



Revista Ibérica de Sistemas e Tecnologias de Informação
Iberian Journal of Information Systems and Technologies

ISSN: 1646-9895

N o v e m b r o 1 6 • N o v e m b e r 1 6



©AISTI 2016 <http://www.aisti.eu>

Nº E11

Edição / Edition

Nº. E11, 11/2016

ISSN: 1646-9895

Indexação / Indexing

Academic Journals Database, CiteFactor, Dialnet, DOAJ, DOI, EBSCO, EI-Compendex, GALE, IndexCopernicus, Index of Information Systems Journals, Latindex, ProQuest, QUALIS, SCImago, SCOPUS, SIS, Ulrich's.

Propriedade e Publicação / Ownership and Publication

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E-mail: aistic@gmail.com

Web: <http://www.aisti.eu>

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Opportunities and Challenges of Using Computer Methods and Applications in Science and Technology in China

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The development of computer methods and applications was one of the great scientific achievements in recent decades, with a profound impact on science and technology. It includes theoretical development and rational applications of mathematical models, variational formulations, and numerical algorithms in lots of area. The researches on computer methods and applications to improve the performance are becoming increasingly important.

The aim of this issue is to provide original and the latest papers at the forefront of modern research describing significant developments of computational methods and their applications in new design techniques, interesting or novel applications, components or standards; emerging computing models such as cloud computing, grid computing; applications of networked systems for remote collaboration and telemedicine; applications of an educational, transactional and cooperational nature; applications of security in computer

We gratefully appreciate the authors for their scholarly contributions. Only manuscripts of sufficient quality that meet the aims and scope of our journal will be reviewed. The manuscript will be assigned to at least two distinguished experts for peer-review who have no conflict of interests with the authors. All manuscripts should not being considered for publication elsewhere or have already been published elsewhere.

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A Correlation Analysis on Sports Industry Based on System Dynamics

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Abstract: In recent years, our country has attached more and more importance to the development of sports industry, and many scholars are having been working on it now. In this paper, the concept of sports industry was defined along with the establishment of systematic dynamics model of sports and related industry with the reference of the input-output table (2007) of China. Moreover, the industrial relationship of sports industry as well as its promotion to national economy was further analyzed here.

Keywords: sports industry, industrial relationship, systematic dynamics, input-output

1. Introduction

With China's economic development, the sports industry is increasingly improved in national economy in China. Since the Olympic Games in 2008, Chinese government has introduced numerous international sport events successively, attached importance to the sports industry gradually, and made great efforts to increase investment in sports industry, so that people in the whole society are in high spirit in sports. Meanwhile, the constant development of the sports industry not only drove national economy, but also exerted a certain influence on such industries as sports-related manufacturing and services. Thus, many scholars also started studies on sports industry.

In recent years, there are more and more studies on sports industry from the input-output theory to the system dynamics. These studies also well reveal the correlation of sports industry.

In the input-out theory, many scholars resolved the problems in sports industry using relevant theories thereof. They got the industrial correlation results by analysis on statistical data and input-output tables about sports industry in one or more regions, and proposed their proposals about the development of sports-related industries. Based on the sports input-output model, Li (2010) analyzed the correlation, sensitivity and influence between China's sports industry and other industries using the 2002 & 2007 Chinese Input-output Tables. Zhou Yi et al. (2012) established the relevant analysis model in the input and output of sports industry using the data related to China's input

and output thereof in 2002 and 2007, conducting a dynamic analysis on the correlation of sports industry.

In system dynamics, many scholars determined key variables and influencing factors in the sports industry, and established a system dynamics model of sports industry. They analyzed the development of the sports industry based on simulation results, and proposed the reasoning proposals. Li et al. (2003) established a system dynamics model for China's sports industry, and performed a simulating comparison and analysis on three kinds developing modes of the industry. Shao (2010) established the kernel variables in China's competitive sports industry, constructing the system dynamics model of sustainable development in the industry, carrying out the simulating analysis on its four developing modes.

In the concept definition, this paper gives the basic concept of sports industry by analyzing and summing up literature as well as the classification of the sports industry based on the 2007 Chinese sports input-output table. By this way, some specific problems are well analyzed and solved in the sports industry.

2. Definition of sports industry

In industrial economics, the industry is defined as a set of economic activities of enterprises of the same attributes. However, the sports industry is not defined in consensus yet currently, and scholars have different views on its definition. Their main discrimination focuses on its two aspects: broad and narrow senses in the concept of sports industry.

In a broad sense, the sports industry refers to a set of the activities to provide sports services to the social public as well actions as related to these activities. In its narrow sense, the sports industry is considered to be only the tertiary industry (service sector), and it is defined as the relevant departments offering the society all kinds of sport labor services.

