$

Q was the item number and the total score was between 0 and 100, where higher scores indicated higher evaluation of the subjects on the system usability. Since this experiment evaluated the interface itself, thus the questionnaire notes would request the subjects to answer without regard to the content factor. This dimension included ten items in total. Moreover, variables used by Scharl and Bauer (1999)

Table 1 Website samples as the research targets

Website type	Research target
Shopping websites (4)	Yahoo! Shopping, CoolBid, PChome, ET MALL
Financial services websites (4)	eTrust, E. Sun Bank Web ATM, Citibank Taiwan, Mybank
Tourism services websites (4)	ezTravel, Lion Travel, Star Travel, ezFly

were also applied in this study, which were content, navigation and interactivity, each including five items. Except the census of population, the other items in this study all applied the Likert 5-point scale method for investigation. Before the complete investigation of this study, 30 students in Lunghwa University of Science and Technology were regarded as the filling-up targets for questionnaire pretesting. After the recovery of questionnaires, credibility analysis was carried out. Indicated by the analysis results, the Alpha value of SUS was 0.7514, while, Alpha values of content, navigation and interactivity were 0.8253, 0.8720, 0.8661, all higher than 0.8. This indicated that this questionnaire had a good credibility.

2.2 Research Design

Consumer-to-Business Electronic Commerce (B2C) websites were taken as the targets of this study and classified into three types according to the goods and services sold by these websites: shopping websites; tourism services websites; financial services websites. Definitions of these three websites were as following:

1. Shopping websites: to provide goods in different types and with different attributes for sales through the websites.
2. Financial services websites: to enable the customers to operate in self-service mode through the websites, so as to meet the clients' requirements;
3. Tourism services websites: to sell many different tourism goods and air tickets through the websites.

2.3 Sampling and Statistic Analysis Methods

To avoid the condition of unable to view the website, in this study, the websites won e-21 golden website medal, the B2C e-commerce medal awarded by Ministry of Economic Affairs were regarded as the sampling targets in collection of websites samples. After all the awarded websites were searched, the research targets were filtered according to the research purpose and assumed demand conditions of this study. At last, four websites for each of the three types, shopping websites, financial services websites and tourism services websites, altogether 12 websites were selected. The relevant data are shown in Table 1.

Fig. 2 Shopping website (ET MALL)

In this study, 90 questionnaires for each of the three types of websites were to be sent out and the subjects could select the website types they would like to evaluate. However, the persons investigated in this study were all the Internet-surfing population; meanwhile, the study subject wanted to know the website usability performance, thus the formal questionnaires were mainly sent out in the form of online questionnaires, so as to contact with the groups to be studied and increase the pluralism of the samples. Since online questionnaire might cause the conditions of subjects' repeated or missed filling-up, thus in design of the online questionnaires, except basic text editing software for HTML editing, PHP grammar was also applied for composing to obtain the IP used by subjects for filling-up and JavaScript grammar was used to check for missed items. In case of missed items, the system would prompt the subjects for the unfilled items automatically, thus to delete the repeated filling and avoid the occurrence of invalid questionnaires. URLs of online questionnaires were divided into three ones according to different websites types (Figs. 2, 3, and 4):

1.	Shopping websites:	http://fabio.blogdns.com/servey_a.html
2.	Financial services websites:	http://fabio.blogdns.com/servey_b.html
3.	Tourism services websites:	http://fabio.blogdns.com/servey_c.html

In this study, convenient sampling was applied to send out the formal questionnaires. The invited targets were mainly day-class students in Lunghwa University of

Fig. 3 Financial services website (eTrust)

Fig. 4 Tourism services website (ezTravel)

Science and Technology, who could fill up the questionnaires through the E-mail sent or connecting to the URLs of the online questionnaires. Meanwhile, the subjects were requested to forward the E-mail to the other friends. Through the sending and forwarding, the period for samples collection was 15 days and the recovered questionnaires were 310 in total. After the repeated questionnaires deleted, 270 valid questionnaires were remained, where, 90 for each of the three website types and the recovered valid questionnaires took up 87.09 % of the total questionnaires. In this study, SPSS was used as the data analysis tool, Frequency Analysis, ANOVA and Multidimensional Scaling Analysis (MDS) methods were applied for statistic analysis .

3 Results and Analysis

3.1 Analysis on Usability

Evaluation on usability was carried out according to the scores in the SUS (system usability scale). The total score was between 0 and 100, where lower scores indicated a poorer usability. The results of usability scores of all types of websites were shown in Table 2.

The overall usability score of all the tested websites was 48, where the shopping websites was 54, which was the highest; the next was the tourism services websites 53 and then the financial services websites 37. Seen from the above data, since the shopping websites and tourism services websites took websites as the main income source, they highly valued the usability of websites. Seen from the overall scores of all the tested websites, the usability of e-commerce websites was thoroughly unsatisfactory.

In this study, whether the usability of different types of the e-commerce websites or the individual websites of the same type was different was discussed. Therefore, variance was used for analysis. Seen from the analysis, P value of the shopping

Table 2 List of usability scores of all types of websites

Website type	Research target	Usability score
Shopping websites	PChome	56
	Yahoo! Shopping	55
	ET MALL	53
	CoolBid	51
Financial services websites	eTrust	38
	E. Sun Bank Web ATM	36.5
	Citibank Taiwan	36
	Mybank	35
Tourism services websites	ezTravel	55
	Lion Travel	54
	ezFly	52
	Star Travel	51

Table 3 Analysis on difference in usability of all websites

Independent variable	Mean value	F value	P value
Shopping websites	54.1	5.034	**0.002
Financial services websites	37	1.712	0.164
Tourism services websites	53.5	2.050	0.107
Overall websites	48.2	276.179	**0.000

*p < 0.05; **p < 0.01; ***p < 0.001

websites was 0.002, less than 0.05, indicating that the usability of shopping websites was significantly different. Through post verification, the usability performance of each shopping website could be seen, where, the performance of PChome was the best, followed by Yahoo! Shopping, and then the ET-MALL, at last the CoolBid. As seen, the interface of PCchome had higher learnability, its operation interface had higher effectiveness, customers had higher satisfaction and the using interface has lower errors.

Seen from the analysis, P values of the financial services websites and tourism services websites were both larger than 0.05, indicating that the usability of these two types of websites was not significantly different. P value of the overall websites was less than 0.05, indicating that the usability of the overall websites was significantly different. Detailed analysis on the usability difference of all websites was shown in Table 3.

Tukey HSD verification method was used further for post verification of the usability of individual website types. As seen, the shopping websites had best performance, followed by the tourism services websites, at last the financial services websites. According to this, the interface of shopping websites had higher learnability, higher customer satisfaction, higher effectiveness in operation interface, and lower errors in using interface.

3.2 Analysis on Content

Content was very important for websites, which concerned the information presentation of a website. The Cronbach's alpha value of the content was 0.931, indicating a good creditability. One-way ANOVA was used to discuss whether there was any difference in the content performances of all types of websites. Seen from Table 4, there was a significant difference in the contents of the shopping websites, financial services websites and tourism services websites.

3.3 Analysis on Navigation of Websites

The Cronbach's alpha value of the navigation was 0.937, indicating a good creditability. Seen from the One-way ANOVA and obtained from Table 5, there was a significant difference in the navigation of shopping websites, financial services websites and tourism services websites.

Table 4 Analysis on difference in the contents of all types of websites

Independent variable	Mean value	F value	P value
Shopping websites	3.56	6.431	***0.000
Financial services websites	3.61	6.436	***0.000
Tourism services websites	3.59	7.573	***0.000
Overall websites	3.58	0.757	0.469

*p < 0.05; **p < 0.01; ***p < 0.001

Table 5 Analysis on difference in the navigation of all types of websites

Independent variable	Mean value	F value	P value
Shopping websites	3.54	4.907	**0.002
Financial services websites	3.59	4.117	**0.007
Tourism services websites	3.58	6.004	**0.001
Overall websites	3.57	0.656	0.519

*p < 0.05; **p < 0.01; ***p < 0.001

Table 6 Analysis on difference in the interactivity of all types of websites

Independent variable	Mean value	F value	P value
Shopping websites	3.56	3.461	*0.017
Financial services websites	3.50	3.251	*0.022
Tourism services websites	3.50	3.494	*0.016
Overall websites	3.48	1.312	0.270

*p < 0.05; **p < 0.01; ***p < 0.001

3.4 Analysis on Interactivity of Websites

The Cronbach's alpha value of the interactivity was 0.903, indicating a good creditability. One-way ANOVA was used to discuss whether there was any difference in the performance of interactivity of all websites, obtained from Table 6, there was a significant difference in the interactivity of shopping websites, financial services websites and tourism services websites.

4 Conclusions and Discussions

4.1 Basic Descriptions on the Samples

The recovered valid samples were 270 in this study, where female (63.7 %) took up a higher proportion than male (36.3 %); as for the age level distribution, subjects with an age of "27–30" took up the highest proportion (26.7 %); as for education level, subjects with an education level "university/college" took up the highest

proportion (95.9 %); as for the Internet-surfing experience, subjects with an experience of "6–7 years" took up the highest proportion (37.4 %), followed by those with an experience of "8–9 years" (22.6 %). Obtained from the results, more than half (60 %) of the subjects had an experience over 6 years. Since the subjects of this study had an abundant Internet-surfing experience, thus the credibility of this evaluation was relatively high (Lin and Yeh 2010). As for the Internet-surfing frequency, the subjects surfing the Internet "several times a day" took up the highest proportion (71.9 %). On the whole, although the questionnaires were sent out through E-mails, the research target was the website performance; thus, seeing from the basic analysis, the overall sample had high research value.

4.2 Usability Performance

Found out from the evaluation of SUS (System Usability Scale), in the three types of tested websites, the shopping websites had the highest overall usability (54), followed by the tourism services websites (53) and at last the financial services websites (37). Where, the score of shopping websites was 1 higher than that of the tourism services websites, thus as seen, the usability performances of these two websites were consistent. The reason might be: Nielsen (1993, 1995) figured out that higher usability could enable the customers to learn all the functions provided by the websites easily, utilize the functions provided by the websites rapidly to achieve their goals and obtain high customers' satisfaction. Thus, the higher usability of shopping websites and tourism services websites was an inevitable result.

Found out in this study, usability performance would vary with the different types of websites, where, the usability performance of shopping websites was the best. Of all the tested shopping websites, the interface of PChome had high learnability, high effectiveness, simple and clear operation and high customers' satisfaction, similar results were also obtained by Vila and Kuster (2012).

4.3 Content Performance

As for the content performance, of all the tested shopping websites, Yahoo! Shopping had the best content performance, followed by PChome and CoolBid, at last ET MALL. Seen from the comparison of scores obtained through SUS (System Usability Scale), Yahoo! Shopping had a higher usability. Of all the tested financial services websites, eTrust had the best content performance, which was the same as the results obtained through SUS. Of all the tested tourism services websites, ezTravel had the best content performance. While, the results obtained through SUS also indicated ezTravel had the highest usability.

4.4 Navigation Performance

As for the navigation performance, of all the tested shopping websites, Yahoo! Shopping had the best navigation performance. Of all the tested financial services websites, eTrust had the best navigation performance. Of all the tested tourism services websites, ezTravel had the best navigation performance. The results of all the above website types were the same as those obtained through SUS. Thus, as seen, navigation could also influence the usability performance.

4.5 Interactivity Performance

The interactivity performance regarded the information communication between the customers and the websites as the main purpose (Nathan and Yeow 2011). Of all the tested shopping websites, Yahoo! Shopping had the best interactivity performance. Seen from the comparison of scores obtained through SUS (System Usability Scale), Yahoo! Shopping had the highest usability. Of all the tested financial services websites, eTrust had the best interactivity performance. Seen from the comparison of scores obtained through SUS (System Usability Scale), eTrust had the highest usability. Of all the tested tourism services websites, ezTravel had the best interactivity performance, which accorded with the results obtained through SUS. Therefore, interactivity performance would influence the usability performance.

4.6 Analysis on Multidimensional Scaling of the Websites

The locations of the 12 websites on the content, navigation and interactivity could be obtained from the analysis on multidimensional scaling. As for content performance, Yahoo! Shopping, PChome, easyTravel, eTrust, Citibank Taiwan had the best performance, while, easyFly, Star Travel, CoolBid had the poorest. It was recommended that the webpage presentation mode of the websites with poor performance should be strengthened.

As for the navigation performance, Yahoo! Shopping, Star Travel, easyTravel had the best performance, while, easyFly, PChome, CoolBid, ET MALL had the poorest. It was recommended that the design of website navigation function of the websites with poor performance should be strengthened.

As for the interactivity performance, ezTravel, eTrust, Yahoo! Shopping, Star Travel had the best performance, while, PChome, CoolBid, ET-MALL and ezFly had the poorest. It was recommended that the interactivity functions, such as the establishment of message board and design of customers' complaint box of the websites with poor performance should be strengthened.

Based on the above, it was recommended in this study that, in operation strategies, the e-commerce websites should regard the usability promotion as their main purpose, where, the shopping websites should highlight their characteristics through the usability, so as to promote the customers' loyalty (Vila and Kuster 2012; Nathan and Yeow 2011).

1. Promotion of content to enable the customers to understand the displayed significance;
2. Improvement of navigation to reduce the adverse impact of the websites caused by poor navigation;
3. Strengthening of interactivity to highlight the websites characteristics.

4.7 Research Limitations and Suggestions

Although there were strict procedures in this study, there were still some limitations as following: In this study, online questionnaires were taken as the medium. Since the contacted samples were the volunteers to participate in the questionnaire filling-up, thus the research results couldn't cover the opinions of all customers on the usability or obtain whether the proportion of subjects distributing in all counties and cities was appropriate. Thus, it was recommended the subsequent researchers to apply Focus Group method and discuss the influence of the other factors on the usability, so as to understand whether the customers had other opinions or requirements on the website usability.

As the Internet and e-commerce developed rapidly, the websites owners would innovate constantly in content provision and services; accordingly, the customers would give different evaluations. Therefore, the results of this study only interpret and conclude according to the current situations. The research targets of this study were only limited to shopping websites, financial services websites and tourism services websites but not included the other types. It was recommended the subsequent researchers to study further on the other types of websites.

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E-Business and Cloud Computing: A New Practice or a Trend

Waleed Noori Hussein and Rosnafisah Sulaiman

Abstract This paper presents literature review that is currently conducted to look into e-Business development with the emergence of cloud computing concept. The discussions in this paper includes the e-Business development, opportunities and challenges, and how the cloud computing is perceived in the e-Business context. This paper also presents the methodology that will be used to gather data to see how far the cloud computing has influenced e-Business for SMEs in Malaysia. Outcome from this research will be a set of recommendation for deploying cloud computing in e-Business environment.

Keywords e-Business • Cloud computing • SMEs

1 Introduction

Electronic business (e-business) has become a part of lifestyle for people and companies. Advances in technological innovation such as web centered technological innovation have made e-business affordable and easy to implement for even small companies. E-business has dramatically changed how enterprise's business processes are implemented and has also enhanced industry structure and shifted the balance of power between corporations and their suppliers and customers. Organizations in every market have had to assess the possibilities and risks provided by e-business. The Internet is driving the new economy and lucrative marketplace by creating unprecedented opportunities for countries, companies and individuals around the world (Zuzana and Jiri 2011). When companies go on the internet, they have to choose which e-business designs best fit their goals. A business model is defined as a mechanism for an organization to make money. It is also defined as a

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method to ensure the company's profit, strategies and differences from its rivals as well as principles of declaration of goods and services in the market (Donelaicio 2009). With the advent of the Internet and plenty of web development technologies, e-business has become a new mantra of businesses in today's world. The Internet has facilitated the development of businesses worldwide in various ways such as to reach wider consumer base and advertises their products more effectively and efficiently (Donelaicio 2009). Cloud computing concept has been discussed widely and has attracted many enterprises. Among the reasons claimed are the flexibility and efficiency that become a must for enterprises to do businesses (Shen and Qian 2011). Cloud computing refers to "computing resources provided by some virtual system on demand, which is done through computer networks" (Shen and Qian 2011). Cloud computing offers great potential to improve productivity and reduce operation costs. Large and small companies are moving towards cloud computing technology which is part of their important strategy (Sultan 2011). However, moving to cloud computing for large companies can be costly and time consuming through moving all their data systems (Staten 2008). This is after considering their existing business operations and the amount of data involved. Therefore, it can be seen that cloud computing concept could be more suitable and affordable for SMEs to sustain their competitiveness and innovativeness (Neves and Marta 2011). The aim of this research is to investigate the common and current practices of online enterprises with regards to cloud computing. This is to determine whether the deployment of cloud is part of technology trend or is it a must to have for every enterprise especially the e-Business companies.

1.1 E-Business: An Overview

E-Business is described as the incorporation of a business's company, such as items, procedures, and solutions, on the World Wide Web (Koon Ang and Husain 2012). E-Business is also about using the convenience and accessibility of the Internet technology to reach the global virtual marketplace in order to improve current businesses or to create a new exclusive company (Koon Ang and Husain 2012). It can be said that the emergence of Internet technology and its technological advancement have changed the way of performing businesses. Thus, it is unquestionable that accessibility of the Internet technology has influenced the evolvement of e-business design towards the advancement and competition in today's companies (Koon Ang and Husain 2012). Moreover, e-business technological advancement has been used substantially by larger companies to further enhance their company strategies especially in the marketing process. In these circumstances the small enterprises (SMEs) could deploy the same technology and approach (Neves and Marta 2011).

IBM defined e-business back in 1997, as "the transformation of key business processes through the use of Internet technologies". It allows businesses to modify their novel marketplaces and trade any opportunities by improving their revenue and reducing their price of dealings and improving versatility in communicating

with company partners (Tan et al. 2010). E-business is the relocation of internal and external business processes to Internet (Prieger and Heil 2010). From these definition e-business is a way of doing business through the internet from anywhere using any device like mobile and tablet. By allowing companies to link their internal and external data systems, e-business will be able to work closely to suppliers as well as partners (Turban et al. 2010). Working closely within the virtual environment, they would be able to reach and satisfy their customers' needs effectively (Yen-Yi 2006). However, the implementation of the e-Business concept requires major changes to the company's structure, strategy, procedure and culture. E-business can describe companies operating in the ICT producing sectors as well as new emerging sectors and industries such as in the area of digital content (Yen-Yi 2006). However, at a more fundamental level, the term e-business also describes the application of ICT to business processes in all sectors of the economy to reduce cost and finding new market.

1.1.1 E-Business Development for SMEs in General and in Malaysia

The development of the global economy will lead to the development of e-business. The development of e-business requires operators or reliable infrastructure to rebuild business models due to the advancement of new technology (Deniss et al. 2011). Therefore, e-business and the Internet provides significant benefits for sustainable business development. The development of e-business can be presented in four states: "advance of internet, transformation, interaction and cooperation". Using the Internet technology will allow companies of different size to develop new online business models that lead towards the improvement of how they operate and communicate with business partners and other stakeholders (Abbasi 2008). In Malaysia, E-business has been proven to be an effective and successful concept of developing business and has been practiced globally. In fact, it has been used as one of the medium to enter international markets (Azahari et al. 2011). As Malaysia moved towards advanced information, communications and multimedia services the technology awareness among Malaysian is increasing tremendously from time to time (Azahari et al. 2011). Thus, a large number of high technology companies from around the world have started to set up in Malaysia Multimedia Super Corridor (MSC) Project (Azahari et al. 2011). According to Telecom Malaysia (TM), the number of Internet users in Malaysia is expected to reach the ten million mark in the next 5 years. This was based on the growing trend of Internet users in the last 3 years (Azahari et al. 2011). E-Business in Malaysia gains a competitive advantage due to access to global market and it is an applicable approach for all types of businesses (Muhammad et al. 2011). The increasing rate of online business transactions around the world and the innovative attitude of the customers are pursuing organizations in Malaysia to adopt e-Business to entertain global marketplace. However, the adoption of e-Business in Malaysia needs a proper business model as well as other strategies that can facilitate this technology for businesses. Furthermore, e-Business practice in Malaysia is acting slowly towards the maturity phase, organizations are reluctant to invest in e-business and

Table 2.1 E-Business good impact

Impact	Description	Author
Better decision-making process	It's a process of first diverging to explore the possibilities and then converging on a solution(s)	Aparna and Turban et al. (2010)
Better management of information	Promote information sharing, effective planning, and coordination of business activities	Mustafa and Mohd (2009)
Improve customer relationship	A relationship of trust with customer enables the success in the market	Chen and Lewis (2009)
Effective order handling and sales	E-business strategic helps the companies and SMEs to save a lot of time and human effort compared to making orders through telephone before adopting e-business technology	Mustafa and Mohd (2009)
Lower transaction costs and increase profits	It can lower the costs to gather the information and negotiate a purchase-and-sale transaction	Vlachos et al. (2009)
Expanded geographical coverage	This is due to the internet technologies which enable them to conduct their business regardless of location and create a virtual business	Vlachos et al. (2009)

they prefer to wait and see approach to the adaptation of e-Business (Enrique et al. 2008). The authors have identified five factors which can be affective to boost E-Business practices in Malaysia. The eye-catching aspects are worldwide growth, security startup; detain business and clients, hr training, government recommendations and control (Enrique et al. 2008).

1.1.2 E-Business Opportunities

The good impacts of adopting e-business technology among enterprises are to include better decision-making process, better management of information, improve customer relationship and customer service, effective order handling and sales, lower transaction cost and the business can be expanded on geographical coverage. The description for the e-Business good impact is summarized in a Table 2.1 below:

1.1.3 Challenges and Issues of E-Business

There are some difficulties and problems revealed with regards to e-business execution. The main problems are protection and confidentiality (Chen and Lewis 2009). The client details, such as the latest purchase, income, address, bank card number, history of credit score and other private details that is gathered digitally by SMEs via Online web allowed biscuits and sometimes malware. It was revealed that malware allows an individual or a company to observe and collect details on the action of a computer user this increases some protection and comfort problems (Chen and Lewis 2009). Great execution is cost also plays a role in e-business current practice (Tan et al. 2010). It was also revealed that the advanced level of

complexness is associated with e-business execution (Kaynak et al. 2005). Lifestyle in e-business implantation has also being mentioned in the latest guides such as company procedures, company components and working methods, worker power, new company designs, the management of change, and the need to progress new methods of thinking, acting and planning (Chu and Smithson 2007). When it comes to e-business, both the client and the company obtain the advantages. Being online makes a company practical, available, affordable and better prepared to help its clients. For our research known the advantages and problems of e-business give us a clear understanding of the possibilities of e -business. So being acquainted with e-business will be easier to research the likelihood of implementing other technology in e-business.

1.2 Cloud Computing

Cloud computing idea is determined often in different ways. Cloud computing provides high accessibility and convenience to a new IT client (Marta et al. 2011). Cloud computing is a style of computing that extremely involved scalable IT-enabled abilities to be provided as a assistance to exterior clients using Online technology (Heiser 2009). "Cloud computing provides on-demand support style and a "pay as you go" technique, which allows clients to use the support only when they need and pay for only what they use (Marston et al. 2011)". Cloud computing offers with details accessibility, software and storage in which the business of a system that provides the solutions may not require the knowledge of the end customers (Marios 2009). It is also mentioned that cloud computing is a latest popular in IT, which goes details away from into huge details facilities. With a large-scale growth of the Online technology and utilization all over the world, no doubt that any programs can now be provided as common solutions over the Online network.

1.2.1 Services Offered

Currently many forms of cloud computing services are provided to customers depending on their needs. Cloud services can be divided into three classes of software namely "Service (SaaS), Platform as a Service (PaaS), and Infrastructure as Service (IaaS)" (Ahronovitz et al. 2011).

- **Software as a service (SaaS)**: This service is provided through the Internet. With SaaS there is no need to install and maintain the software. Many services like scheduling, planning management task, calendars, file sharing and storing at low cost have been offered by service provider companies (Sultan 2010).

Table 2.2 The benefits of cloud computing

Benefit	Description	Authors
Easy management	The maintenance of the infrastructure, hardware or software is simplified	Miller (2009) and Yashpalsinh and Kirit (2012)
Cost reduction	Cloud computing drastically reduces the IT spending for companies	Miller (2009), Yashpalsinh and Kirit (2012), and Weiss (2007)
Uninterrupted services	Lower outages are provided by cloud computing services, thus providing uninterrupted services to the user	Miller (2009) and Yashpalsinh and Kirit (2012)
Disaster management	In case of disasters, an off-site backup is always helpful. Keeping crucial data backed up using cloud storage services is the need of the hour for most of the organizations	Miller (2009) and Yashpalsinh and Kirit (2012)
Green computing	As it reduce many power-hungry carbon footprints data centers and reduces the need of more electric power for maintaining data centers	Miller (2009), Yashpalsinh and Kirit (2012), and Weiss (2007)

The customers only pay for what they use. As this kind of software is accessible through the Internet, means it should be accessed by any device such as PC, Smartphone or a tablet (Jena and Mahanti 2011). The most relevant and subscribed SaaS by most companies is Google applications such as Gmail, Google Docs and Google apps.

- **Platform as a Service (PaaS)**: In this type of services, the clients will host their applications at various remote locations that allow them to access and manage their running applications without controlling the operating system. However, the issue with PaaS is the vendor can lock-in or apply some restrictions that could cause the customers to opt-out for large and well known organizations such as Microsoft and Google (Sultan 2010).
- **Infrastructures as a service (IaaS)**: In this type of services, companies may keep their data and may use the processing and storage that initially provided by their own data centre. This allows the companies to utilize computational power based on their demand. A good example is Amazon web services (Sultan 2010). However, one of the issues in IaaS is the server may imply high costs, constant and trustworthy power supply, costs with the cooling systems and require a strong and high-speed Internet connection (Sultan 2010).

1.2.2 Benefits of Cloud Computing

Previous studies have reported the benefits of cloud computing in a general context (Yashpalsinh and Kirit 2012; Weiss 2007). Among the benefits that can be seen through cloud computing is: "easy management, cost reduction, uninterrupted services and disaster management" (Miller 2009). The benefits of cloud computing are summarized in Table 2.2.

These benefits can make large and small enterprise thinking of changing their business process. Cloud computing benefits can help companies to save money and do business in more efficient and flexible way especially for SME's. Usually SME's has restricted costs and facilities for our analysis these advantage will be one of the objectives for SME's to implement cloud computing.

1.2.3 Problem and Issues of Cloud Computing

There are some problems and issues reported with regards to cloud computing implementation. The main issues with cloud computing are security and privacy. Placing or handing over personal or company confidential data to another company (the service provider) is not preferable to some people. Corporate users may hesitate, to some extent, in adopting cloud services as they cannot ensure the security of their company's information. However, on the other hand, the service provider companies may claim for their reputable services and security measures which could still be questionable with today's technology advancement. Issues with privacy are also critical for online companies. It was reported that one of the ways to solve this issue is by using proper authentication techniques. Another solution is to provide with an authorization that allows each user can access data and applications that related to their job. Time replication and costs also contribute to cloud computing current practice and data resiliency. The reliability of cloud computing services has also being discussed in recent publications such as server downtimes. The Offline cloud has also reported to be an issue as cloud computing is fully dependent upon internet connection if the customer has a problem with internet connection then he/she is unable to access the application or data from the internet (Victor 2010). The performance of cloud computing service has also being discussed in recent publication such as the connection quality between the user and the Cloud Computing server (Benlian and Hess 2011). The need for high speed internet has also discussed in recent publication such as network failures (Weiss 2007). These problems and issues of cloud may make many companies hesitate of moving towards cloud technology, but they have to notice that the cloud brings more benefits despite the problem and issues that may occur. It can be seen that the SME's awareness of data security is still low but more focusing on getting services at low cost. Our research will explore the issues of cloud further during the data collection process.

1.3 E-Business and Cloud Computing

In e-business context, the potential of cloud computing is not just about decreasing cost, but it is also about increasing profit, remain contact with the advance technology and helping business to strengthen their business relation (Shen and Qian 2011). The adoption of cloud computing could also benefit the small businesses by helping them

to gain competitive advantage over their rivals and fast access to common use business applications at negligible cost (Heiser 2009). Cloud computing services can be used by different business type to different companies' size. Cloud computing provides IT service providers with new ways of handling business that provides opportunities for non-IT enterprises or new start-up e-Business companies to gain some benefits by facilitating the cloud computing services in their business operation (Accenture 2009). Cloud computing in businesses is about sharing resources, minimizing organizational expenditure and collaboration between networks or organizations (Accenture 2009). The key advantage that companies can gain from cloud computing comes with pay-per-use model, in which the end user only pays for what they use IDC Report (2009). Other advantages are: reduce costs, save in other IT expenses, and no need to buy or update software because it runs in the cloud. This also includes scalability which can increase and decrease their computing power on a demand basis and foster innovation (Neves and Marta 2011). In addition, cloud computing is considered to be part of green technology due to the less use of energy. However, there is some risk need to be considered when applying cloud computing such as security as mentioned in the previous section which presents one of the real threats for companies. Moreover, the availability, performance, cost lack of audit and hard to integrate with in- house applications are another risk that needs to be considered (IDC Report 2009). it's obvious that large and small enterprise we're able to make good use of these technologies by implementing it with their business process. Cloud computing has been used by large companies, small business can gain the same advantage of the cloud even more due to their low budget. Cloud brings scalability, flexibility and collaboration in e-business. The findings of this study indicate that the study is quite informative and useful for both large and small enterprises to apply cloud computing technology. For our research this finding gives us a clear understanding of the benefit and issues that SME's need to consider when applying cloud computing. There is a need to investigate cloud applications and service that has been used by SME's which they benefited from.

2 Methodology

Figure 1 show how this research is carried out. In this research both qualitative and quantitative approaches are used. The data will be collected by using structured questionnaire that will be distributed online and by e-mail. Consequently, to interpret the results obtained from the questionnaire a statistical analysis will be perform using tables, figures and graphs. For our research this finding as mentioned gives us a clear understanding of the benefit and issues that SME's need to consider when applying cloud computing. The findings of this study also indicate that it is worthwhile for SME's to take note of the results of this study before going for actual implementation of cloud computing technology. Our outcome will be a set of recommendation for Malaysian SMEs that will help SME's to choose a suitable cloud provider and applications.

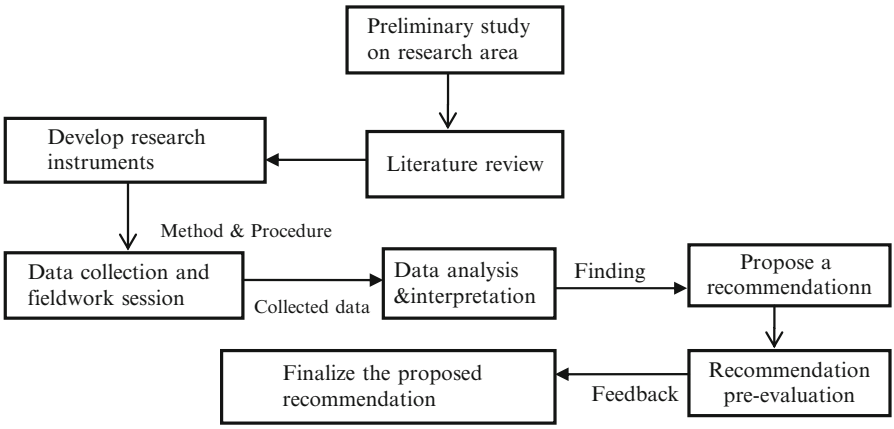

Fig. 1 Key stage in the research process

3 Conclusion

E-business advance has led to new opportunities and challenges for enterprises. With the emergence of Cloud concept, it can bring a great benefit to an enterprise's especially for SMEs in terms of IT infrastructure. However, there are some risks and issues that need to be considered and explored when applying cloud computing. The adoption of e-business and cloud computing technologies and its development could lead to main changes in enterprises and its competitive space. These changes may create many opportunities for the enterprises to apply cloud computing successfully. In this paper, the potential of cloud computing and e-business has been discussed to give a good understanding of cloud computing in e-business and to acknowledge the factors that may affect e-business current practices. The methodology that will be used is also described. This study is about understanding the potential of cloud computing in e-business as well as benefits and issues of cloud computing for enterprises. The finding of our research will be use to propose a set of recommendation for Malaysian SMEs in deploying cloud applications.

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Multi-level Access Control in the Data Pipeline of the International Supply Chain System

Potchara Pruksasri, Jan van den Berg, Wout Hofman, and Semir Daskapan

Abstract The Seamless Integrated Data Pipeline system was proposed to the European Union in order to overcome the information quality shortcomings of the current international supply chain information exchange systems. Next to identification and authorization of stakeholders, secure access control needs to be considered at design time of the new data pipeline system. This challenge is taken up in this paper. First, based on an analysis of the proposed data pipeline concept, access control requirements are being defined. Second, a new multi-level access control model is being designed. The resulting model organizes access control at two levels, namely, at country and at service level, herewith enabling secure information exchange between global stakeholders.

Keywords Data pipeline • Access control • Supply chain security

1 Introduction

Logistics movements continued to increase in the past decades. Goods are being moved around the world while, at the same time, information concerning these goods is being exchanged between relevant stakeholders. This information is crucial to the efficient working of the supply chain system. E.g., customs want to make import decisions in advance on arriving goods based on data from many sources including the origin of the goods, the trader, transport path, etc. However, current information systems in the supply chain suffer from data incorrectness and

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inconsistency (Hesketh 2010). In order to improve this situation, UK and Dutch customs proposed a new information system called 'The Seamless Integrated Data Pipeline' or 'The Data Pipeline' (Hesketh 2009), having as starting point that data should be exchanged directly between origin and destination based on the assumption that data at the origin are genuine and correct.

Information security usually focuses on the three key items confidentiality, integrity and availability (the well-known CIA Triad (Johnson 2010)). In the past few years, several studies on securing the Data Pipeline have been conducted, for example, around integrity of supply chain visibility (Hulstijn et al. 2012), and on identification and authentication protocols (Pruksasri et al. 2012). Access control on data, however, has not been studied yet but concerns the final step in creating a complete secure information exchange system. Access control of the Data Pipeline differs from traditional access approaches due to its global character, the involvement of many stakeholders with different roles, its high dynamics, requirements of high information quality, among others. It then raises the question which access control model is (most) suitable for the Data Pipeline. This paper answers this question by proposing a new access control model called 'Multi-level Access Control' that enables access control between global stakeholders.

The remainder of this paper is structured as follows. Relevant background information on the Data Pipeline is given in Sect. 2. Next, an analysis resulting into model requirements is provided in Sect. 3. Section 4 identifies, for each (in Sect. 3) identified level, an appropriate access control approach. Section 5 describes the full model, Sect. 6 provides a short discussion, and in Sect. 7, we draw conclusions.

2 Background

2.1 The Seamless Integrated Data Pipeline

The Seamless Integrated Data Pipeline has been proposed by UK and Dutch customs in order to enhance information quality. One of the main causes of the incorrectness of current information exchange is that, now, information is shared and processed by several intermediate actors before arriving at its destination. For example, for export declaration, an exporter may provide product information to a customs' broker who processes the information into another data format before submitting it to a customs department. The submitted information may differ from the original one due to (un)intended modification by the custom broker. To tackle this problem, the information exchange process has been redesigned by shifting from the traditional 'data-push' model to a 'data-pull' (Rukanova et al. 2011): in the new approach, relevant actors requiring certain information are supposed to *directly* access the source system of the owner. Underlying assumption is that data at the origin are (most) correct.

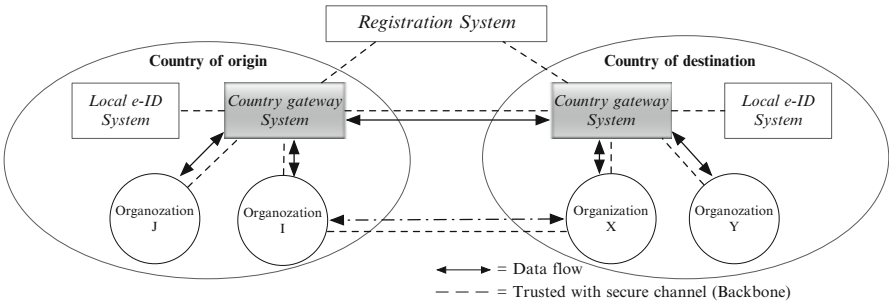

Fig. 1 Distributed Trusted Backbone's components

Data Pipeline members consist of many international organizations, which are cooperating in groups to perform some certain supply chain activities such as import, export, and transit. These groups are called 'Communities' (Hofman 2011). A community may contain many organizations as members. Members exchange information between each other. One organization can be a member of many communities.

2.2 *Distributed Trusted Backbone of the Data Pipeline*

A major security component of the infrastructure needed to implement the Data Pipeline is the Distributed Trusted Backbone (DTB) (Pruksasri et al. 2012). The DTB was introduced when designing a system for secure identification and authentication of all members. The DTB consists of three main sub-systems: the Registration system, the Gateway system and the Local e-ID system. These sub-systems are linked together in order to establish a secure channel between members based on the 'chain of trust' concept (Stallings 2003) by means of a specific PKI infrastructure (Adams and Lloyd 2002). Figure 1 shows the DTB's components of the secure information exchange of the Data Pipeline.

In addition, the DTB solves a complexity problem in global data exchange. If all n global stakeholders exchange data directly, the number of communication links needed is of order n^2. By introducing a backbone of m gateways (with $m << n$) and by forcing global stakeholders to interact via the backbone, the number of communication links needed is reduced to a number of order m^2n. Identification and Authentication with the DTB are implemented as follows. To become a member linked to the Data Pipeline, an organization should start with registering itself at the Registration system. This (virtually centralized) system records profile, network address, type, country of the organization, etc. A Gateway, a trusted system located in each country, acts as a single entry point of the country and links to the Registration system by a secure channel based on the Trusted Third Party (TTP) concept and PKI technology. In this way, the chain of trust between the Registration system and Gateways is established. The Local e-ID system or the identification and authentication system, which is already existing in every country (Eertink et al. 2008), is used to identify and authenticate local members and also links to the Gateway to extend the

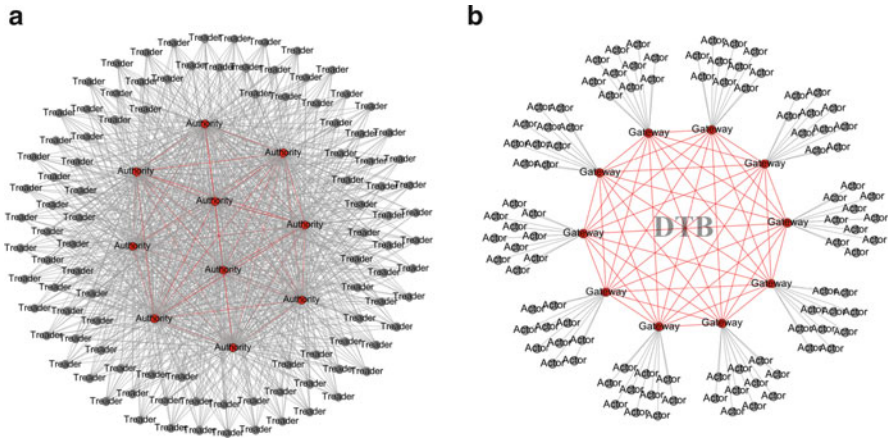

Fig. 2 Data communication in current supply chain system (**a**) and the Data Pipeline with DTB (**b**)

chain of trust of the Data Pipeline to local members. In this way, connections in the Data Pipeline are secured by means of the DTB in order to globally enable secure information exchange between international active actors. The next challenge is to establish appropriate access control for the Data Pipeline (Fig. 2).

3 Access Control Requirements

As an example of information exchange in the Digital Pipeline, we consider governmental authorities in a country of destination that expect to receive, long before arrival of the goods, information from organizations in the country of origin in order to analyze risks associated with their import. Usually customs perform the risk assessment to identify suspicious containers to be inspected based on the information they get from the relevant partners. Figure 3 shows the key elements of the Data Pipeline that support the execution of information requests. We assume that organization I from country A ($Org[I_A]$) wishes to access data at organization X in country B ($Org[X_B]$). The connection between $Org[I_A]$ and $Org[X_B]$ is established through *three levels of access* in the Data Pipeline network: Country, System and Data Source levels. This section describes those three levels in more detail.

3.1 Country Level

As was described above, any Data Pipeline member needs to register to the Registration system. Members who next want to retrieve information from others start with establishing a connection to a destination system through the Gateway

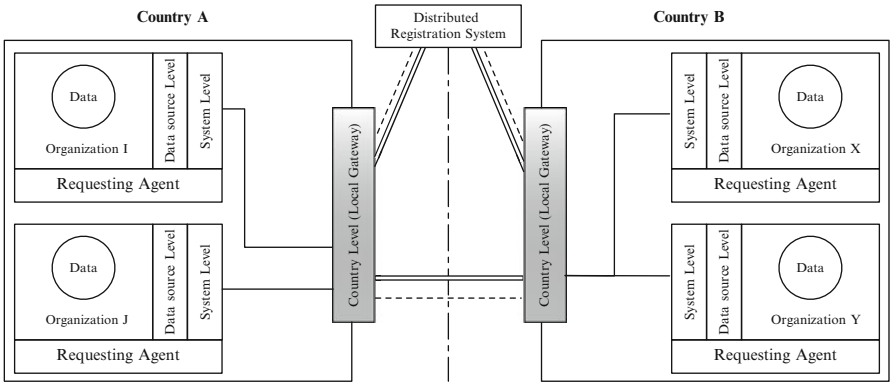

Fig. 3 Levels of access of the Data Pipeline

system. A Gateway acts as a Trusted Third Party (TTP) (Daskapan et al. 2004) between local members and other Data Pipeline members. A Gateway is the first access point of a country. The Gateways together guarantee chains of trust between countries. Hence, the first level of access must be checked here: this concerns *access control at the Country level*.