In this paper, the sports industry is believed to include not only sports services but also material products such as manufacturing product related to sports. With advancement of science and technology, especially development of the tertiary industry—services, there a fuzzy boundary and even blended to some extents between primary, secondary and tertiary industries. Similarly, the sports industry should not be divided rigidly by the three-industry classification, but it should be a comprehensive sector (Zhang Lin, 2013). As a matter of fact, the sports industry includes many types of sport services. Compared with sport material products, its service products are dominant in sport products.

This paper believes the concept of sports industry in the broad sense, and takes the industry as a set of the activities to provide sports services and products to the public as well as the actions related to these activities.

3. Associated industries of the sports industry

Major sports-associated industries can be determined based on above definition of the sports industry as well as its input-output tables. According to the output utilization structure of the 2007 sports input-output table, the sports industry has a total output of

RMB1,533,240.606 million Yuan, a mid-use volume of RMB423,004.834 million RMB, and a final utilization volume of RMB297,839.383 million RMB with a mid-utilization rate of 27.59%, indicating its service property. This paper will focus on other sectors whose direct consumption coefficient is greater than 0.05 in the sports industry. As shown as Table 1, the sectors whose direct consumption coefficient is more than 0.1 are:

Sector	Direct consumption coefficient	Sector	Direct consumption coefficient
Insurance	0.143370	Radar & broadcast equipment manufacturing	0.073795
Hygiene	0.141757	Other traffic and transport products manufacturing	0.071393
Postal service	0.139504	Seasoning, fermenting products processing	0.070493
Software	0.116560	Public facility management	0.070401
Daily chemical product manufacturing	0.108352	Liquid milk & its products processing	0.065655
Social security	0.101106	Environment management	0.065591
Shipping	0.092139	Other food processing	0.064840
Communication device manufacturing	0.091401	Resident services	0.062750
Sports	0.090295	Computer services	0.062044
Public management and social organization	0.089259	Telecommunications & other information transmission services	0.061569
Household electrical & non-electrical device manufacturing	0.088629	Other services	0.060064
Soft drinks & refined tea processing	0.083750	Railway transport facility manufacturing	0.057949
Car manufacturing	0.082071	Alcohol and spirits brewing	0.055459
Manufacturing of special machines for farming, forestry, husbandry and fishery	0.081834	Finance	0.054394
Lodging	0.080889	Aviation transportation	0.053561
Medical device manufacturing	0.078428	Weaving knitting products and other products manufacturing	0.053165
Furniture manufacturing	0.077538	Lifting equipment manufacturing	0.052505
Instrument & meter manufacturing	0.052491	Mine, metallurgical and building special facility manufacturing	0.051598
Artware & other manufacturing	0.050849		

Table 1 – Other sectors whose direct consumption coefficient is greater than 0.05 in the sports industry

insurance, hygiene, postal service, software, daily chemical product manufacturing, and social security.

Based on the classification pattern of the thrice industries, the sectors involved in Table 1 are classified into manufacturing, services and sports industry related to the sports, and their direct coefficients are 1.487363, 1.394958 and 0.090295 respectively.

As a result, the industries related to sports industry by the sports input-output table are manufacturing and services industries related to sports.

4. System dynamics model of sports industry

4.1. Determination of kernel variables

An authoritative description is made for China's sports industry development as a whole by the two indexes—value added and the number of employees engaged in sports industry from A Gazette of 2006—2008 National Sports & Its Related Industries jointly issued by National Bureau of Statistics (NBS) and the State General Administration of Sports in 2010. The calculating sports value added may reflect general scale, development level and contribution of sports industry to national economy, directly presenting its status in the national economy operation. The index—the number of employees engaged in the sports can directly reflect its contribution to the availability of labor force resources and employment. For this reason, this paper selects the two indexes as the model status variables to analyze the value added in manufacturing, services, sports and the number of employees related to sports industry.

4.2. Basic hypotheses of the system

- Hypothesis 1: Development of sports and its related industries change with time.
- Hypothesis 2: Development degree for sports and its related industries are affected by the kernel variables of the system.
- Hypothesis 3: The sports and its related industries are made up of three main parts: sports industry, its related manufacturing and services.
- Hypothesis 4: A positive correlation exists between GDP and the number of employees & productive forces in sports industry.
- Hypothesis 5: Influence of the other factors out of the system is not considered on other related industries.

4.3. The cause & effect relation diagram of system dynamics in sports industry

After the influencing factors on the sports industry are determined, the cause-effect relation diagram is plotted by the system dynamic software Vensim as shown in Fig. 1

The relevant loops in Fig. 1 mainly reflect the process of the value added of sports industry & its related industries and the increasing values from the number of employees engaged in the industry in different circulation routes. As this paper mainly studies development of sports industry, so it only explores the kernel variable—the value added of the sports industry. In Fig. 1, the main feedback loop of the main cause-effect relation for the kernel variable—the value added of sports industry is:

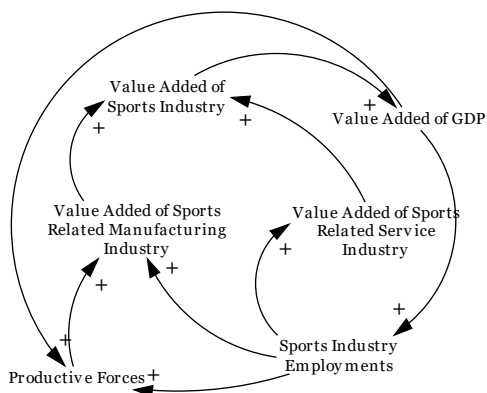
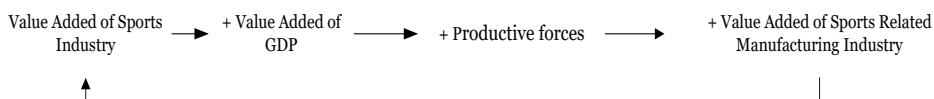
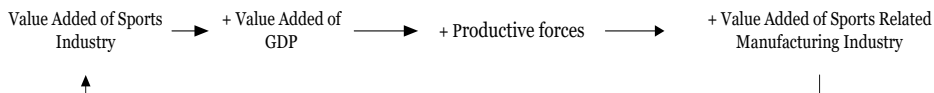


Figure 1 – The cause-effect relation diagram of system dynamics for sports industry

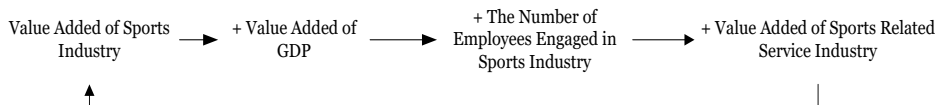
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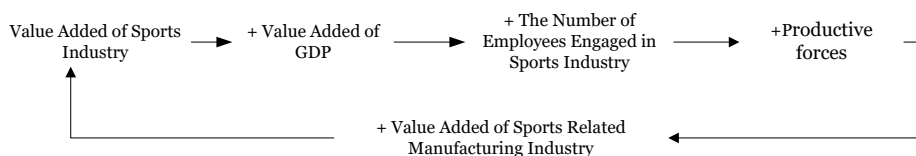
(2).



(3).



(4).



Above cause-effect relations belong to the positive feedback loops, and all loops demonstrate a positive feedback relation of the value added in sports industry and the number of employees, sports-related manufacturing & services.

From the second and third loops in the cause-effect relation feedback loops in Fig. 1, the number of employees engaged in sports industry can promote both its related manufacturing and its related services, to further drive sports industry in good development, so that it can make more contribution to GDP growth. The fourth loop indicates an inevitable improvement of productive forces with the increase of the number of employees, which drives the throughput of related manufacturing, so that the sound development of sports industry leads to an increment of GDP. The increase of GDP can put in increase of the number of employees. As a result, a virtuous cycle comes into being.

Xu et al. (2014) plotted the cause-effect relation diagram of Beijing sports sustainable development taking the value added of sports industry and the employees as kernel variables. Shao (2010) plotted the dynamic cause-effect relation diagram of sustainable development of sport system in China's national economy taking the Man and the Fund as the kernel variables of the system. The former is subdivided into the sports-core employees, the employees outside of sports industry, and the sports-related employees. By this way, they studied the feedback relation to the value added in sports industry, and reflected the influence of investment in hierarchies of sports industry on the value added. The latter means that a rational control of personnel composition and a reasoning distribution of fund proportions can make the positive feedback of the two kernel variables significantly presented and constantly enhanced. These studies further verify the research conclusions in this paper.

4.4. The system dynamic flow diagram of sports industry

The system dynamic cause-effect relation diagram of sports industry indicates the process of the positive feedback interaction between variables, but it can't well describe the property and change degree of system variables. Hence, the system dynamics flow diagram is established on the basis of the existing analysis on the cause-effect relation as shown in Fig. 2.