The most essential factor that needs to be considered at this level concerns the establishment of a security policy between countries. Such bilateral agreements for exchanging information should be compliant with international laws.

Requirement 1. Data access at country level is only allowed with countries with which a bilateral agreement has been settled.

3.2 System Level

After having established access control at country level, the remote request from an actor in one country will arrive at the target system where required information is stored. Each organization is responsible for securing the information stored in its computer systems. Thus, the second step of the access control must be executed at the organizational system. We call this "access control at the System level".

As was mentioned above in Sect. 2.1, the Data Pipeline communities are divided into two layers: the logistics and the governance layers. The Data Pipeline members are also distinguished into two groups: Trader and Authority. Members of the trade group could be private organizations such as Exporter, Logistic Service Provider (LSP) or Sea carrier. Members of the authority group might be governmental authorities like Customs or Tax Department. They perform control activities. Members of the logistics and the governance layer require information for two purposes: the logistics and governance purposes. The governance purpose is a key to designing the Data Pipeline. LSP's system must allow the customs as an

authority to connect to its system and request information. So, the control of access at the system level clearly needs the type of organization as a key to access the trader's system

Requirement 2. Trader's information systems should only answer requests from stakeholders who have successfully registered as authority of the Data Pipeline.

Similarly we noticed that different organizations provide different kinds of services in the supply chain. This yields a third requirement:

Requirement 3. Trader's information systems should only answer requests from authorities related to their business service.

3.3 Data Source Level

The variety of organization in the Data Pipeline makes information also diverse. E.g., exporters export their product to many countries and buy services from a LSP to transport their product to customers. An authority from one destination may want to know the information of a product that is entering to the country. Only the information of the product that is transported to that destination should be provided to the authority. In order to protect information against unwanted inspection, *access control at the Data source level* should be established.

A Malaysia-Netherlands trade lane (Horst et al. 2012) is a good example to describe this situation. A Malaysian exporter buys services from the LSP in order to transport products to his customer. This LSP provides services of transport to many European destinations including the Netherlands. Before products arrive at the Netherlands, Dutch customs may need information on products; so Dutch customs make a request to the LSP. The LSP should provide only goods information that is transporting to the Netherlands to the Dutch customs.

Requirement 4. *Data a*ccess should be limited to authorities of a destination country with an information request related to products to be transported to that country.

4 Mapping of Access Control Models

In this section we move forward to the next design step by showing which access control model is (most) suitable to each level. Well-known access control models such as the Mandatory access control (Bell and La Padula 1976), the Discretionary access control (Lampson 1974) and the Role-based access control (Sandhu et al. 1996) are chosen as potential models for our system.

4.1 Country Level

At the country level, the access control might be placed into two possible spots, namely (*i*) at the center of the Data Pipeline, and (*ii*) at the Gateway system. First, to place the access control at the center of the Data Pipeline, a potential model is MAC (Bell and La Padula 1976). A system-wide policy describes who is allowed to have access to resources and works well with the Access Control List (ACL). Individual users cannot alter that access. Actor and information are classified into different levels of trust and sensitivity. When countries achieve to sign an agreement, the name of the partner countries will be appended to the ACL by reporting to the Data Pipeline. Advantages of this model are that the management can be performed at one point, and the implementation is not very complicated. However, to set up a centralized access control may not be accepted because of the single point of failure reason. The single control system concerns a gigantic system consisting of many countries and therefore concerns a high security risk. Managing the ACL is also difficult since the Data Pipeline is not under control of any country. Moreover, any update of the ACL must be submitted to the central system, implying that it is not flexible and maybe rather slow as well.

To place the access control at the Gateway seems to be a better solution because each country can manage the ACL by itself. It is independent of the Data Pipeline system and is more flexible and faster than centralized management. The ACL can be easily updated when the government signs a new agreement with a new partner. At the Gateway, the DAC and MAC can be placed to control access. There are some pros and cons here. With DAC, an access control model can set an access control mechanism to allow or deny access for individual actors to a given resource. It relies on the resource owner to control. Every organizational system in the country can be viewed as one resource. To grant permission to a requester, the country of the requester must be defined in the access matrix. Based on the concept of DAC, not only the country must be defined in the access matrix, but also all requesters. This means the complexity of the access matrix will be huge because the number of countries multiplied by the number of the requesters is a large number. On the other hand, since the Gateway is viewed as the first point of accessing the country, the MAC access control can be placed at this spot. Since all systems in the country can be also viewed as one resource, it makes MAC suitable for this level because it is simpler than DAC in case of granting permission to every requester. User labels of the MAC can be defined for requesters by grouping them. It greatly decreases the complexity of the ACL and makes updating of the ACL much easier than DAC.

4.2 System Level

Access control at system level depends on the organization's attributes and its different services. The centralized control at the Data Pipeline seems unsuitable

for this level because the consistency of policy can be in conflict between the organization and the Data Pipeline. The keys of designing an access control are that it must be able to distinguish the purpose of the request and grant permission for certain relevant requesters as in the requirements we defined in Sect. 3.2; hence, the access control should be organization's responsibility. The access control at this level should support information owners to manage the control by themselves in order to prevent any conflicts on policy level. In this case the DAC is a potential model.

Information of the organization in practice can be separated into many parts, and each part may be related to specific services that are useful for specific requesters. The organization should be able to design the access control based on service type, identify permitted requesters who can access the system and define permissions on its information for those requesters by itself. Finally, each type of service can be different for a different requester. For example, the customs is involved in transportation of goods; it should have the right to access the system of an organization that provides a transportation service in the community. But an agricultural department, for example, should not be able to connect the system since it is not related to the transportation of goods.

The DAC shows its advantages in terms of flexibility that permissions can be directly updated by organizations (information owners). They can grant permission for a requester who is related to their services. Thus, it is very flexible and comfortable for the information owner, and also independent from the central Data Pipeline's policy.

4.3 Data Source Level

The data source level is the most complicated level of the Data Pipeline. Information of each organization varies in type and format while it needs to be restricted only for related requester. For instance, in tax control procedure, customs wants information of value of the product to be processed; meanwhile, agricultural department also needs information of safety to execute the safety control procedure. Another case, regarding the community's concept of the Data Pipeline, an organization can be a member of one or many communities. It also causes the role of organization different depend on the community.

Thus, an access control model, which is suitable for this level should support multi-roles concept. The RBAC (Sandhu et al. 1996) seems to be fit for this level; however, it may not be fully appropriate because only the role is not enough for control the requester. The service should be taken into account as well since the relationship between organizations in the community is about selling and buying services from others. Look at the LSPs, they provide services for an exporter to transport goods to his customers, and at the same time, they also use some services from other providers like the Sea carrier to transport goods overseas. On the one hand, the LSPs act as a service provider for an exporter, and they also act as a service user of the Sea carrier company. So, accessing information based on

services of organization can be used to form a group of requesters. For instance, information, which is in transport service at the LSP should be shared for many organizations depending on the service relationship.

The customs that are related to the LSP in terms of the transportation of goods to the country should be accessible to the information. An exporter and the freight forwarder should have the right to access as an organization who buys services from the LSP. The Sea Carrier, the local transporter or Port terminal that the LSP buy services from should also have permit on information too. Therefore, grouping requesters based on services to control of access is a potential model for this level. The RBAC is flexible for the complicated system, which consists of many actors act in different roles. This model can be altered based on others such as attribute, country, group or service.

5 Multi-level Access Control Model for the Data Pipeline

5.1 Model Description

Access control at the Data pipeline must support information exchange between international members both governmental and private organizations. Obviously, such global access control should be separated into levels. We propose to use the country and service levels. The service levels refer to organization activities that are distinguished in each organization, at system and data source levels. The country level takes place at the Gateway and examines a permission of requesting organization using organization profile, which is registered at the Data Pipeline Registration system. The MAC mechanism checks the country of requesting organization with its Access Control List (ACL) and allows an organization that is on the list to access the country. The sensitivity of all systems can be set to accessible state that means they can be remote accessed from an eligible organization that is measured by the gateway. Meanwhile, the gateway groups the connections of requesting organization by labeling them based on country and organization type, Authority and Trader types, to decrease the complexity of ACL. Thus, the manipulation of ACL is efficient and flexible (Fig. 4).

At the service level, it is the responsibility of an individual organization. The access control needs to be flexible and consistent with organization policies. Furthermore, the information owner has a connection between two groups of partners that are governance authorities and business partners. These partners are in the same community, so the information owner based on the relationship between organization and service will define the access control. The access control could be set for all relevant partners, and the connections are already filtered at the country level. Therefore, the access matrix of the DAC each organization is less complicated. The source system allows relevant organizations connect to the system while others, who are not in selling or buying services, are not allowed to do so.

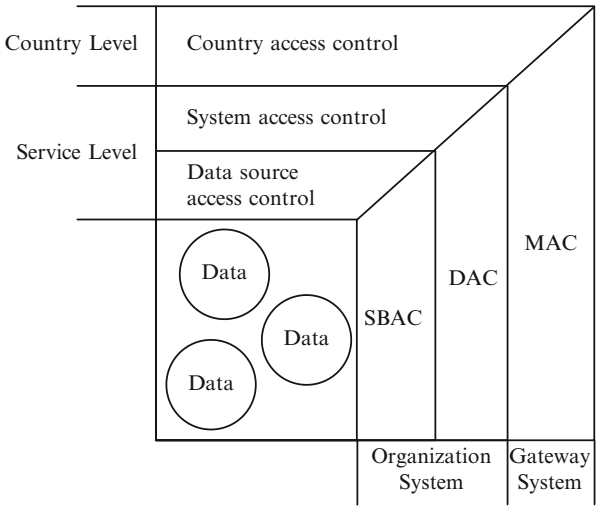

Fig. 4 Access control levels of the Data Pipeline

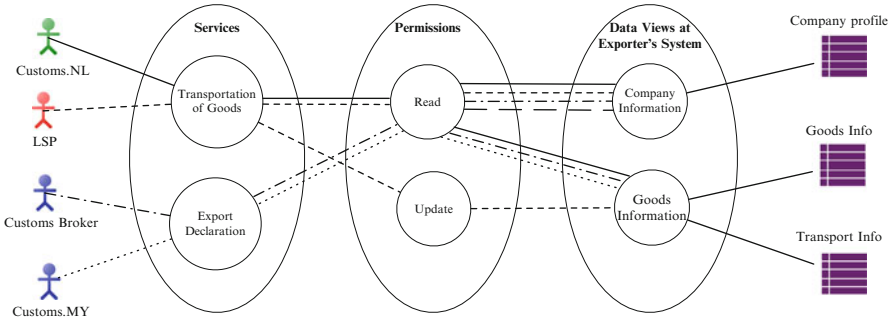

Fig. 5 Service based Access Control of the exporter

Besides the access control at the organization system, the organization should consider the services. Information at the source should be formed as a data view, which is consistently created with a services and requesting organizations. The services are used as a basis of designing the access control, which makes the access control more flexible and supportive of remote connections. The services based access control components show in Fig. 5.

The Service based Access Control (SBAC) is defined based on the supply chain activities which members are cooperating such as the transportation of goods or the export declaration. The above figure presents an example of the access control at the Data source level of the exporter's system. An exporter shares company profile and goods information for relevant partners. All partners who are related to an exporter's activities are able to request the exporter company profile. Some partners like the Dutch Customs, the Customs Broker and the Malaysian Customs are able to read information of goods while the LSP cannot because the LSP does not need to

know about the detail of the product inside the box during its transportation. This access model is fit to control an access based by the characteristic for services. The MAC, DAC and SBAC are placed at each level of access for controlling a requesting connection. The mixed model called the Multi-level Access Control makes the Data Pipeline completely in control of accessing source information. Permissions of all requesters are limited under this proposed solution.

6 Discussion

The Multi-level Access Control model is a combination of several access control models: MAC, DAC and SBAC (adapted from RBAC). We studied several access control models before choosing some potential model for our solution. We have chosen the most effective mechanism for our model and the basic requirements as we were designed have been met. To make our model effective, the complexity has to be analyzed and determined more in detail. We initially observed that the complexity of the governance layer is lower than the logistics layer because of the number of actors.

The proposed model completely supports the establishment of a connection between an authority and traders, which is the heart of the supply chain system, but the link between two individual traders is not yet fully designed. We have been studying the dynamics of the traders of the Data Pipeline, and we found that needs to be carefully considered in terms of complexity and flexibly of the model. This proposed solution completed a core module of the Data Pipeline and has to be implemented and tested based on real business processes to show proof-of-concept.

Besides, when we look at the information, the relevant information may be spread over many systems, for instance product information is stored at the exporter's system and transport information is recorded at the LSP's system. Thus, requesting information should be able to get from one system and be able to jump to another system, which is related to the same supply chain activity. We call the crawling information. It is crucial for requesting information so shared information at the source should be refined to show a clue of related information system in order to help the requester continue requests for further information.

7 Conclusions

The Multi-level Access Control model meets the security requirements of the Data Pipeline access control. The Gateway and the Registration systems are cooperating to enable the first line of filtering at the country level based on an organization's profiles, which are recorded in the system. It makes sure that only requesters from countries where a bilateral agreement has been made are able to access local partners. At the system level, the combination of the DAC and SBAC controls a

connection from authorities that are related to the goods and services to make a request for information. Thus, this solution provides information protection at both country and system level. Eventually, information at the trader's system is ready to be secure exchanged with the government authorities within the Data Pipeline system.

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A Smart Parking and Reservation System for QR-Code-Based Car Park

Wai Chong Chia and Nami Salimi

Abstract This paper presents a system that allows users to reserve a parking lot by using their smartphones. The aim of this project is to shorten the time required to look for an empty parking lot, and resolve the congestion issue in car park at mall. When the smartphone is connected to the internet, the user is only required to make a reservation by paying the first-hour rate through PayPal. A parking lot will be reserved for the user for an hour. At the same time, a QR-Code will then be generated, and user can enter the car park anytime within the hour by using the QR-Code. Before the user exits the car park, the user only required to pay the balance through PayPal. This reduces the hassle of queuing up for in front the payment machine. After the payment, a new QR-Code will then be generated, and the user will exit the car park by using this new QR-Code.

Keywords Car Park • Reservation • Smartphone • QR-Code • PayPal

1 Introduction

One of the issues encountered by many drivers after entering a mall is that they would have to hover around the car park to look for an empty parking lot. At the same time, new cars are coming into the car park can make the congestion issue becomes increasingly significant. In addition to this issue, drivers will also have to queue up paying for car park before exit. This happens daily, especially when all the people are leaving from work. Some attempts had been made to resolve the two aforementioned issues by using the Short Messaging Service (SMS).

The basic idea is to reserve and/or pay for the parking by using SMS. For example (Hanif et al. 2010), has proposed a system that allows user to reserve a

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parking lot by using SMS. After a SMS is received, the system will reply the user through SMS, the parking lot allocated, password to enter the car park, as well as date and time. User then can enter the car park by using the password given. Another system that uses SMS to reserve a parking lot is proposed in (Khang et al. 2010). In addition to SMS, it also incorporated a Breadth First Search (BFS) algorithm to determine the parking lot that will be allocated to a user.

Although the use of SMS can be very convenient, the deployment of such system requires the support from local mobile operator. As been stated in (Novomax 2013), this involves renting a special number to receive the SMS. If the system was to allow users to pay for the parking through SMS, part of the income may have to go to the local mobile operator as well. Indirectly, this can lead to increase in implementation cost and time.

Besides SMS, few companies have started to use QR-Code in their parking system as well. However, these systems are developed for the on-street parking, and QR-Codes are mainly being used to replace parking meters. For example, (Parkmobile 2013) and (ParkNOW! 2013) have been working on replacing the mechanism of paying through the parking meters, with a new mechanism that uses QR-Code and mobile application. In this case, user is just required to scan the QR-Code on the parking meter, and settle the payment through the mobile application. This allows users to extend their session easily and remove the hassle of searching for coins. Overall, the idea of using QR-Codes for gated parking is still very new.

This paper presents a system that aims to resolve the congestion and queuing issues. The proposed system allows users to reserve a parking lot by using their smartphones, before they reach the mall. An Android application has been developed to serve the aforementioned purpose. A uses just need to have an internet connection and PayPal account. First, a user will have to run the Android application, and select the level that he/she prefers to park the car. Next, the user will be asked to pay for the first-hour rate by using PayPal. Once the payment is completed, an empty parking lot will be reserved for the user throughout the hour. At the same time, a QR-Code is generated. The user then can enter the car park by using the QR-Code. Indirectly, this also helps to reduce the use of ticket.

Before the user exits the car park, he/she is just required to run the Android application, and pay for the balance by using PayPal. A new QR-Code will then be generated for user to exit the car park. Not only that it helps to remove the hassle of queuing up to pay for the parking, users are no longer required to search for small notes or coins when paying as well. In addition to the Android application, a car park management system has been developed to govern the entering and exiting of cars in the car park. This management system is used to verify the validity and integrity of the QR-Code.

Besides targeting on the aforementioned issues, the security measure of the system is also taken into consideration. In this case, the security measure is referring to how good the system can prevent the user from cheating on the car park charges. This is also one of the aspects that determine whether the car park management will choose to adopt the system. Furthermore, the system also attempts to minimize the amount of data communication required. For example,

users are only required to go online when making reservation, or when paying for the balance. It is not necessary for them to stay online for the management system to determine whether they have pay for the correct amount or whether a valid QR-Code has been used.

This paper is organized as follows. The proposed system is explained in detail in Sect. 2. This is followed by simulation results and discussions that are presented in Sect. 3. The main findings are concluded and shown in Sect. 4.

2 Proposed System

An overview of the proposed system is shown in Fig. 1. Generally, the proposed system can be separated into two parts, the Android application and the car park management system. The operation of the proposed system will be explained in terms of entering phase and exiting phase. As suggested by the name, entering phase is referring to the time where user is making reservation and entering the car park, whereas the exiting phase is referring to the time where user is paying the balance and exiting the car park.

(a) Entering Phase: When a user wants to make a reservation, he/she is just required to run the Android application, and the application will check with the availability database to determine the availability of parking lot. Then, the user is allowed to select the level that he/she prefers, and settle the payment by using PayPal. A QR-Code is generated after the payment is successful. At the same time, the availability database is updated. When the user reaches the car park, he/she is just required to show the QR-Code. Once the camera at the entrance captures the QR-Code, the car park management system will start to verify the validity of the QR-Code. If the QR-Code is valid, the management system will update the QR-Code database, and open the gate.
(b) Exiting Phase: When the user wants to exit the car park, the application will calculate the balance that the user has to pay. Similarly, the user has to complete the payment by using PayPal. A new QR-Code is then generated for user to exit code. Overall, two QR-Codes will be produced for each case, one for entering the car park, and one for exiting the car park. It is also important to note that the availability database and QR-Code database can be stored in the same database but different tables. The Android application and the car park management system are explained in detail in the following subsections.