In this paper, the influencing factors on the value added on sports industry are determined from sports-related industries, and the sports-related industries are categorized by the thrice industries, and their direct consumption coefficient is calculated. It is found from the direct consumption coefficients in Table 2 that the sports-related manufacturing and services have strong dependency on the sports industry, so that their industrial value added facilitate the value added of sports industry.

Li Guo et al. (2013) established the system dynamic flow diagram of development of China's sports and its related industries by the kernel variables--industrial value added and the number of employees, giving seven subdividing influencing factors of sports and its industrial value added. They proposed three modes of sports development by a control of the fund input proportion to industries. But no matter how to control the fund, it is still found from the flow diagram after simulation that both the value added of sports and its related industries and the employees in sports increased year by year, but

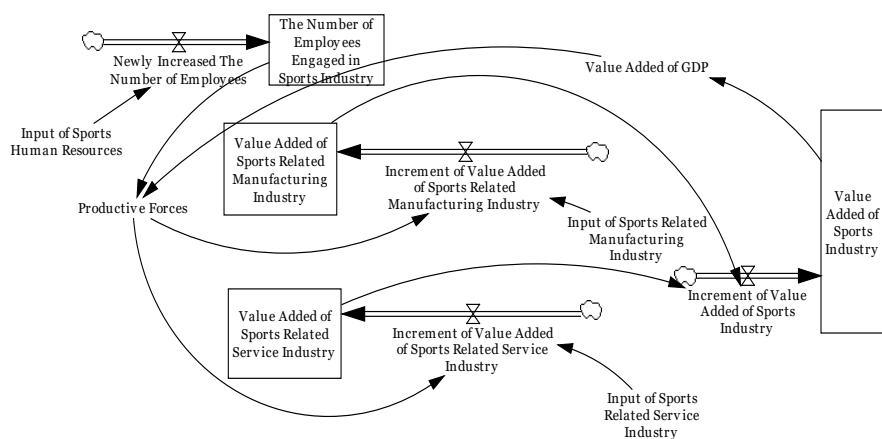


Figure 2 – System dynamics flow diagram of sports industry

only there is a different rate in the increase trend in the different fund input proportions. This study also supported the conclusions put forth in this paper.

Industry	Direct consumption coefficient
Sports-related manufacturing	1.487363
Sports-related services	1.394958
Sports	0.090295

Table 2 – Direct consumption coefficient of sports and its related industries

From the value added of sports industry, the study in this paper indicates this industry can drive the national economy. The sports-related industries and the number of employees thereof can facilitate their own development under the circumstance of certain investment and resources, so that the value added of sports industry presents a positive growth with the value added of its related industries. Thus, the value added of sports industry has a positive influence on national economy.

Li et al. (2010) figured out the influence and sensitivity coefficients of China's sports industry. It is concluded based on the calculating results that the sports industry has a very strong industrial influence, but with a lower sensitivity coefficient, so that it driving role couldn't be given full play to national economy. This means more actively developing the sports and its related industries to improve national economy. Zhou Yi et al. (2012) conducted a input-output calculation in the sports-related industries based on 2002 and 2007 sports input-output tables. They analyzed the development situations and problems in sports and its related industries, considering the sports-related manufacturing had increasing dependency on the outside. During 2002–2007, the net export volume in manufacturing made up 37.66% at large, up nearly six percent points in the five years, while the net export volume in the services decreased by nearly

three percent points. This is because the sports services industry was mainly used for domestic consumption. So, it is concluded developing sports and its related industries facilitate final consumption and export for earning foreign exchanges. So sports industry has a good effect on the better development of national economy.

5. Conclusions

The sports industry is defined first in this paper, then its related industries are determined by the output structure in the 2007 sports input-output table, and the kernel variables are established for the system dynamics model of sports industry before the model is built. Moreover, the cause-effect relation diagram and flow diagram are plotted for the sports system dynamics using Vensim software, and they are compared based on literature analysis, so as to analyze the relation of the sports industry with its related industries and national economy. It is concluded in this paper that the sports-related industries have dependency on the sports industry, and have played an active role in the development of sports industry. The thriving sports-related industries can drive the national economy.

Acknowledgements

The publishing of the paper is supported by the Fundamental Research Funds for the Central Universities.

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Study of Ideological and Political Education of College Students in Various Dimension Based on Computer Platform

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Pages: 9–17

Abstract: This paper surveys the rational evaluation and current situation of occupational characteristic of college students whose major is computer science and builds stereoscopic and multi-dimension working model. The paper mainly deconstructs the stereoscopic and multi-dimension working model in aspects such as topic source, manner source, and information source. According to subject resources of computer science department in colleges, we build digital operating platform about working information of students in computer science department.