2.1 Android Application

The operation of the Android application is described with a flow chart shown in Fig. 2. This flow chart will be explained in conjunction with the snapshots shown in Fig. 3. The main page shown in Fig. 3a is first displayed when user runs the

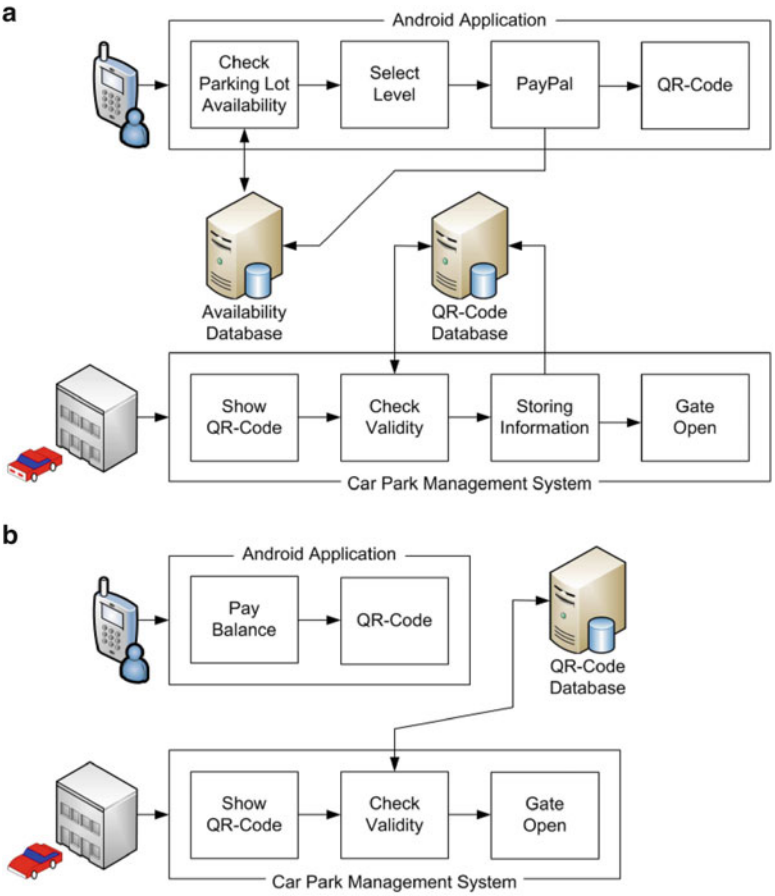

Fig. 1 The operation of the proposed system when (**a**) entering the car park and (**b**) exiting the car park

application. The user is only allowed to click on the reservation button, if the user did not make any reservation previously, or the reservation has already expired. Otherwise, the user is only allowed to click on the payment button. This is achieved by reading the Shared Preferences (myPrefs). If it is empty, then it means that no reservation has been made. At this moment, the application only allows a user to have one valid reservation at a time. In the following two subsections, the operation of the application during the entering phase and exiting phase will be explained in detail.

(a) Entering Phase Assuming that the user did not make any reservation previously, the level selection page shown in Fig. 3b will be displayed after the user clicked on the reservation button. At the same time, the application also reads the availability of parking lot from the database. The user can choose the level that he/she prefers to park the car. Based on the users' selection, the application

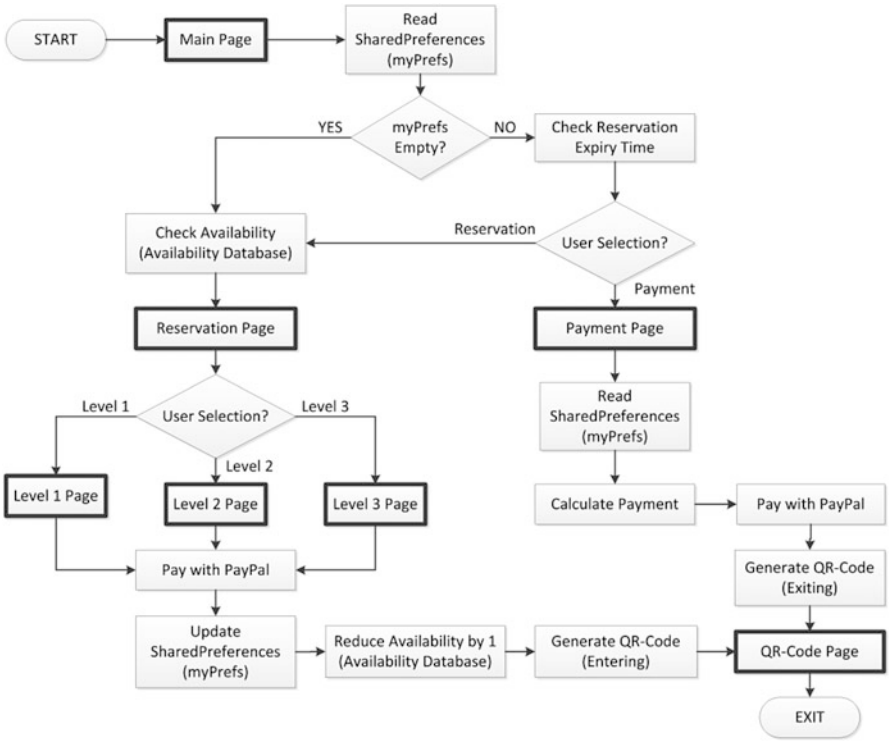

Fig. 2 The flow chart that describes the operation of the Android application

will move to the respective level page as depicted in Fig. 3c and d where the reservation fee is shown. The reservation fee is necessary as it prevents user from abusing the system. In this case, the user is only required to pay for the first-hour rate, and a parking lot will be reserved for the user for 1 h. If the user never turns up in the end, the parking lot can be released to others after 1 h.

(b) Exiting Phase After the payment is completed, the reservation information will be written into myPrefs, and the number of empty parking lots in the selected level will be deducted by one as well. The application then moves to the page where the QR-Code is shown as illustrated in Fig. 3f. User is also allowed to save this QR-Code into the image gallery, so that it is not necessary to run the application again. One can directly access to the QR-Code in the image gallery.

On the other hand, assuming that the user had made a reservation and enter the car park, the payment page shown in Fig. 3e will be displayed after the user clicked on the payment button. The user is required to pay for the balance before he/she can acquire a new QR-Code that is used to exit the car park. The balance is calculated based on the reservation information stored in myPrefs. Consider the case where the user had made a reservation at 10:00 A.M., reach the car park at 10:30 A.M., and then exit at 2:00 P.M. Since the user had paid the reservation fee (first-hour rate),

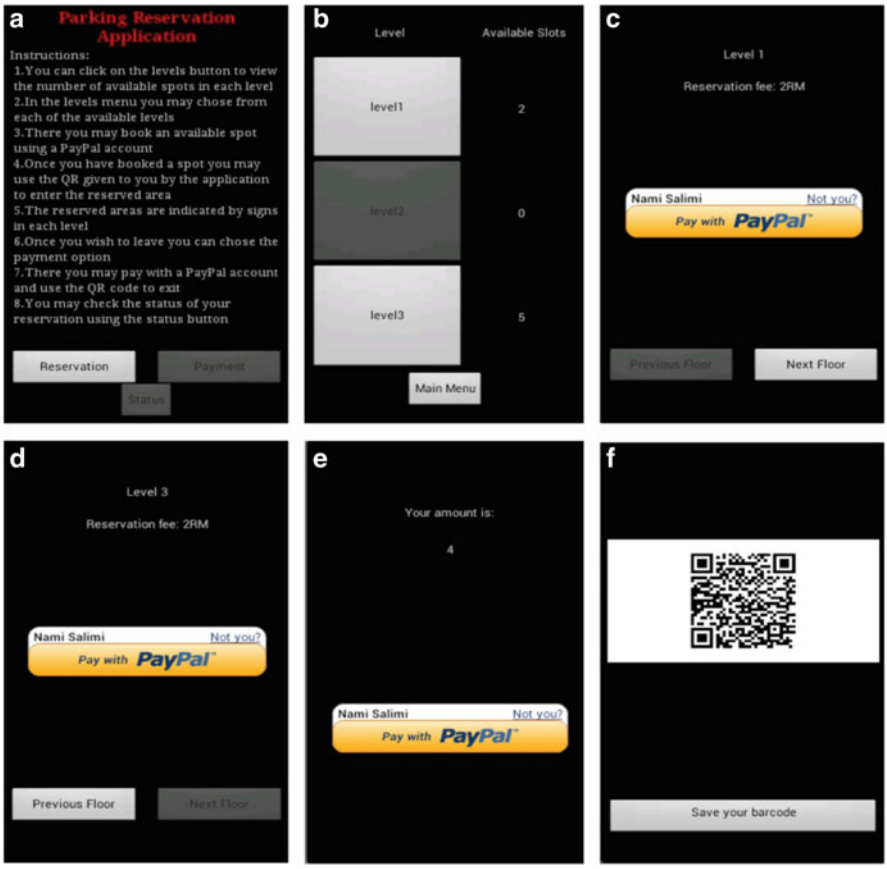

Fig. 3 Snapshots of the Android application. (**a**) Main page (**b**) Level selection page (**c**) Level 1 page (**d**) Level 3 page (**e**) Payment page (**f**) QR-Code page

which also serves as the parking fee for the first hour, he/she is only required to pay for the remaining 3 h (11:00 A.M. to 2:00 P.M.). Assuming that the rate is RM2.00 per hour, the user has to pay RM6.00 as the balance. The user will have to complete the payment by using PayPal as well.

2.2 Generate QR-Code

The QR-Code is generated by using the Zxing library. In fact, QR-Code can be seen as a graphic representation of a set of alphanumeric. Figure 4 shows an example of converting a set of alphanumeric, which is constructed by concatenating the information listed in Table 1, to the QR-Code. First, the time where the reservation or payment is made is incorporated for the car park management system to determine the validity, as well as to calculate the balance. The reservation time is

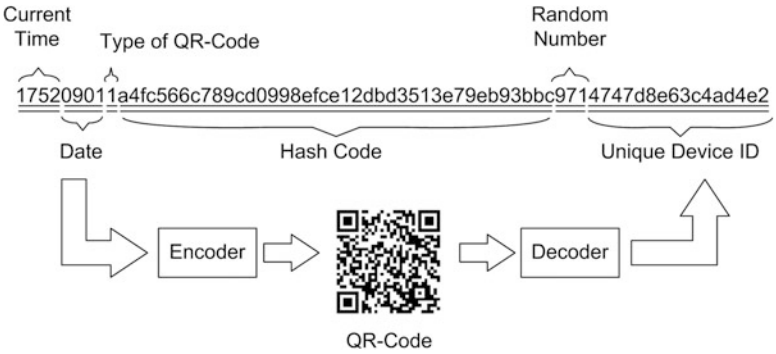

Fig. 4 An example of generating the QR-Code from a set of alphanumeric that is constructed by concatenating the information listed in Table 1

Table 1 List of information included in the QR-Code

Information	Description
Time	The time where the reservation/payment is made
Reservation time	The time where the reservation is made Only appear in the QR-Code used for exiting
Date	The date where the reservation is made
Type of QR-Code	'1' for entering purpose and '0' for exiting purpose
Hash Code	Generated from three random numbers by using SHA-1 function A string of 40 hexadecimals
Random number	Three random numbers used to generate the Hash Code
Device ID	The unique ID of the smartphone

only added into the QR-Code that is used to exit the car park. This follows by a digit used to indicate whether the QR-Code is for entering or exiting purpose. The Hash Code is a string of 40 hexadecimals generated from three random numbers by using the SHA-1 function. At last, the unique device ID of a Smartphone is also included. The reason of incorporating all these information into the QR-Code will be explained in detail in later sections.

2.3 Car Park Management System

The management system is used to govern the entering and exiting of car in the car park. Its main task is to identify the validity of the QR-Code and control the process of opening and closing the gate. This management system is designed in such a way that it prevents user from cheating the system through the following methods.

(i) Sharing of QR-Code among the users. Since the QR-Code can be stored into the image gallery, it is possible for a user to share the QR-Code by sending it to another user.

(ii) User generates a counterfeit QR-Code to enter the car park. This is possible if a user attempts to read and understand the information stored in the generated QR-Code.
(iii) Shorten the total amount of parking hours. For example, if the user enters the car park at 10:00 A.M. and exit at 10:00 P.M., the total parking fee should be RM24.00, assuming that the rate is RM2.00 per hour. However, if the user settles the balance after entering the car park, and makes a new reservation and pay for it right before exiting, then the total parking fee that he/she has paid for is only RM4.00.

The reason of incorporating the unique device ID into the QR-Code is to avoid the situation of (i) and (iii). When a user enters the car park by using the QR-Code, the management system will extract the information from the newly captured QR-Code, and match these information with the information stored in the QR-Code database. Searching for the same device ID determines whether the QR-Code database contains a record that shows that the QR-Code has already been used by another user to enter the car park. Hence, it prevents users from sharing the QR-Code. Since the reservation time was also stored into the QR-Code database together with the device ID, the management can math this reservation time with the reservation time extracted from the QR-Code that is used to exit the car park. This ensures that a user will have to pay the balance that was calculated based on the reservation time first found in the QR-Code database. Any discrepancy in between the reservation time captured from the new QR-Code and the reservation found in the QR-Code database will stop user from exiting the car park. Similarly, the operation of this car park management system will be explained in terms of entering and exiting phase as well.

(a) Entering Phase: The operation of the management system during the entering phase is described with a flow chart shown in Fig. 5. First, the QR-Code is captured and the information in the QR-Code is extracted. It has been mentioned in Table 1 that the three digits random number used to generate the Hash Code is also included in the QR-Code. The system will recalculate the Hash Code based on these three digits random number. If the Hash Code generated by the system is same as the Hash Code extracted from the QR- Code, then the Hash Code is considered valid. When the Hash Code is found to be valid, the system will start to search the QR-Code database for same device ID. If the searching returns nothing, the system then proceeds to check the type of QR-Code, as well as to validate the reservation time and date. At last, all the information extracted from the QR-Code will be stored into the QR-Code database, if nothing goes wrong. A welcome message is displayed, and the gate will open.
(b) Exiting Phase: The operation of the management system during the exiting phase is described with a flow chart shown in Fig. 6. Generally, the operation is very much same as the entering phase. The main difference is in the process of checking the reservation time. In this case, the reservation time extracted from the QR-Code has to be the same as the reservation time obtained from the QR-Code database.

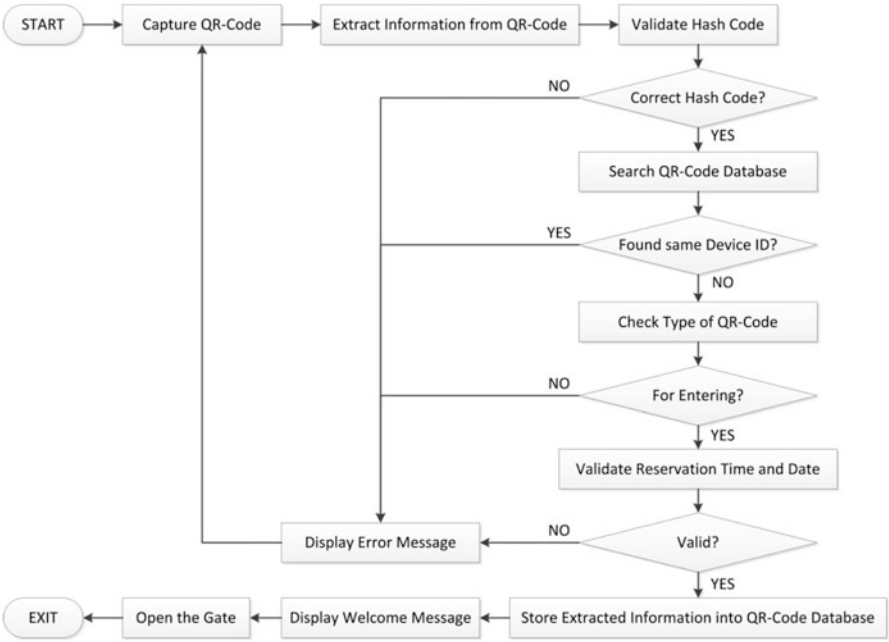

Fig. 5 The flow chart that describes the operation of the management system during the entering phase

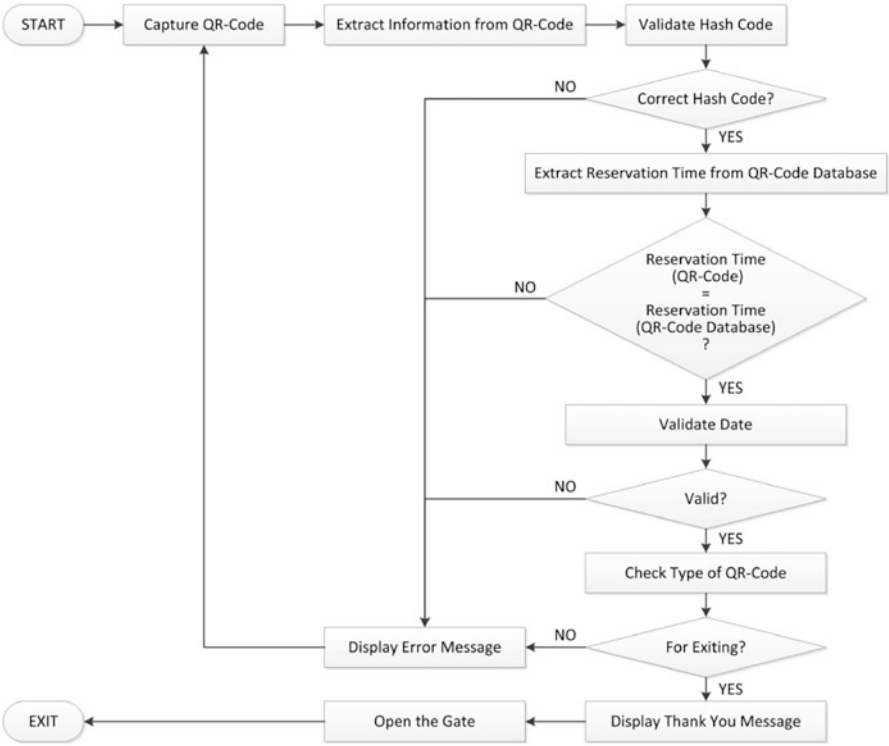

Fig. 6 The flow chart that describes the operation of the management system during the exiting phase

3 Simulation Results and Discussions

At this moment, the Android application has been fully tested on the Android Virtual Device (AVD), and the functionality of the car park management system is emulated by using a webcam and a JAVA program that runs on the PC. The Availability database and QR-Code database are created using (XAMPP 2013). Some of the simulation results have been consolidated and shown in Fig. 7. The QR-Codes captured by the webcam are listed in the right hand side of the figure, whereas the responses of the system to the respective QR-Codes are shown in the left hand side of the figure.

Figure 7a emulated the response of the system when a valid QR-Code is captured. Since it is a valid QR-Code, the system displays the welcome message and opens the gate. However, if one of the Hash Code has been changed from a to b as shown in Fig. 7b, it can be seen that the system is able to detect the error and prevent the user from entering the car park. When another user attempt to reuse the QR-Code to enter the car park, the system will display a message to indicate that the QR-Code has already been used. It should be noted that the QR-Code shown in Fig. 7c is same as the QR-Code shown in Fig. 7a. At last, Fig. 7d illustrated the case when a valid QR-Code is used to exit the car park. It can be seen that the QR-Code contains a longer set of alphanumeric, due to the extra reservation time.

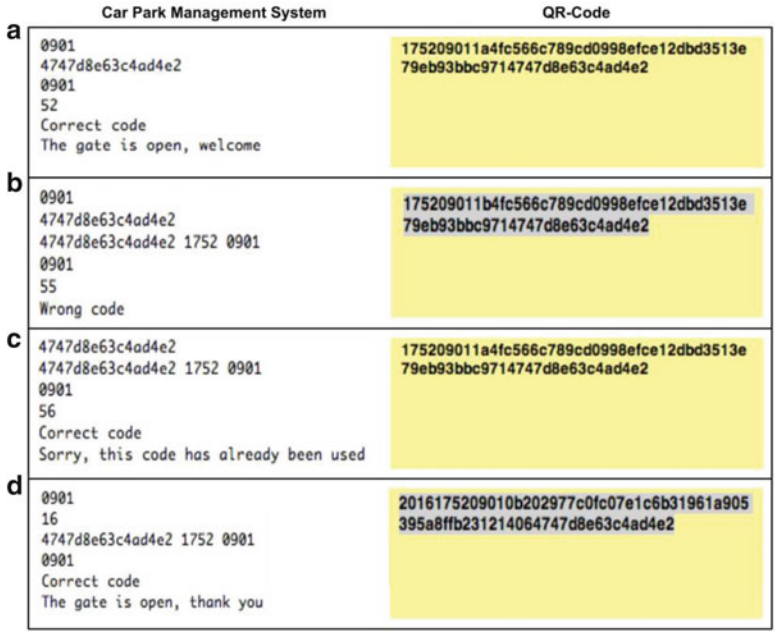

Fig. 7 Responses of the system when (**a**) a valid QR-Code for entering; (**b**) a QR- Code with invalid Hash Code; (**c**) a QR-Code that same as (**a**), (**d**) a valid QR-Code for exiting is used

4 Conclusion

A system that allows users to enter and exit the car park by using QR-Codes is proposed in this paper. When compared to the SMS-based system, the pro- posed system omitted the need to seek for support from local mobile operator. Indirectly, this helps to reduce the time and cost of deployment. The process of making reservation or paying for the parking is carried out on the Smartphone by using the Android application. This removes the need of queuing in front the payment machine. The simulation results are also shown that the management system is able to detect non-valid QR-Codes. Only a valid QR-Code can be used to enter and exit the car park. In the future, many works can be done to improve the system. For example, the entire system will be tested on actual Smartphone and database, as well as the situation when a large number of users are using the system simultaneously. In addition, the proposed system will be extended to include some algorithms that can be used to determine the sequence of allocating the parking lots to the users. Furthermore, the set of alphanumeric can be can be encrypted to increase the difficulty in creating counterfeit QR-Code as well.

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A Study on Smart Work Center

Han-Chan Lee, So-Hyun Lee, Jin-Won Park, and Hee-Woong Kim

Abstract In July 2010, the Korean government announced a plan to implement smart work centers to resolve low birth rate, low productivity and social costs of the urban traffic jams. This empirical study was conducted to find factors affecting the Smart Work Center use. Based on the IS Success Model, 'operation Infra Quality' and 'User Satisfaction' have positive impact on the Smart Work Center use. 'System Infra Quality' and 'IT Infra Quality' have positive impact on the 'User Satisfaction'. Consequently 'System Infra Quality' and 'IT Infra Quality' have positive impact on the Smart Work Center use indirectly. Also 'Job fit' and 'Social Influence' has positive impact on the Smart Work Center use.

Keywords Smart Work • Smart work center • IS Success Model

1 Introduction

Labor productivity per capita of Korea is the 28th in OECD 38 countries, whereas total annual labor hours are 2,074. This figure shows the longest hours in OECD countries. Not only this, child birth rate is the 217th in the total child birth rate of 222 countries, which shows seriousness of low birth rate (Korea Development Institute (KDI) 2011).

Presidential Council on National ICT Strategies announced via press bulletin that low birth rate, aging society, low labor productivity, chronic traffic congestion in metropolitan city are the causes of social cost (annual 2.6 trillion) and

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Ministry of Public Administration and Security and Korea Communications Commission are jointly going to establish the promotion strategies for smart work to solve these current issues and will increase the rate of labor with smart work up to 30 % of total labor population by 2015. In order to achieve this, it starts with 2 smart work centers and will expand up to 500 centers by 2015. Along with this, the advancement of network infra for promoting smart work is parallel proceeded, in which Wi-Fi service zone will be 53,000 by 2010, wiBro service zone will be 84 by 2012, broadband network at 100 Mbps will be supported nationwide by 2015, Giga internet service which is ten times faster than current one will be expanded up to 20 % of the land as the part of advancement of wire/wireless infra. Government is planning to combine world class IT infra and its serviceable capacity with smart work in order to solve productivity improvement, job creation, low birth rate and aging issues, government innovation and low carbon green growth as a part of national current issues and to provide a new growth engine for private companies.

Domestic studies in relation with smart work were carried out with terminology of remote work, in which majority of studies under smart work category were on home office presented in related academic journals and degree thesis. These studies adapt simply conceptual approaches or engineering based approaches with communication based technology as per teleworking implementation (Lee and Lee 2011). However, recent emerging smart work center related researches and mobile work utilizing mobile office research were only small volumes. In overseas cases, great deals of empirical studies were conducted under terminology of telework, but they focused only on transportation, urban planning, organizational behavior, regulations and social aspects (Bailey and Kurland 2002).

According to basic statistics survey for establishing IT based remote work policy, respondents were asked what factors are important for expanding remote work and 61 % of them responded that work environment and conditions improvement are the factors. It showed that Korea had world best internet infra but physical infra for smart work was not well-established (Hong 2011a). For the successful settlement of smart work, it requires physical infra with same environment with offices so that work can be performed at anytime and anywhere, that is smart work center, and requires acceptance and awareness of people and requires related research on this matter (Hong 2011b).

This paper aims to study empirically on what factors are important for the successful smart work from the infra and services aspects and to contribute establishment, operation and service of smart work centers.

For the purpose of this study, we have applied information system success model of DeLone and McLean (2003) and limited the scope of this study to find out what factors effect to successful settlement. The subjects of the study are real users of a firm that established mobile office system and smart work cent on its own.

2 Theoretical Background

2.1 Smart Work

The concept of smart work is beyond the existing fixed work space and is the future-oriented work environment where work can be performed conveniently and efficiently in different places, in mobile environment at anytime and anywhere (Korea Communications Commission 2011a, b).

The types of smart work in terms of work places are classified: mobile work which has no special constraints, and both home office and office work where use home and workplace using IT technology, and work at center where dedicated center established adjacent employee's residence are used. Or, it can be classified into three categories without work at office; home office, mobile work and work at smart work center (CIS 2010a, b; Nam 2010a, b).

Home office means work space is prepared at home using IT technology and equipped with work related facility and equipment (Korea Communications Commission 2011a, b) this is one of the flexible work type and access to intranet of the firm using security and access verification and conduct video conference for collaboration and coordination. For the expansion of home office requires home office infra cost and to establish measurement method on work performance and reward. In particular, result oriented performance assessment system is to be established, rather than process oriented so that face-to-face work style can be overcome. Issues of home office lies in poor work environment compared to existing office in the company.

Mobile work means enterprise work environment where work can be performed by accessing the system, data and process of the company at anytime and anywhere using wireless information technology such as mobile terminals like smart phones, and wireless internet (3G/4G/Wi-Fi/Wibro) (Korea Communications Commission 2011a, b). Works such as electronic approval, email check can be processed via access to intra net of the firm via mobile devices e.g., smart phone without time and space restraints even during transportation by car, or in business trip. This type of work make transit possible to field centered work from office oriented work and reduces unnecessary return to office for processing work and input presence or absence. This also reduces time and cost, which consequently improve productivity and harmony between life and work. However, it has shortage in collaboration with related divisions and the level of work compared to the level of work when working in the office.

2.2 Smart Work Center

Smart work center means remote office where IT infra is established adjacent to residence area of employees who can go and work under office working environment.

Also, work at smart work center means work in similar environment as the company office with IT infra in the smart work center, which is dedicated facility established near residence area of employees (Korea Communications Commission 2011a, b). This supplements disadvantages in work commitment, work duty management and poor office environment and collaboration of home office and mobile work.

For overseas case of smart work center, US president Obama has signed on Remote Work Promotion Act (Telework Enhancement Act of 2010) for the employees of federal government and remote work is preceded at full scale. Also 14 smart work centers were established for both government agencies and civil enterprises. Through the past experience, US came to aware the importance of institutional support from high level government for the locations of smart work center and changes of corporate culture. Also, they took high priority in smart work center due to security issues that may occur in home office and smart work center.

For Japan, smart work is preceded with objectives of solving low birth rate, decrease of labor population and social issues under the value of work continuity and power saving effect after great earthquakes. Specially, civil funded smart work centers were developed in metropolitan cities, Tokyo and Osaka.

Netherland is one of the most promoted countries in smart work and 49 % of overall entities implement remote work. This country certified "W" Mark as smart work center for the business area if it reaches a certain level. Overall satisfaction level is 7.7 points out of full 10 points. Besides, USA and Japan are the good example of active promotion of smart work center.

Korean government is planning to establish and support total 500 smart work centers by 2015 which for 50 of public and 450 of civil centers, for wide expansion of centers. Survey result about satisfaction level after experimental work at smart work showed that 84.3 % of respondents were satisfied; 74 % were benefited from commuting time and cost saving. Furthermore, 83.2 % showed intention of utilizing smart work center in the future. Government is planning to expand the scope of smart work center mainly on capital zone and regional major points on the basis of result of model project from 2012. In the civil sector, KT is expected to establish 28 smart work centers by the end of 2011 as the leading player. Also, Samsung Electronics opened 'work smart center' at Bundang in Gyeonggi-do and Samsung-dong as a model, and Samsung SDS is operating 6 AWZs (Adaptive Working Zone) as public office equipped with PC, multifunctional device and video conference room as a part of smart work center.

2.3 Information System Success Model

DeLone and McLean analyzed comprehensively over 180 concept studies related with information system success factors and empirical thesis and developed their own information system success model. The model of DeLone and McLean proposed 6 interrelated factors containing System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact, on the

basis of frameworks of Shannon and Weaver (1949) expanded research of Mason (Gatian 1994), and Influence concept about individual and system (DeLone and McLean 1992).

System Quality means information processing system itself. Under this category, they summarized 12 research results including Bailey and Pearson's (1983) which measured access convenience, system flexibility, and system integration and response time (DeLone and McLean 2003). Information Quality means the output from information system and they summarized nine research results including Larcker and Lessig (1980) that developed six question items to measure importance and availability of provided information (1992). Use is presented as Information Use, which uses output from information system. This was suggested as a factor for measuring MIS (Management Information System) success by the many researchers. User Satisfaction means the response of users that use output from information system. According to related studies, User Satisfaction is found that it is connected with users' attitude toward computer system. Also, impact provides better understanding to users in the decision making situation and improve productivity in the process of decision making. Organizational Impact means the effect of information on the performance of organization (DeLone and McLean 1992).

Seddon (1997) suggested the new model that has modified the model of DeLone and McLean added with individual user's experience of information system and net benefits of individual/organization/society level. Seddon also identified that System Quality and Information Quality impacted usefulness and user satisfaction and Net Benefits impacted usefulness and user satisfaction as individual, organization and society use information system.

After 10 years, DeLone and McLean (2003) added Service Quality based on changed role of information system and researches in that period and suggested updated model applied with Net Benefits concept which integrated individual impacts and organization impacts. Also, by adding Intention to Use concept, they explained that Use was the users' behavior, whereas Intention To Use was a matter of attitude. Their updated information system success model contained arrows between factors illustrating positive and negative result simultaneously.

The result of Use and User Satisfaction may positive and negative impact to Net Benefits. In turn, the result of Net Benefits may positive and negative impact to Intention to use and User Satisfaction as Feedback Loop.

2.4 A Conceptual Framework

As described in theoretical background, DeLone and McLean analyzed comprehensively over 180 concept studies related with information system success factors and developed (1992) their own information system success model. And 10 years after, they added service quality aspect and suggested updated model with application of net benefit concept (2003). Smart Work Center of the six elements of information system success model, DeLone's and McLean (2003) the quality of

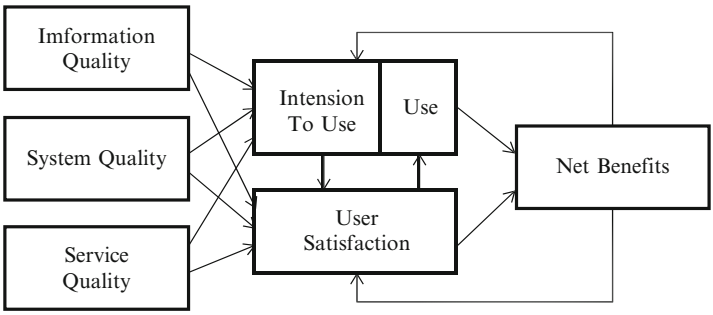

Fig. 1 **Updated** DeLone and McLean IS Success Model

the information presented by the government, instead of unrelated three infrastructure elements as shown in Fig. 1 and has applied this research and we will verify these infrastructure elements and service quality factors affect user satisfaction and use Smart Work Center does. And use of activation and user satisfaction, and ultimately no affect on an individual's net income will be verified through quantitative survey research.

In DeLone and McLean's information system success model (2003) there existed Feedback loop which from Use to User satisfaction, from net benefit to Use intention and User satisfaction, whereas this study has not considered feedback loop since this is not longitudinal study to investigate repetitively for a certain period, but a cross-sectional study to measure the status at this current point of time.

In conceptual framework, facility infra means work space, meeting space, common service space and lounge, whereas IT infra means various applications (security SW, communication too, office program) consisting wire/wireless network and mobile office. Operational infra means operation related infra including physical security and seat reservation management system. Service quality means the services provided by operator who manage three different infra.

Use means how smart work center is used by users, visit frequency and use pattern, whereas User Satisfaction means opinions and feeling of users about experience of smart work center. Net Benefits means practical gains in terms of time or cost or improvement of quality of life for individual users after use of smart work center.

3 Research Model and Hypotheses

Venkatesh et al. (2003) combined eight models related with technology acceptance to describe the intention of users to use information system and users' activity afterward and then proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) model, in which 32 meaning full concepts found from existing studies were integrated. Venkatesh et al. suggested four core concepts: expectation on performance, effort, social influence and promotion condition (Bolton and Lemon 1999).

For concept of expectation on performance, it was suggested with usefulness, external motivation, work appropriateness, relative benefits and expected output. For social influence, subjective norms, social factors and images, and promotion condition was suggested with recognized behavior control, promotion condition and compatibility.

In this study, research model was designed with two factors; infra factor of smart work center based on information system success model, and service factor of operation staff, which impact to usage of smart work center and users' satisfaction. Usage of smart work center and users' satisfaction are set as antecedent factors as they provide practical benefit to individual users. And, for additional factors that impact usage of smart work center in UTAUT model, appropriateness, accessibility, complexity of users' work and social influence are set. Smart work center is the workplace in a similar environment with company office utilizing IT infra, and it is defined as complex space providing office environment for knowledge based work and being equipped with IT based remote workable system (Korea Communications Commission 2011a, b). Its (environment) system consists of facility, IT and operation infra. Quality of facility infra is defined as appropriateness of components of physical facility, and quality of IT infra is defined as appropriateness of components of applications and network for communication and work in a similar way as is performed in the company. Quality of operational infra is defined as appropriateness of components of the system that make operation convenient and improve efficiency in smart work center (Korea Communications Commission 2011a, b). According to studies of Pitt et al. (1995) and DeLone and McLean (2003) it is suggested that system quality impact to use of information system. Service quality is defined as overall support provided by service provider (Parasuraman et al. 1988). Parasuraman et al. (1988) and (Pitt et al. 1995) observed the importance of service quality of information system when measuring effectiveness of the system and applied 22-item SERVQUAL as measuring instrument for test. SERVQUAL consists of six factors, tangibles, reliability, responsiveness, assurance, and empathy. According to studies of Pitt et al. (1995) and DeLone and McLean (2003) it was suggested that service quality also impacted to use of information system. Since this relationship can be applied in a similar way to smart work center environment, the following hypothesis is set;

H1a: Quality of facilities infrastructure has a positive effect on the use of smart work center

H1b: Quality of IT infrastructure has a positive effect on the use of smart work center.

H1c:Quality of management infrastructure has a positive effect on the use of smart work center.

H2: Quality of service has a positive effect on the use of smart work center.

DeLone and McLean (2003) defined users' satisfaction as users' response about information system after use, and highlighted that users' satisfaction was related with users' attitude toward computer system. Seddon and Kiew (1994) also found that service quality impacted critically users' satisfaction. As described earlier, service quality was defined as overall support provided by service provider

(Parasuraman et al. 1988) and it was suggested from Pitt et al. (1995) and DeLone and McLean (Chin et al. 1996) that service quality also impacted users' satisfaction. Since these relationships can be applied in a similar way to smart work center environment, the following hypothesis is set;

H3a: Quality of facilities infrastructure has a positive effect on user satisfaction.
H3b: Quality of IT infrastructure has a positive effect on user satisfaction.
H3c: Quality of management infrastructure has a positive effect on user satisfaction
H4: Quality of service has a positive effect on user satisfaction

Bhattacherjee (2001) defined users' satisfaction as users' impact by the use of smart work center. Bolton and Lemon (1999) tested empirically that users' satisfaction impacted system use positively. According to Expectancy Disconfirmation Theory, it was found that users who were satisfied with system would continually use information system. Since these relationships can be applied in a similar way to smart work center environment, the following hypothesis is set;

H5: Satisfaction of users has a positive effect on the use of smart work center

DeLone and Mclean (2003) combined impact to individual and organization into one and explained that net benefits were measured by work and decision making. Seddon (1997) suggested net benefit as the concept that was inclusive of gains from past and future. Livari (2005) suggested in his research that the more users use system, the bigger impact was made to performance. Leidner (1998) verified that use of information system impacted significantly work performance (efficiency of decision making). Since these relationships can be applied in a similar way to smart work center environment, the following hypothesis is set;

H6: Use of smart work center has a positive effect on the individual net profit..

DeLone and Mclean (2003) combined impact to individual and organization into one and explained that net benefits were measured by work and decision making. Gatian (1994) found that users' satisfaction and decision making output were closed interrelated. Users' satisfaction led to performance, which in turn brought about net benefit in the end. Since these relationships can be applied in a similar way to smart work center environment, the following hypothesis is set;

H7: Users satisfaction has a positive effect on the individual net profit

Work appropriateness was suggested by Thompson et al. (1991) and was defined how system capacity was utilized to reinforce work competence of individual (Venkatesh et al. 2003). If system or work was appropriate, individual work productivity was improved and quality of output was also improved (Floyd 1986). Therefore, the more a person was appropriate non- face to face work, rather than face-to face type of work, and independent work and its performance, rather than collaborative work, the more smart work center is appropriate, whereas the work group that requires more collaboration and face-to-face type of work would decrease its use of smart work center.

Accessibility is often defined as convenience of use of smart work center and O'Reilly (1982) suggested in his study that accessibility of information is more related with use of information than quality of information and proved empirically that better accessibility of information is more frequently used. Also Venkatesh et al. (2003) claimed objective elements for promoting system use, e.g. preparation for supporting computer in the environment where behavior can be easier and convenient. Therefore, if smart work center is established in geographically good location or well implemented to make access easy and convenient in use, it would be more utilized.

Complexity is defined as the degree of complication of smart work center to understand and use (Parasuraman et al. 1988). The more complicated the smart work center, the less it will be accepted and utilized (Tornatzky and Klein 1982). Therefore if smart work center has more complicated system factor or hard to understand, or takes much time to understand how to use, the less it would be used.

Social influence is defined as the degree of influence of individual by other people to use smart work center (Venkatesh et al. 2003). In the study of Triandis (1971) people's behavior is influenced by social norms or information received from other people. Pavri (1988) also highlighted social norms influenced the use of system. Therefore, when executive director encouraged or institutional support are provided at organizational level to use smart work center, or when people who already experienced provided positive comments or recommendation, it would positively impact to use of smart work center.

4 Research Methodology

We have adapted quantitative method for collecting survey data. Survey was conducted for about 2 weeks from 20 October ~3 November, 2011 with people who work for an enterprise in Korea which implemented and used smart work center on its own. Along with this, direct survey was conducted with users in the smart work center. I have collected total 163 cases and used total 150 significant data with removing 13 cases, which had no experience of smart work center. Samples of users in smart work center at A enterprise who responded the survey are featured; male 87 % (137 persons) and female 13 % (19 persons), majority of age range was 30s, which takes 50 % (75 persons). Ranks were staff 32 % (48 persons), followed by department head 29 % (43 persons) and assistant manager 17 % (26 persons), which showed even distribution. Works were task related planning 44 % (66 person), which takes highest ratio. Each department showed higher rate of use than the one of HQ and employment period showed even distribution from under 5 to 20 years. Use of smart work center featured that less than 3 months use of smart work center took the highest ratio 56 % (84 persons), followed by 4~6 months 33 % (49 persons). Monthly use frequency featured that 3–4 times were the highest 69 % (103 persons). Hours per day was over 8 h

(122 persons), 4–7 h 15 % (22 persons), which showed that most of respondents were committed to work without moving their place.

Questions for each factor of the study are measured with Likert scales seven points ('1 = Never' ~'7 = highly likely'). Measuring items were selected on the basis of questions proved its validity and significance from existing studies to ensure the validity of contents and some were modified partly for the purpose of this study.

5 Analysis and Testing Results

5.1 Instrument Validation

In order to analyze measuring items of this study, I have used PLS (Partial Least Square) which is appropriate study on social phenomenon or organization in related with information system (Barclay et al. 1995) and I have conducted reliability and validity analysis and hypothesis testing. First, in order to test validity of concept of question, I have conducted factor analysis. Factors to be analyzed are complexity as Reflective Construct, work appropriateness, accessibility, social influence, user satisfaction, use of smart work center, net benefits of individual. For over 0.6 of factor loading, it showed significance of loadage. Also, accumulative distribution is 79.5 %, that means about 79 % explanatory power of total distribution. Items with low loading value were removed.

Next is convergent validity. When each item has over 0.6 fact loading value and over 0.5 average variance extracted, (Bolton and Lemon 1999; Cho et al. 2008) it is considered reliable. Therefore, each item is ensured of convergent validity.

For discriminant validity, when average variance extracted is over 0.7 and corresponding variance is compared with other variance about coefficient of correlation, the lowest value (0.81) among square root of average variance extracted is over the biggest value of coefficient of correlation, which means that items of the study are ensured of discriminant validity (Barclay et al. 1995; Chin 1998).

And, the result of Harman's Single factor Test, the first factor showed 14.6 %, and the other showed between 8.1 – 12.38 %. Therefore, it is determined that Common Method Bias risk is low.

5.2 Testing Result

Since it was determined that reliability and validity were ensured through analysis of items, we have conducted bootstrap analysis using Smart PLS 2.0 for hypothesis testing.

According to the result of hypothesis testing about factors that may influence the use of smart work center, hypothesis (H1c) that quality of operation infra would be increased by using of smart work center from the infra aspect, was adapted with 0.05 % significance level, and other hypothesis (H1a.b, H2) that quality of facility infra, IT infra, and service quality would be increased by using of smart work was declined. Also, work appropriateness and social influence would be influenced by using of smart work centers were adapted with significance level 0.1 %, 0.05 % respectively. Accessibility and complexity were found that they were not significantly impact on using of smart work.

Furthermore hypothesis (H5) that user satisfaction would increase use of smart work center was adapted with 0.001 % significance level.

The result of hypothesis testing about factors influencing user satisfaction showed that quality of facility infra, IT infra, and service quality would increase user's satisfaction and were adapted with significance level 0.01 %, 0.1 %, 0.001 % respectively. Hypothesis (H5) that service quality would increase user's satisfaction was declined. According to the result of hypothesis testing about factors influencing individual net benefit, hypothesis (H6, H7) that use of smart work center and user satisfaction would increase individual net benefits were adapted with 0.05 %, 0.001 % significance level, respectively.

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An OGS-Based Dynamic Time Warping Algorithm for Time Series Data

Mi Zhou

Abstract Dynamic Time Warping (DTW) is a powerful technique in the time-series similarity search. However, its performance on large-scale data is unsatisfactory because of its high computational cost. Although many methods have been proposed to alleviate this, they are mostly in- direct methods, i.e., they do not improve the DTW algorithm itself. In this paper, we propose to incorporate the Ordered Graph Search (OGS) and the lower bound for DTW into an improved DTW algorithm and apply it on time series data. Extensive experiments show that the improved DTW algorithm is faster than the original dynamic programming based algorithm on multi-dimensional time series data. It is also especially useful in the post-processing stage of searching in large time series data based on DTW distance.

Keywords Dynamic Time Warping • Ordered Graph Search • Time Series • Lower Bound

1 Introduction

The technique of searching for similar patterns among time-series data has been applied in many areas. Generally, a time series $X = \langle x_1, x_2, \ldots, x_n \rangle$ is a sequence of real numbers, where each number x_i represents the value at a certain point of time. Most of the work in this community exploits Euclidean distance as the similarity measure. However, the Euclidean distance is so rigid that in 1 the case where two times series are globally similar but locally out of phase, it usually will return a large value concealing the underlying similarity.

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A more suitable similarity measure is the Dynamic Time Warping (DTW) distance (Rabiner and Juang 1993; Sakoe and Chiba 1978) which originated from the field of speech recognition that allows a flexible alignment between sequences and tries to find the optimal one to minimize the distance between sequences. Now it is widely accepted that DTW is a state-of-the-art time series similarity measure (Lei and Sun 2007). However, its performance with very large databases is poor because its time complexity is $O(n2)$ which is very high.

Although many methods have been proposed to alleviate this, e.g., the lower bound for DTW (Keogh 2002; Zhou and Wong 2011), segment-wise DTW (Zhou and Wong 2005), and derivative dynamic time warping (Keogh and Pazzani 2001) etc., they are mostly indirect methods. In other words, they do not improve the DTW algorithm itself.

As far as we know, there is only one method (Brown et al. 1982) in the literature which has improved the DTW algorithm itself. Different from the traditional dynamic programming (DP) based DTW algorithm, the algorithm in Brown et al. (1982) is based on the Ordered Graph Searching (OGS) technique. This approach can be explained as follows. First, the grid of points in warping window in which the warping path lies is represented as a directed graph (digraph). The nodes in the graph represent local distances, and allowable node transitions are represented by branches of the digraph. The objective of the OGS-DTW algorithm is to find the optimal warping path in the digraph which yields the minimum cumulative distance. The gain in efficiency for OGS-DTW is achieved by omitting the local distance calculations associated with nodes which are not searched. While DP-DTW requires all local distances within the warping window be calculated.

The key element of the OGS-DTW algorithm is the estimation of the distance from one node in warping matrix to the end of warping path. The better the estimation is, the fewer nodes the algorithm visits during the searching. Unlike the estimation used in Brown et al. (1982) which is a statistical value got from experiments which is unsuitable for time series data, we propose to use the lower bound for DTW as the estimation to guide the searching.

The rest of the paper is organized as follows. The OGS-DTW algorithm is described in detail in Sect. 2. After some tentative experiments, considerations about OGS-DTW are also discussed in this section. In Sect. 3, the performance of OGS-DTW is investigated through extensive experiments. Finally, a brief conclusion is given in Sect. 4.

2 OGS-DTW Algorithm

2.1 Algorithm

Traditional DP-DTW requires all local distances within the warping window be calculated to find the optimal warping path. Unlike it, OGS-DTW search for the

optimal warping path using the classical A^* algorithm based on some heuristics. The local distance calculations associated with nodes which are not searched are omitted and a lot of computation is saved. The OGS-DTW algorithm can be described as follows (Brown et al. 1982).

First, the grid of points in warping window is represented as a directed graph (digraph). The nodes in the graph represent local distances, and allowable node transitions are represented by branches of the digraph. Each node i in the digraph is represented by its coordinate (n, m), and the starting node is $s = (1, 1)$, and the ending node is $t = (N, M)$. For any path passing through node i, the path cost (the cumulative distance along the path) is denoted as $f(i) = g(i) + h(i)$ where $g(i)$ is the minimum cost of the path from node s to node i, and $h(i)$ is the minimum cost of the path from node i to node t. In the OGS process, $g(i)$ is known exactly; however, $h(i)$ is not known, and therefore must be estimated.

Thus, an estimate of $f(i)$ is $\hat{f}(i) = g(i) + \hat{h}(i)$ where $\hat{h}(i)$ is the estimate of $h(i)$. During the searching, the node i which currently provides the smallest $\hat{f}(i)$ is expanded until the terminal node t is reached.

The path that first terminates on the node t will be the optimal path if the following conditions are met:

1. the expansion operation is consistent for all nodes
2. $\forall i = s$, $g(i) > 0$ and $\forall i, j$ such that j is a successor of i, $g(i) \leq g(j)$
3. $\forall i, \hat{f}(i) \leq f(i)$ (i.e., the estimation $\hat{h}(i)$ is not more than the actual cost $h(i)$)
4. $\forall i = t$, $\hat{h}(i) > 0$ and $\forall i, j$ such that j is a successor of i, $\hat{h}(i) - \hat{h}(j) \leq c(i, j)$, where $c(i, j)$ is the local distance at node i

Note that in speech recognition, condition (1) is not satisfied due to the asymmetric path constraint used in DTW algorithm; while in time series searching, a symmetric path constraint is used, all the conditions are met, and the admissibility of the OGS-DTW algorithm is guaranteed.

The only unspecified quantity for the OGS-DTW algorithm is $h(i)$. Unlike the one used in Brown et al. (1982) which is a statistical value got from experiments, we can construct a more robust $\hat{h}$ function which can be used in any case based on our boundary-based lower bound technique (Zhou and Wong 2011). A lower-bound function for DTW is a function that always returns a value smaller than or equal to the actual DTW distance. Formally, a lower-bound function $LB(X, Y)$ is a function that for any two sequences Q and S, $LB(Q, S) \leq DTW(Q, S)$. Apparently, the lower bound function satisfies the aforementioned admissibility condition (3).

The proposed $\hat{h}$ is illustrated in Fig. 1. Refer to the figure, given any node i, we can put a series of boundary (a connective series of nodes through which any warping path must pass) along the path from node i to the terminal node t. At each boundary, a estimate which is not more than the local distance of the intersection node between any warping path and the boundary is collected, the sum of estimates collected at all boundaries will serve as the $\hat{h}$ value. Due to the space limitation, please refer to (Zhou and Wong 2011) for more details of the lower bound function.

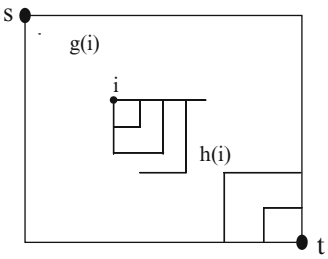

Fig. 1 Boundary-based $\hat{h}$ function

2.2 Some Considerations

After some tentative experiments, we find that there are some issues need to be considered while introducing the OGS-DTW algorithm into time series searching area.

The overall computational cost of $\hat{h}$ function is quite high if we calculate it on the fly for every node expanded. Thus the overall cost of OGS-DTW may be even greater than that of DP-DTW, this has violated our initial motivation. Nevertheless, if the time series we encounter is multi-dimensional, that is, the computational cost of local distance calculation is high, the computational cost of $\hat{h}$ function will be relatively smaller than in the one dimensional time series case, OGS-DTW maybe be faster than DP-DTW.

Another scenario in which OGS-DTW will perform better is the large warping window. Since the gain of performance of OGS-DTW comes from the unvisited nodes, if we have used a looser path constraint, the warping window will get bigger and more nodes will have to be visited for DP-DTW, while the number of nodes visited by OGS-DTW keeps almost the same given its searching nature, OGS-DTW will relatively perform better in this situation.

The ideas above are trying to find scenarios where DP-DTW has to visit more nodes and do more computations. We can also find the situation in which the computational cost of $\hat{h}$ function is very small therefore the performance of OGS-DTW is greatly improved. Fortunately, there is a very common scenario in which the assumption is true. In post-processing stage of searching for similar sequences facilitated by an index, all the needed information to calculate $\hat{h}$ function are available in the index structure, the overhead of computing $\hat{h}$ is trivial and OGS-DTW is more preferable than the traditional DP-DTW. Another obvious observation related to the performance of OGS-DTW is that a tighter lower bound function will gives the algorithm more informative guidance during searching and fewer nodes will be visited. Therefore, we can also use a better lower bound function to improve OGS-DTW.

All the ideas discussed here will be validate through experiments as shown in the next section.

3 Experiments

A lot of experiments are carried out to show that how to improve OGS-DTW algorithm. The settings for the experiments are as follows. In each experiment, if it is not specified, 100 query sequences *Q and* 100 data sequences *D both* of length 64 randomly selected are used. After normalizing all sequences by the *Z* -Normalization, OGS-DTW and DP-DTW are performed individually to calculate each DT *W* (*Q, D*). The average running time over 10,000 pairs of *Q* and *D* is collected. The warping window is set as 10 % of the length of sequence.

The first try is to increase the dimensionality of time series. Note that the lower bound function used here is the one proposed in Keogh (2002) named as LB Keogh.

Furthermore, as we have analyzed in the above section, we also calculate the facilitating information needed by LB Keogh in advance and save them such that we don't need compute LB Keogh on the fly during the OGS search. Since no real data set has so many varied dimensionalities, synthesized multi-dimensional random walk data are used. Refer to Fig. 2, as we expected we see that OGS- DTW outperforms DP-DTW given high dimensional time series data. Since the conclusion for different warping window size is quite obvious, we omit the result. The second try is to use better lower bound functions to further improve OGS-DTW. In Zhou and Wong (2011) a better lower bound function in most cases than LB Keogh is proposed named LB Corner. As in the first experiment, the facilitating information needed by LB Corner is computed in advance and saved. Refer to Fig. 3, we can clearly see that OGS-DTW outperforms DP-DTW even better given a better lower bound function.

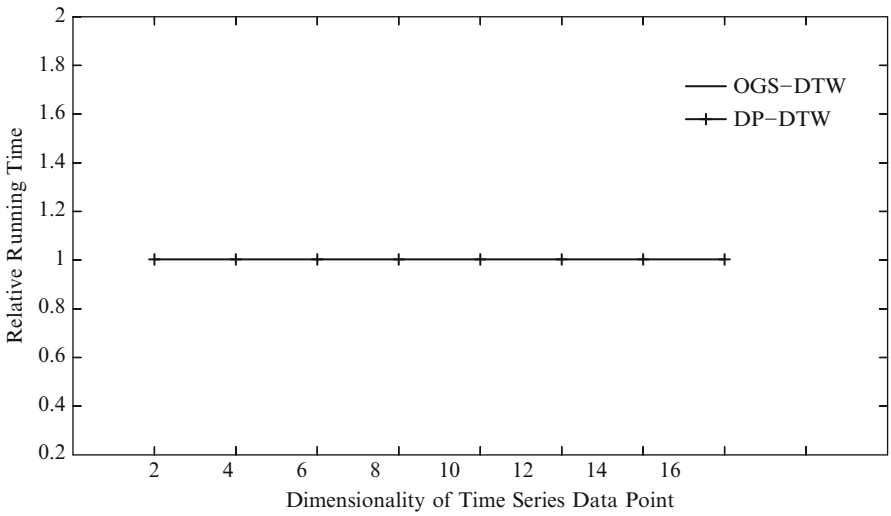

Fig. 2 Relative running time under different dimensionality

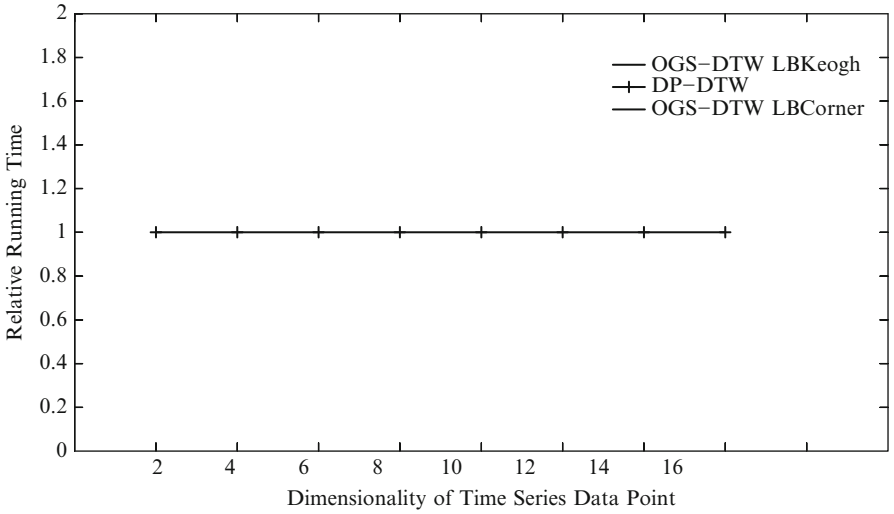

Fig. 3 Relative running time under different dimensionality and lower bound

4 Conclusion

In this paper, we propose to use the boundary-based lower bound function for DTW distance as the key component to implement the OGS-DTW algorithm and apply it on time series data. Theoretical analysis and experimental result show that OGS-DTW equipped with a good lower bound function is a better choice than the traditional DP-DTW algorithm for multi-dimensional time series data and in the post-processing stage of searching in index.

Future research directions include the devising of even better lower bound functions and a bi-directional OGS-DTW algorithm to further improve its speed.

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Analysis of Operators' Smart Home Products Industry Chain Cooperation Model Based on Game Theory Perspective

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Abstract This article analyzes the operators of the possibility of cooperation with the smart home industry, and proposes a cooperation model of a smart home industry and operators from the perspective of game theory. Smart home industry, as a very key part of the Internet of Things, has good prospects for development. But marketing as well as the pace of development in the current market is very difficult. Operators under the impact of the various parties, as the relative strength of the party are not as a simple pipeline supplier, but more concerned about the development and integration of the whole industry chain. In such situations, the cooperation between operators and smart home industry will be of concern. This paper argues that the cooperation between operators and smart home industry is inevitable road. Smart home enterprises need to cooperate together with the operators to jointly promote the development of smart home industry. A way of achieving the combination of smart home industry and the operators is uniting the mobile network with "fixed network" so as to develop the huge potential industry.

Keywords Smart home • Operators • Local fixed network

1 Foreword

Smart home is a residential platform, integrated wiring technology, network communication technology, smart home system design, security technology, automatic control technology, audio and video technology to home life related facilities, to build efficient residential facilities and family schedule transaction management system and to improve home safety, convenience, comfort, artistry, and the living environment of the environmental protection and energy saving (Alan et al. 2006;

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Chenggui 2012). The current smart home organically combines with home life of the various subsystems, including appliance control, security alarm, remote control, environmental monitoring, community service, network communications and other subsystems to serve ours' home life.

Specific practice, smart home is mainly composed of two parts of information appliances and home intelligent network. Information appliances synthesize the micro-computer and communications technology into the traditional household appliances, make the appliances intelligent and have a network terminal, anytime, anywhere access and process information. The important feature of information appliances is a two-way transmission of digital information through the Internet, so it is a home appliance on the network instead of PC peripherals. Family intelligent network, which intra-connects the information appliances and extra-connects the Internet, is a combination of 3C (computer, communication and control) technology and the traditional family system. It makes home information appliances with information about local/remote interactive features, both local and remote users can also control and status monitor the information appliance within the home network. From the architecture of the home network point of view, smart home can be divided into four parts, namely, information appliances, home networks, residential gateways and broadband access technologies.

Smart home market on behalf of manufacturers, a class based on the traditional building intercom manufacturers based, main is the Guanlin, Anjubao, Shidean, Zhenwei, etc., of such vendors provide an intelligent integrated control platform, this platform integrated security alarm, home appliance control, and many other subsystems; mainly based appliance manufacturers such as Haier, TCL, Midea, etc., such vendors main provider of information network home appliances mainly; there is also a focus on lighting control, curtain control module and interface manufacturers, representatives of manufacturers Super, Bochuang, Ruilang, Qisheng, etc., with the first two categories of vendors to provide various types of smart switches and interfaces module. In addition, there are some large companies beginning to focus on the provision of smart home design program, by designing home program, integrating a variety of smart home products to provide customers with complete smart home.

2 The China Smart Home Industry Development

"12th Five-Year Plan" makes – 12 key application areas of things technologies clearly, including smart grid, transportation and logistics industry, healthcare, smart home, environment and security detection, fine agriculture and animal husbandry, industrial and automatic control financial services sector, public security, defense and military, and the wisdom of the city. As an important application of the Internet of Things, smart home market is a very promising sunrise industry (Li and Duan 2012a; Li and Duan 2012b).

The relevant agency statistics show that by the end of 2012, the home networking market totalled $ 5.7 billion and smart home product sales reached $ 14 billion.

In the next 5 years, the average annual growth rate of the global family of intelligent market will reach 8 %. In order to grab a piece of "cake", many domestic enterprises have to test the water in the industry, including large enterprises such as TCL, Haier, Tsinghua Tongfang which make use of brand advantage to reach the industry, and the thousands of small and medium enterprises are increasingly becoming a new force in the industry.

Insiders introduced that there are three aspects of the problem of the smart home industry in China: there is no uniform industry standard in the smart home industry, many small and medium enterprises do things in their own way, bringing about non-compatibility between their products; due to not doing in-depth market research by the technical staff, developed products are technically advanced, but the practicality of the product, and complicated to operate, and the demand of the market; because a lot of R & D funds technically are required in the investment, some SMEs do not have the ability of continuous innovation, and even have more difficulty scaling production, resulting in high prices (Liwei 2007).

We put aside for other reasons, just from the market perspective, the smart home industry, there are major problems:

1. Smart home indeed bears unlimited business opportunities, but for such a huge market, businesses are not very familiar with the real needs of the users, or cannot totally think on the users' point of view to create value and position the market. This requires manufacturers to study the deep needs of consumers, and do for the industrial development of the status quo to better market positioning.
2. Smart home products are too dependent on the industry to promote sales of products, of which the most obvious is the real estate industry. Reduction in the property market housing turnover, is bound to be a direct result of the reduction in the amount of decoration, with the renovation amount of decline, the amount of smart decoration will be followed to reduce the development of smart home industry will be affected. How to train users of consumer demand better, and few limited to the development of real estate industry has also become the key to the development of smart home industry.
3. As for smart home businesses, many obstacles exist in the promotion process, of which the most important is the price problem. While many enterprises reduce costs through improved technology and other methods, but due to the uncertainty of the market demand, the promotion is not in place, the majority of consumers do not have a clear understanding of the price of such a new product, always feel the price is too high. Various types of smart home products are expensive, often complete set of configuration down from several thousand to as many as tens of thousands, but in fact, compared with the hundreds of tens of thousands, hundreds of thousands invested in the owners home improvement, such smart home shares only a minimal ratio. Strengthening the guidance of end users' consumer attitudes will be the important part of marketing.
4. Smart home products is still in the early stages of the marketing, all aspects are not perfect, especially at home industry which high customer service is required, and related.

After market products and services is also a big factor. Limited to scale, smart home supporting manufacturers have not been able to form a system maintenance system, once the problems, after-sales and maintenance of a timely manner is a big problem.

3 The Existing Problems and Bottlenecks in the Development of Chinese Operators

3.1 MS Business Be Greatly Affected

The statistics released by the National Ministry of Industry and Information Technology (MIIT) recently show that the national mobile SMS in 2012 amounted to 897.31 billion, an increase of only 2.1 %, which was the lowest increase in the past 4 years. According to mobile phone users in China last year, an increase of 11 % to calculate, in fact, the amount of text messages sent per capita fell 9 %. One of DCCI Internet Data Center statistics more frightened operators is the national carrier's overall SMS – 2012 compared with 2011 decreased by 20 %, MMS decreased by 25 %, and the telephone traffic even down 5 %. Facebook and Twitter network applications such blocked even in China, also failed to prevent the impact of the domestic Internet companies for Chinese operators. If micro blogging and QQ such application has not completely eroded the operators of the business, then the emergence and rapid development of the micro-channel can be described as a blow to the carrier which is not small. With the rapid development of the micro-channel the SMS business provided by operators is at stake, imagine with the provision of micro-channel real-time call business, what the telephone service of operators will in turn develop into? (Xian Zheng and Ming Yao 2006). Things cannot be stopped, cannot go backwards.

3.2 Flow Business Cannot Meet User Needs

Problems due to the network effect, China Mobile lost a large number of high-end customers in China Unicom, 3G services in China's development is also unsatisfactory. However, with the rapid development of fast and efficient development of the mobile phone hardware, as well as mobile phone applications, traffic business operators are increasingly unable to meet everyone's needs. Whether the quality of service or price, traffic operations are unable to meet the user's requirements.

3.3 Seamless Wireless Network Construction Difficulties Step by Step

With the rapid development of the mobile Internet, the demand for seamless wireless free network has been beyond imagination. At home, in the car, in restaurants, etc. people want to have free wireless network like Free WIFI almost in all the places, you can use anytime, anywhere (Yanjie 2011). However, due to technical constraints as well as the reality of the inevitable problems, fully realizing that such expectations is clearly hard.

3.4 No Place to Display a Lot of Resources for the Operators

If today's Internet companies are springing up, momentum is fierce, so operators awash in resources can be described as the source of the Yellow River and bred many lives, relying on a lot of resources, but gradually forgotten or cast aside (Zhaohui and Shiyuan 2002).

Funds, personnel, credit and authority, and a series of valuable resources that Internet companies cannot match, have not been completely cast in the hands of the operators. People kind of can see the sadness in the future.

4 Operators and the Smart Home Business Game Showdown

Smart home has been in the Chinese market for some time, but for the vast Chinese market, there is still much space for the development of the smart home industry. The point is not just because the technology of the smart home industry is not yet fully mature, more marketing. Some high-end smart home business strives to work with some senior real estate property company to promote higher-end smart home products, but no matter how high the price is, the base is so small piece of short board so that the profits of the industry as a whole can't leap forward. Only by grasping the majority of consumer groups, the promotion of new technologies and new products to the majority of users, can the industry obtain a qualitative improvement.

Most of the smart home enterprises are too professional, marketing is relatively simple, and there are some limitations in terms of funding and personnel. In addition, another very important point is that the credibility and authority of the force. This point is not suit for the vast majority of smart home businesses. However, these shortcomings of the smart home business are precisely existed in the operators, to some extent; the smart home industry can't be separated with the cooperation of the operators to get better development.

Here, we may as well to do this kind of assumption demo, we make certain operators: A. smart home enterprise, B. Operators have two options: to cooperate with B; not to cooperate with B. Likewise, the smart home business also have two choices.

When operators choose the smart home business operators is equivalent to choose to carry out a new business, and this business is great potential for development, the market is almost empty. The development of the land is good; it will not only open up a whole new market, but also will get a lot of profit. In view of this, we will set A's payoff to 8, but also precisely because of gaps in the market and the industry's emerging in specific aspects of the implementation of the will there is a certain risk, but due to the good development of smart home and the prospects for the future, the proceeds cannot be overlooked, so in the end we let A 6. For the smart home business operators clearly has a pro-development, but due to the sharing of profits with operators, the smart home business income decreased, so that the proceeds of the B 4. When the operators and the smart home business have chosen to maintain the status quo, do not intend to cooperate with each other, for operators, it found little possibility of this opportunity, but do not cooperate with each other under the premise for operators, compared to now nothing to lose, so that the proceeds of the A 0, but the situation is somewhat different for the smart home businesses. For smart home businesses, the speed of development will be slower than the cooperation of many, and even the impact on future earnings, so that B gains −1.

When operators choose to cooperate and contribute to the promotion of smart home products, but smart home business do not want to work with operators to choose their own promotion and sales, there is no significant impact for the operators, we make the payoff of the A 0, but for the smart home business, when this marketing model is informed to the operators and operators with their own strength can find other smart home companies to seek cooperation. That, for uncooperative smart home enterprises, will undoubtedly be a big blow, and likely other companies grab market, so that the payoff of B −2. Turn, when the smart home company choose to cooperate, operators uncooperative, in fact, for the smart home companies do not have much impact, they will looking for other carriers to establish cooperative relations, so that the payoff of the B 0, but for the operators, will therefore missed opportunities from a long-term point of view, then, there is a certain loss, so that the payoff of A −2.

Notation we use game theory habit expressed above Game, as shown below:

		B	
		cooperative	uncooperative
A	cooperative	4 6	−2 0
	uncooperative	0 −2	−1 0

5 The Recommendations of the Operators Smart Home Industry Cooperation

From the above analysis, we can see that the operators' smart home business is an inevitable road. Specifically, operators need to be together with the smart home business cooperation to jointly promote the development of the smart home industry. A way of achieving the combination of smart home industry and the operators is uniting the mobile network with "fixed network" so as to develop the huge potential industry.

Today, competition in the domestic operators market focuses on the mobile network, the core of the 3G and 4G networks. However, the various operators in the 3G market development and competition are more homogeneous, focusing on the performance of three communications giants of 3G applications and services less the same. First, the homogenization of competition is not only no use for the formation of a standardized and ordered market, but also more is not conducive to the sustainable and healthy development of domestic telecommunications carriers. Second, the ability of successful breakout in the 3G homogenization of competition is based on the fundamental of enterprises to maintain a high-speed sustainable development and the 3G era. Proposed, with the Internet of Things in this context and the introduction of cloud computing technology, operators seem to be more at a loss in mobile networks competition. Cannot say completely plagiarism, but they don't present a lot of innovation and revenue.

If operators are willing to combine mobile network with "fixed network" perfectly, and promote smart home together with smart home business industry, it will indicate a new direction for operators to form its own features strategic layout and operation building, at the same time, provide the market with a differentiated path for getting rid of homogeneous competition and fully activating the service operators.

The so-called "fixed network" is not the original meaning of the fixed telephone network, but only home gateway for the fixed residential local network convergence. Each family residential units, each "fixed-line" units, fixed local network via a home gateway connects with the outside world networks to achieve the indoor network wireless coverage, the data network wired connection indoor and outdoor, and indoor and outdoor communication networks wireless connection.

The combination of Mobile networks with fixed-line contains two aspects. On the one hand is the combination of the data network, data network cords to each household, each family achieves indoor wireless coverage network through the wireless router. Every family will become a hot spot. On the other hand, a combination of a communications network, will occur in the home of a mobile communication business to focus on each home gateway management, in the home gateway and the base station of the mobile communication network "semi wireless, the semi-fixed connections", to exchange data, processing business. Such mobile communications business at home will without contact with a nearby base station, but through a home gateway to focus on re-contact with the base station. This will reduce network conflicts, improve the quality of network service, and enhance customer satisfaction.

On the basis of the sound in the network and the perfect combination of the mobile network with "fixed network", many of the features of the smart home can be achieved and can achieve the promotion and realization of a wider range of operators led driven. Specifically, reflected in the following aspects.

First, at home, fixed and mobile telephone can conveniently control and monitor the condition of electrical household appliances. For the smart home products via the local network control electrical functions, you can directly use the home wireless local network; for the intelligent home control products via the use of telephone, those can be integrated to the home gateway. Fixed telephone and mobile phone can control the smart appliances directly by the home gateway, without consuming too many resources.

Second, the new smart home products use the powerful operators as favourable striker. Operators can give the user a sense of trust, and financially strong operators can effectively promote the rapid spread of the smart home, is conducive to the development of new industries like the smart home industry.

Third, the operators find another emerging field of ICT through tough market competition, to open a road of innovation. Operators now have not only confined as simple pipeline – communications services suppliers, but focus more on promotion of services related to information and communication technology field to the majority of users to achieve greater value.

Fourth, operators plan network from the point of view of the family to maximize the use and value of the network. Different with the developed countries, our national data survey shows that China's mobile phone users use most telephone and data networks in the indoor, which means that it is very necessary and beneficial for us to pass on the mobile phone business to the home gateway control.

Cooperation and development will be improved in the constant practice, but the cooperation of the operators and the smart home industry will be the inevitable road for common progress.

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Examining Factors Correlated with Consumer Online Shopping Behaviour

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Abstract Online shopping enables consumers to search for information and purchase products or services through direct interaction with online store. This study aims to examine the correlation of Internet marketing environment, product characteristics, familiarity and confidence, and promotional offers with consumer online shopping behaviour. Two-hundred questionnaires were distributed to the respondents, who are students and staff at a public university in the Federal Territory of Labuan, Malaysia, following simple random sampling as a means of data collection. Correlation analysis was used as a statistical measure to determine the strength of the relationship between one dependent variable and a series of other independent variables. Results revealed that familiarity and confidence was found to greatly correlated with consumer online shopping behaviour followed by promotional offers. A clear understanding of consumer online shopping behaviour can help marketing managers predict the online shopping rate and evaluate the future growth of online commerce.

Keywords Internet marketing environment • Product characteristics • Multiple regression analysis • Malaysia

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1 Introduction

The Internet has changed the way people shop and day-to-day lives. Internet usage has grown rapidly over the past years and has become a common means for delivering and trading information, services, and goods (Albarq 2006). In recent years, shopping online has become the norm and all over the world consumers prefers to shop online as it has many advantages (Ahmad et al. 2010). The Internet-based electronic commerce environment enables consumers to search for information and purchase products or services through direct interaction with online store. Although, purchasing online is still a small part of Internet usage, most analysts expect it will increase dramatically when consumers feel convinced and secure about their purchases and protection of their privacy. Internet shopping in Malaysia is in its infancy (Delafrooz et al. 2009). Web-retailers can only offer certain ranges of products and services to web-shoppers, including e-banking services, technology gadgets, cosmetics, clothing, and the booking of airline tickets (Kwek et al. 2010a). The first groups of products are ones consumers do not need to see personally before purchasing. These products include e-banking services and the booking of airline tickets. This group of products is suitable for Internet shopping because the Internet provides transaction and communication functions. The second groups of products are items consumers prefer to see and touch before purchasing. These products include technology gadgets, cosmetics, and clothing. This group of products is not suitable for Internet shopping because the images and information about the product may not be accurate or sufficient for consumers to perform Internet-based transactions. This study aims to examine the correlation of Internet marketing environment, product characteristics, familiarity and confidence, and promotional offers with consumer online shopping behaviour.

2 Literature Review

Online shopping has eliminated on the consumer's side such traditional shopping inconveniences as battling crowds, standing in long checkout lines, and fighting for parking spaces at a busy mall (Ahmad et al. 2010). The customers are able to evaluate the available products and their prices from a multiplicity of diverse outlets through the Internet. These comparison-shopping sites may save customers' time and money because they can see which retailer has the best price without visiting many websites. Thus, it allows consumers to browse online shopping websites in the privacy of their home (Ahmad et al. 2010).

2.1 Internet Marketing Environment

Internet marketing environment is related to a paperless environment where a computer is used as a medium to recognise, reproduce, and store product information that enable online businesses to be operated without limits anytime and

anywhere in 24 h a day, 7 days a week and 365 days a year principle (Haque et al. 2006). Consumers are free to shop at different websites and they are able to switch from one website to another in just a click (Ahmad et al. 2010). Shoppers are more attracted to well-designed online shopping sites that are easy-to-navigate and visually appealing. Thus, the website design does influence shoppers' purchases (Sorce et al. 2005). Through a superior understanding of the web shopper's online purchase intention, web retailers will be able to enlarge valuable and efficient web-shopping strategies to create a centre of attention for new and potential web-shopping customers (Kwek et al. 2010a). Internet marketing is becoming a more and more important strategy for the company to promote, advertise and interact more with online customers. With a good understanding of the web shoppers' online purchase intentions, web retailers will be able to develop effective and efficient web-shopping strategies to attract new and potential web-shopping customers (Kwek et al. 2010b). Therefore, the study hypothesizes that:

H1: The Internet marketing environment significantly correlated with consumer online shopping behaviour.

2.2 *Product Characteristics*

The product is related to anything that can be offered to a market that can satisfy the customers' needs and wants which include services (Kotler and Armstrong 2012). In order to provide more accurate information and a better shopping experience, most of the online retailers are turning to merchandise that allows shoppers to interact with the products and examine them online (Kim and Jihyun 2009). Product characteristics are very important in developing the online business. Besides that, products can include more tangible objects such as cars, computers or cell phones, and these products also include services, events, persons, places, organisations, ideas or a mixture of these (Kotler and Armstrong 2012). Before the consumers purchase products through the Internet, they use the Internet as a cue to identify the characteristics and the brand of a product itself (Kuo et al. 2010). In order to provide more accurate information and a better shopping experience, most of the online retailers are turning to the product virtualization technology that allow the shoppers to interact with the products and examine the products online (Kim and Forsythe 2010). Thus, it is expected that:

H2: Product characteristics significantly correlated with consumer online shopping behaviour.

2.3 *Familiarity and Confidence*

Familiarity is related to the amount of goods in relation to experience that has been accumulated by the consumers (Maenpaa et al. 2008). The familiarity of the customer

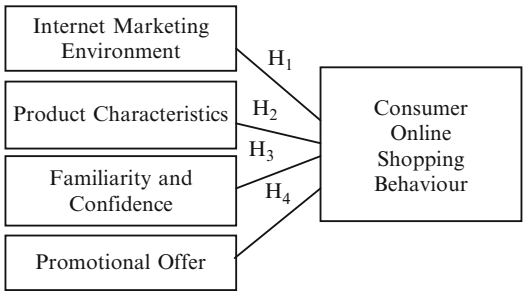

Fig. 1 Proposed theoretical framework

with the computer and the Internet and frequency and length of his or her usage, were found to be positively associated with adoption behaviour in general (Man et al. 2005). Kim and Jihyun (2009) highlight the importance to assess the consumer confidence when they going to shop with the online retailer. When the product familiarity is increased, it can improve the consumers' cognitive structures and task performance as well as their ability to analyse, elaborate and remember the product information (Maenpaa et al. 2008). Familiarity becomes more important to increase customer satisfaction and it differentiates between familiar and unfamiliar fields (Kotler and Armstrong 2012). Thus, a better understanding of the technology and its operating processes will definitely alleviate concerns and lead to higher usage of online shopping (Man et al. 2005). Accordingly, the study hypothesizes that:

H3: Familiarity and confidence significantly correlated with consumer online shopping behaviour.

2.4 Promotional Offer

Promotion is related to a form of strategic communication to inform, persuade, and remind the potential buyers of a product in order to influence an opinion or elicit a response (McDaniel et al. 2011). Promotion can bring benefits to the consumers for enjoying shopping and searching for information (Odunlami and Ogunsiji 2011). Sales promotion, a part of the marketing campaign, consists of a diverse collection of incentive tools, mostly short term designed to stimulate quicker or greater purchase of particular products or services by consumers (Kotler and Armstrong 2012). Sales promotions enhance consumer's number of shopping trips to the store. Hence, the study posits that:

H4: Promotional offer significantly correlated with consumer online shopping behaviour.

Hence, the study proposed the following theoretical framework (Fig. 1):

3 Methodology

Two-hundred questionnaires distributed to the respondents who are students and staff in a public university in the Federal Territory of Labuan, Malaysia following simple random sampling method. All respondents were asked to complete the questionnaire which comprised of three sections. Section A consisted of demographic profile which consists of gender, age, and level of education. While section B examined the consumer Internet shopping experience. Section C examined the consumer shopping behaviour via the Internet. All of these questions were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The four factors applied consisted of Internet marketing environment, product characteristics, familiarity and confidence, and promotional offers adapted from Haque, Khatibi, and Mahmud (Haque et al. 2009). Statistical Package for Social Sciences (SPSS) version 17 computer program was utilized in order to calculate the descriptive analysis. Correlation analysis is used to examine the proposed hypotheses.

4 Results and Discussion

Table 1 depicts frequency analysis of the demographic profile of respondents. 122 (61 %) of the respondents were female and 39 % males. Seventy-seven percentage were aged 21–25 years followed by 11 % aged 26–30 years. More than half of the respondents (62 %) held bachelor degrees.

4.1 Reliability Analysis

Reliability of measurement was tested using the Cronbach's Alpha in order to measure the internal consistency of the scales (Nunnally 1978). Table 2 infers that the Cronbach's alpha values of all variables were greater than 0.70, implying all variables are reliable and have high internal consistency. No item deletion was performed as the reliability for each factor was high.

4.2 Correlation Analysis Between Variables

Pearson correlations were calculated to identify the correlations between the five variables: consumer online shopping behaviour, Internet marketing environment, product characteristics, familiarity and confidence, and promotional offers. The average score of the multi-items for a construct was computed since a single construct in the questionnaire was measured by multiple items, and the score was

Table 1 Demographic profile of respondents

	Frequency	Percentage
Gender		
Male	78	39
Female	122	61
Age (years old)		
Below 20	10	5
21–25	154	77
26–30	22	11
31–35	10	5
Above 36	4	2
Level of Education		
Primary	8	4
Secondary	46	23
Bachelor/Degree	124	62
Master/PhD	22	11

Table 2 Reliability analysis

Variables	Number of items	Cronbach α
Consumer Online Shopping Behaviour (COSB)	3	0.846
Internet Marketing Environment (IME)	4	0.810
Product Characteristics (PC)	4	0.835
Familiarity and Confidence (FC)	8	0.804
Promotional Offer (PO)	4	0.807

Table 3 Correlation analysis

	COSB	IME	PC	FC	PO
COSB	**1.000**				
IME	**0.453****	1.000			
PC	**0.123**	0.235**	1.000		
FC	**0.636****	0.449**	0.156*	1.000	
PO	**0.593****	0.565**	0.277**	0.503**	1.000
Mean	**11.110**	13.440	13.150	27.040	14.280
SD	**2.088**	2.710	2.550	3.251	2.427

*$p < 0.05$; **$p < 0.01$

used in correlation analysis and regression analysis. The correlation coefficient value (r) should not go beyond 0.80 to avoid multicollinearity. Since the highest correlation coefficient is 0.636, which is less than 0.80, there is no multicollinearity problem in this research. All major variables were significantly correlated, except product characteristics (Table 3).

Results in Table 3 demonstrated that Internet marketing environment has a significant correlation with consumer online shopping behaviour ($r = 0.453$; $p < 0.05$), signify H1 is supported. Results for H2 revealed that product characteristics is not significantly correlated with consumer online shopping behaviour ($r = 0.123$; $p > 0.05$). Hence, H2 is not sustained. Next, H3 has shown that a significant correlation was found between familiarity and confidence on consumer

online shopping behaviour ($r = 0.636$; $p < 0.05$). p-value for H4 was <0.05, implying H4 is supported by the data where promotional offer has a significant correlation with consumer online shopping behaviour ($r = 0.593$; $p < 0.05$).

5 Discussion

This study examined the correlation of Internet marketing environment, product characteristics, familiarity and confidence, and promotional offer with consumer online shopping behaviour among 200 students and staff in a public university in Federal Territory of Labuan, Malaysia. Familiarity and confidence is significantly correlated with consumer online shopping behaviour followed by promotional offer, implying hypothesis 3 and 4 were accepted. The correlation coefficient for familiarity and confidence is greater than promotional offers and Internet marketing environment in terms of its correlation with consumer online shopping behaviour. It signifies that familiarity and confidence with the services is the most influential factor to affect consumer online shopping behaviour. Similar results were found by Maenpaa et al. (2008)'s study. Consumers make a distinction between familiar and unfamiliar products online that can affect consumer satisfaction (Haque et al. 2009). Kim (2012) noted that company reputation, structural assurance, and trusting stance, and initial trust beliefs affects consumer attitude to shop online. The new e-vendors with unfamiliar brand name are affected greatly as their brand still not well position in consumer minds. Many customers believe that people who trust a traditional brick and mortar retailer will have a similar level of confidence shopping online for products with the retailer (Kim and Jihyun 2009).

Promotional offer is the second factor that significantly correlated with consumer online shopping behaviour. This result is comparable to Odunlami and Ogunsiji (2011)'s study that promotional offer is a major determinant of consumer online shopping behaviour. Sales promotion can be used to increase sales, usage or trial of products or services, and it is an important component of the overall marketing strategy which can provide an incentive that can reach the target audience. For instance, this promotion can bring benefits to the consumers for enjoying online shopping and searching the information (Odunlami and Ogunsiji 2011). A result has confirmed that consumers put less emphasis on product characteristics which was found to insignificantly correlate with consumer online shopping behaviour. Inability to feel product is one of the limitation where consumers would want to touch and feel most of the goods before buying. This is due to the fact that the shoppers don't trust what product is in the box. Many of the consumers would want to have it opened and checked, right in front of their eyes but this process is not possible while shopping online. Delay in delivery by the web stores where the stock gets delivered after a week or two but shoppers will find out only after completing their payment. These limitations have caused shoppers to be wary about ordering products online. In other words, consumer confidence with online shopping is affected with issues such as shipping costs, privacy, and the inability to touch and

feel products (Castañeda and Montoro 2007; Lim et al. 2011; Narayanasamy et al. 2011; Suki 2006; Suki and Suki 2007; Ramanathan 2011). However, those who believe that online transactions are not secure enough to protect the payment information from disclosure and who tend to buy in great haste when the purchase becomes necessary may eventually be another group to become online shoppers. Experienced Internet users and experienced online shoppers are more likely to be potential future online shoppers.

6 Conclusion

Familiarity and confidence was found to exert a great correlation with consumer online shopping behaviour among students and staff in a public university in Federal Territory of Labuan, Malaysia followed by promotional offer. Hence, the findings provide additional insight into consumers' online shopping behaviour in Malaysia. Results of this study should encourage strategy development for the Internet marketing environment, product characteristics, familiarity and confidence, and promotional offers. A clear understanding of consumer online shopping behaviour can help marketing managers predict the online shopping rate and evaluate the future growth of online commerce. Meanwhile, input regarding what motivates consumers to shop online would help e-vendors in formulating strategy, technology, and marketing decisions as well as website design (Haque et al. 2009).

The retailer or any organization should develop and explore security issues of online transactions making sure they are secure and provide the consumers with confidence to shop online. It is recommended that additional studies be undertaken to examine consumer behaviour and online shopping patterns in other regions and with larger samples. Demographics differences from the perspective of gender, income and education level should also be explored explicitly in order to examine the dissimilar perceptions of consumer online shopping behaviour related to the adoption of and use of information technology (López-Bonilla and López-Bonilla 2008; Ulbrich and Christensen 2011) and mobile commerce (Ozok and Wei 2010). It would be interesting to investigate the effect of the proposed model using multivariate statistical data analysis such as structural equation modeling.

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Effects of Social Needs, Social Influences and Convenience on Smartphones Dependency

Norazah Mohd Suki and Norbayah Mohd Suki

Abstract This study aims to examine the effect of social needs, social influences and convenience of smartphone on students' dependency on smartphones. A total of 200 completed and usable questionnaires were received from the respondents which comprises of students from one of the public higher institution in Federal Territory of Labuan, Malaysia by utilizing simple random sampling method. Results via the analysis of structural equation modeling (SEM) revealed that all proposed hypotheses were supported. Social needs were found to be the strongest effect. Students heavily and actively use smartphone to stay connected with friends and family through social networking web sites such as Twitter, Facebook, MySpace and etc. Smartphone allow them to stay connected with those they care about. Based on the findings, the implications are discussed in the paper and directions for future research are also highlighted.

Keywords Social needs • Social influence • Dependency • Smartphone • Purchase behavior • Structural equation modeling

1 Introduction

Smartphone is an information technology tool to perform mobile Internet (Park and Chen 2007), which capable of accessing Internet at broadband speed ranging from 144 kbps to 2 MBps or more (Euromonitor 2010). Smartphone sales showed a strong

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growth in 2012 whereby 154 million unit smartphones sold to end users as of August 2012, with Apple and Samsung contributing to these positive sales (Gartner 2012). The most universal mobile operating systems (OS) used by modern smartphones including Apple's iOS, Google's Android, Microsoft's Windows Phone, Nokia's Symbian, RIM's and BlackBerry OS. Student of university widely contributed to the increasing number of smartphone demand sales. Factor that influence the number of acceptance toward the smartphone usage is because the functionality that can help user in their daily life especially for business people and student in the university. This has lead on the research of what factors that shaping the student willingness to purchase the smartphone. As a consequence, this research aims to examine the effect of social needs, social influences and convenience of smartphone on students' dependency on smartphones.

2 Literature Review

Consumer has become highly dependent on smartphones as it is with them when they commute, relax at home, travel overseas and so on (Genova 2010). Featuring contains such as instant messaging, downloading application, utilising information services such as WiFi and global positioning system (GPS) and entertainment (Euromonitor 2010), smartphones have seen an increase in terms of demand due to the popularity and functions offered in the phones (Park and Chen 2007). Genova (2010) stated that smartphones can be use at anytime and any place. Relative advantage and ease of use of smartphone are the innovation characteristics that frequently being investigated (Davis 1989). The influence of social needs, social influences and convenience of smartphone on ones dependency on smartphones is described below.

2.1 Social Needs

Social needs including ones needs of love, affection, belonging and acceptance from social surroundings. Smartphone are significantly varying the way people live on how people shop, buying, searching, playing and connect to the world (Goldman 2010) besides developing and expanding sense of affection among circle of friends and family members. Smartphone devices are programmed with various software tools which allow the users to interact with other users more efficiently and effectively without geographical limitations globally (Carayannis et al. 2012). Smartphone offer larger and higher resolution screen and provide consumers with tremendous array of features, including mobile web browsing, thousands of applications, email, instant messaging, picture messaging, video and audio playback, GPS, games, a video camera, picture and video editing, and much more (Goldman 2010). In Peterson and Low (2011)'s study, almost three quarter of the students stated that they enjoyed with

the contract or package provided by the smartphone provider which provides them with unlimited Internet access to their mobile phone or a limited Internet services which is sufficient for their needs. In view of that, the study hypothesizes that:

H1. Social needs significantly affect the students' dependency on smartphones.

2.2 Social Influences

Social influence is related to the way other people affect one's beliefs, feelings and behavior (Mason et al. 2007). It is likely that the individual will adopt the particular thought, attitude, feeling and behavior as well (Mei et al. 2012). Thus, consumers may be susceptible to social influence by observations, perceptions or anticipations of decisions made by others in engaging to smartphones (Suki and Suki 2007). Consumers are dependent on their smartphones when they have high continuous usage and reluctant to be part from it (Tian et al. 2009). Thus, consumer's expectations for future purchase behavior will be affected by their past experience as they heavily dependent on smartphones because of the underlying motives (Kuhlmeier and Knight 2005). Friends and family members are seen as social influences that are perceived to be important to consumers in promoting and encouraging a greater dependency on smartphone (Auter 2007).

Schiffman et al. (2009) stated that the influences of social class, culture and subculture although are less tangible are important input factors that are internalized and affect how consumers evaluate and adopt products. According to Smura et al. (2009), in most developed countries, mobile phone have become an inseparable part of everyday life and a majority of people carry them all the time. Suki and Suki (2007) found that heavy mobile phone users possess a higher level of knowledge, have more social participation, maintain extensive interpersonal networks, and have contact with people not only within the social system but also outside it. An intention to buy a brand is based on a consumer's attitude towards buying the brands as well as the influence of social norms about what other people expect (Jamil and Wong 2010). Therefore, it is hypothesized:

H2. Social influences significantly affect the students' dependency on smartphones.

2.3 Convenience of Smartphone

The smartphone allows users to do thing that never thought could be done without being tethered to a home or office computers, from comparing store prices and searching for restaurant reviews to checking into a hotel and social networking (Goldman 2010) at anytime and anywhere. With smartphone and free software downloaded inside it, users can swipe the barcode of a product in the physical store and then the product information and company information can be generated

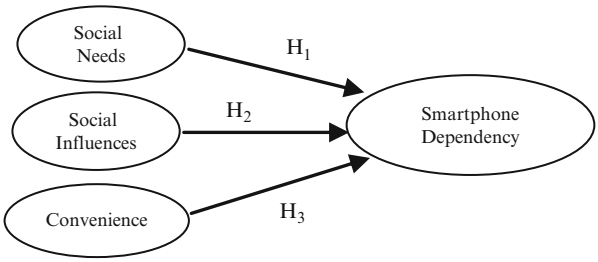

Fig. 1 Proposed theoretical framework

automatically and promptly in real time. By means of smartphone, consumers can easily and quickly shop for products across multiple channels with substantially greater level of convenience, flexibility, efficiency and personalisation (Persaud and Azhar 2012). This showed that advances in mobile technologies do provide promising further benefits (Smura et al. 2009). Accordingly, the study hypothesized that:

H3. Convenience of smartphone significantly affects students' dependency on smartphone.

Figure 1 illustrates the proposed the research framework.

3 Methodology

A total of 200 completed and usable questionnaires were received from the respondents which comprises of students from one of the public higher institution in Federal Territory of Labuan, Malaysia by utilizing simple random sampling method where every unit in the population have an equal chance to be selected in the sample. The study sample included respondents who are holding smartphone. They were considered as members of a digital generation who actively involve in online social networking (Park 2012). Data were collected by conducting survey between January 15 and February 15 of 2012 (about 1 month). Qualitative research design lean towards utilizing small sample sizes (Miller et al. 2011).

A survey instrument was designed to ask respondents about their experience and perception with smartphone. Measurements of items were adapted from Ting et al. (2011) and were used to operationalise research constructs in this study. Social needs and social influences were measured using four items each. Convenience and dependency were measured by five items. Each item was measured on a five-point Likert scale (i.e. 1 = disagree strongly; 5 = agree strongly). The Statistical Package for the Social Sciences (SPSS) computer program version 17.0 was used for statistical analysis and to attain the statistic data for this study. Descriptive statistics was applied to provide the profile of the respondents. The structural equation modeling (SEM) was used to examine the hypothesized relationships among the constructs in this study.

4 Results and Discussion

The descriptive analysis of demographic profile of respondents is available in Table 1 where 49 % of the respondents were male and the balances were female. A large number of respondents came from the age group of 20 years old and above (97.5 %). Students undertaking bachelor degree represented the largest number of respondents with 68 %, followed by students holding STPM 19.5 % and Diploma with 10 %.

4.1 Structural Equation Modelling

SEM technique via AMOS 5.0 computer program, using maximum likelihood estimation, was utilized to verify the research framework and hypotheses. SEM involves two levels of analysis: the measurement model and the structure model.

4.2 The Measurement Model

The measurement model was estimated to determine whether the intended constructs are measured by the underlying latent variables in the hypothesized model. It is necessary to determine that the measurement model has a satisfactory level of validity and reliability before testing for a significant relationship in the structural model (Fornell and Larcker 1981). The psychometric properties of the model in terms of reliability, convergent validity and discriminant validity were evaluated via Confirmatory Factor Analysis (CFA) model.

Table 1 Demographic profile of respondents

	Frequency	Percentage
Gender		
Male	98	49.0
Female	102	51.0
Age		
<19 years	5	2.5
20–23 years	158	79.0
24–27 Years	37	18.5
Education level		
SPM	5	2.5
STPM	39	19.5
Diploma	20	10.0
Degree	136	68.0

Table 2 Reliability analysis and item loadings

Constructs	Items	Standardized loadings	Composite reliability	Average variance extracted
Social	C1	.539	0.826	0.956
Needs	C2	.515		
	C3	.830		
	C4	.909		
Social	D1	.776	0.842	0.842
Influences	D2	.990		
	D3	.735		
Convenience	H2	.690	0.907	0.907
	H3	.596		
	H4	.817		
	H5	.492		
Dependency	F2	.551	0.831	0.831
	F3	.998		
	F4	.589		

4.3 Construct Reliability

Composite reliability (CR) for the CFA model was used to measure the reliability of a construct in the measurement model. CR offers a more retrospective approach to overall reliability and estimates consistency of the construct itself, including the stability and equivalence of the construct (Hair et al. 2010). The reading of CR for all the latent variables was above the threshold value of 0.70 (see Table 2), i.e. greater than the benchmark stated by Hair et al. (2010), indicating the high internal consistency of scales and the reliability of the latent variables.

4.4 Convergent Validity

Convergent validity shows the extent to which indicators of a specific construct converge or have a high proportion of variance in common (Hair et al. 2010). This validity measured using standardized factor loadings and average variance extracted (AVE). The factor loadings of latent to observed variable should be above 0.50 (Hair et al. 2010). An item from convenience factor (i.e. 'Using a smartphone would allow me to accomplish task more quickly') and two items from dependency factor (i.e. 'I always use my smartphone to deal with my job'), and 'In my daily life, usage of smartphone is high' were removed as its standardized factor loadings below 0.50. The result of the CFA in Table 2 infers that the standardized factor loadings of all observed variables are adequate ranging from 0.515 to 0.998. This finding indicates that the constructs conform to the convergent validity. Next, all AVE values are above the recommended 0.50 level (Hair

Table 3 Correlation analysis

	1	2	3	4
(1) Social needs	0.914			
(2) Social influence	0.123	0.709		
(3) Convenience	0.144*	0.078	0.823	
(4) Dependency	0.862**	0.130*	0.089*	0.951
Mean	2.633	3.648	3.80	2.629
Std. Deviation	0.956	0.910	0.633	0.991
Skewness	0.351	−0.598	−0.849	0.227
Kurtosis	−0.771	−0.041	1.310	−0.757

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

et al. 2010), thus demonstrates convergent validity. This implies that more than one-half of the variances observed in the items were accounted for by their hypothesized factors. Overall, the convergent validity test indicates that the proposed constructs of the model are adequate.

4.5 Discriminant Validity

Discriminant validity shows the extent to which a construct is truly distinct from other constructs (Hair et al. 2010). If the items in a construct correlated more highly with each other than with items measuring other constructs, the measure was regarded as having discriminant validity. A commonly used statistical measure of discriminant validity is a comparison of the AVE value with correlation squared (Fornell and Larcker 1981). Table 3 shows the correlation matrix for the constructs. The correlation estimates indicate significant two-way correlation between specified variables. All of the correlations between variables were less than 1 and statistically significant at the $p < 0.05$ level, confirming a positive correlation among variables. Social needs ($r = 0.862, p < 0.01$) turned out to have the highest association with dependency.

The diagonal elements in the correlation matrix in Table 3 have been replaced by the square roots of the AVE. For discriminant validity to be considered satisfactory, these diagonal elements should be larger than the off-diagonal elements in the related rows and columns. Thus, discriminant validity is justified in this study and appears satisfactory, i.e. multicollinearity is absent. The skewness of all the items ranges from −0.598 to 0.351, below ±2.0. Similarly, the values for kurtosis ranges from −0.041 to 1.310 well below the threshold of ±10. Both the skewness and kurtosis are well below the said threshold, implying that the scores approximate a "normal distribution" or "bell-shaped curve".

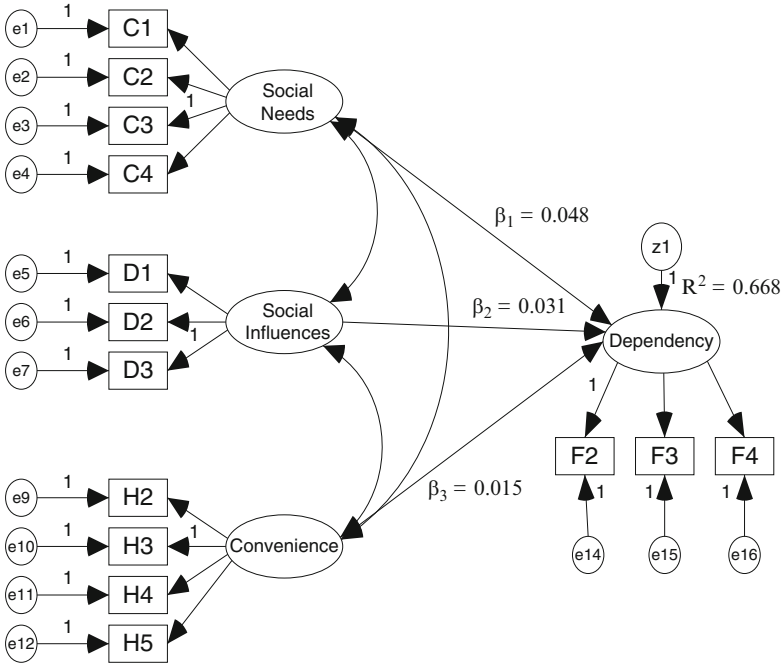

Fig. 2 Path diagram of the structural model

4.6 The Structural Model

A structural model was estimated to provide an empirical measure of the hypothesized relationships among the research variables and constructs by performing a simultaneous test. The structural model can be evaluated by two indices: (i) the path coefficients (β), and (ii) R^2. Comparison of all the fit indices provided evidence of a good model fit: Chi-square/df = 1.190, CFI = 0.979, GFI = 0.931, NFI = 0.945, and RMSEA = 0.057, implies the hypothesized structural model fits the data reasonably well. The results of the multivariate test of the structural model show that the social needs, social influences and convenience as a whole explained 66.8 % of the variance in the dependency. Figure 2 shows the path diagram with the structural model estimates included on the paths, where the estimate parameters are standardized path coefficients and all path coefficients are significant at the 95 % level.

The estimation of the structural model in Table 4 indicates that all hypotheses were supported and consistent with expectations, because the hypothesized relationship was significant ($p < 0.05$) and in the anticipated direction. The most significant finding was found in relation to the social needs factor ($\beta_1 = 0.048$; $p < 0.05$), which was confirmed as the most important predictor of dependency on smartphone. This significant result is analogous with Auter (2007) and Donahue (2010)'s study.

Table 4 Hypotheses testing results

Path			β	S.E.	C.R.	*p*
Social needs	--->	Dependency	0.048	0.036	−0.622	0.045*
Social influences	--->	Dependency	0.031	0.032	0.436	0.039*
Convenience	--->	Dependency	0.015	0.087	0.189	0.034*

*$p < 0.05$

It is confirmed in this study that students heavily and actively use smartphone to stay connected with friends and family through social networking web sites such as Twitter, Facebook, MySpace, etc.). In other words, smartphone allow them to stay connected with those they care about. Interestingly, smartphone bring easiness for them to observe what's happenings globally at any time 7 days a week, 24 h a day, and 367 days a year.

Next, there was support for H2 indicating that social influences do affect dependency on smartphone ($\beta_2 = 0.031$; $p < 0.05$). The finding is in coherence with discovery by Park and Chen (2007). This confirms that social influences such as pressure from friends and family do influence their usage rate of smartphone. Indeed, they do concern whether their friends like the brand of smartphone they are currently using and would buy a smartphone if it helped them to fit in with their social group. H3 was also supported as convenience was the third most significant factor in explaining dependency on smartphone ($\beta_3 = 0.015$; $p < 0.05$). Having a smartphone is like having both a mobile phone and a computer together, it enables them to receive learning materials anywhere they go and prefer carrying smartphone rather than laptop. Preceding research by Goldman (2010) found comparable finding.

5 Conclusion and Recommendation

This study examined the influence of social needs, social influences and convenience of smartphone on students' dependency on smartphones. All in all, results through SEM concluded that all hypotheses were supported. Social needs have the strongest effect on the students' dependency on smartphone, followed by social influences and convenience. Prior research by Woodcock et al. (2012) indicated that most students have not made strong connections for themselves between their personal smartphone technology, their needs as learners and the way they learn. One of factor that affecting convenience factor is the speed of the Internet connection at the university and the availability of Wi-Fi services which is one of the important thing to use for some of smartphone application. Nevertheless, Woodcock et al. (2012) suggested that academics and educational developers need to enhance the students' acceptance on the usage of personal technologies such as smartphone and tablet PCs to enlightening their learning process. On the smartphone provider side, they are recommended to continuously increase the smartphone functionality to be of relevant among students.

There are a few limitations that might limit the current research findings, which is the sample was only distributed among 200 students from one of the public higher institution in Federal Territory of Labuan, Malaysia and it have limiting research finding regarding the influence of students' purchased behavior towards smartphone. It is recommended to widen the coverage of sample selection to improve the generalizability of the result and to provide more accurate and holistic results. Future study should be conducted across student regardless university level or secondary level in Malaysia to earn more accurate and holistic results of buying behavior factor and to reflect different cultures among university students. A comparison between different cultural groupings would have will guide on the differences and similarities on how smartphones are perceived and used among students. Furthermore, this research brings implication in terms of it employed qualitative research design which provides insight and in-depth understanding related to the research objective involved. This type of research design has been positively acknowledged by preceding researchers (Miller et al. 2011; Leech and Onwuegbuzie 2009; Seitz 1993).

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