Keywords: computer platform, survey platform, ideological and political education

1. Introduction

Effectiveness is always the theme of ideological and political education of college students (Abreu et al. 2015). Direction is the premise of effectiveness. Students in computer science department in college are common with other college students in new era, but they also have obvious characteristics. Only seize the common of students in new era and analyse the characteristic of students in computer science department objectively can we increase the direction of this kind of students and ensure effectiveness of ideological and political education.

2. The survey platform of occupational characteristic of students in computer science department

2.1. The rational evaluation of occupational characteristic of talents in computer science department

1. Active logical thinking and creative minds

Computer is the machine operating logical operation. The sphere of logical operation is from adder in bottom to Internet knowledge shared globally (Zhou, 2014). Whatever the program development or the network management, they both need to understand the logical relationship between program and network profoundly. Therefore, thorough

logical minds are the core basis of working in computer industry and the basis of working in IT industry. The technology of computer industry has the fastest upgrading. Its occupational character needs people to create constantly and have the courage to challenge themselves, or they will be eliminated (Zhang, 2014).

2. Be good at communicating and have consciousness of teamwork

As the new technology is changing all the time, the study and development of computer system is no more one works alone but more depend on the team to study together, clear division of labour and good teamwork. Microsoft is famous for its special teamwork (Dong, 2010). More than 3000 development engineers and testers participated the development of products like Windows 2000 and they wrote 5,000,000 lines of codes. This project will never finish without high degree of unity, understanding of all participants and division of labour. So cultivating students in computer science major should cultivate their ability of teamwork consciously both in the mind and in the way (Li, 2010).

2.2. Uncomfortable condition of occupational characteristic of students in computer science major

1. Afraid of subjects knowledge is keep changing and impetuous mind is obvious.

IT industry is changing all the time. Every time there is new mind, new idea, new technology so it is an industry fill with challenges. This makes some students in computer science major fear of subject knowledge, doubt of their ability and be confused of their future. This fear psychology reflects impetuous minds and behaviour that wants quick success. It is especially obvious in freshman (Marschall, 2002). They want to change their major and the number of students changing their major is always high.

2. Be addicted in virtual world and the communication way is becoming virtual

For most students whose major is computer science, computer is their important partner in study and life. According to incomplete statistics, the average time students in computer science major spend with computer is at least 6 hours, even much more (Cao and Li, 2010). Because of too much rely on computer; the communication way of most of students in computer science major is becoming virtual. They spend little time in communicating with others in real but more time in communicating on online platform by online form MSN, QQ, Weibo and so on. Some of them even addicted in virtual world, such as online games, online information, and making friends online. These problems is especially obvious in college students whose major is computer science (Liu, 2011).

3. Like publicizing individuality and lack of teamwork

The mind of college students whose major is computer science is creative and open and their opinion is new and unique. Most students whose major is computer science are boys and girls just have a low proportion, which brings natural obstacle to normal personal communication. Because of limitation of major, most of their time is spend in program code so they dislike collective activities. However, they like to show themselves through network and self-existence. Just for over-reliance on computer, some students gradually become unsociable and introverted. They don't want to communicate with others; some even have psychological problems and don't have teamwork awareness.

3. Deconstruction of working model stereoscopic multi-demission of ideological and political education for college students in computer science major

The working model of ideological and political education for college students in computer science major is showing in Figure 1.

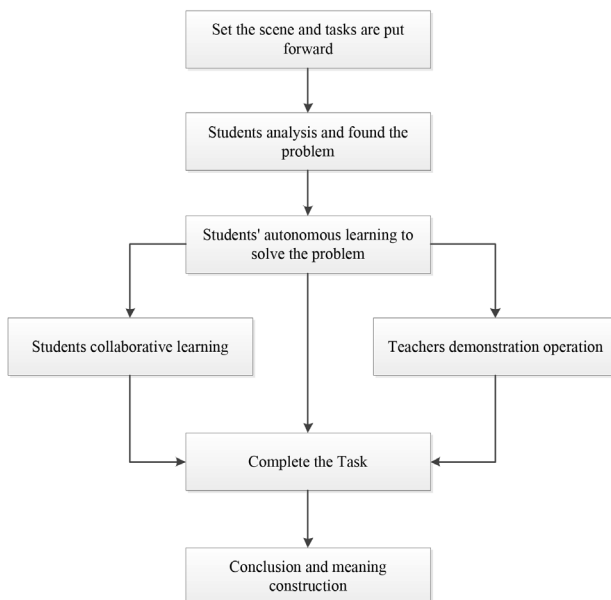


Figure 1 – Sketch teaching modes

3.1. Source of main part (diversification of main part of education)

To make ideological and political work more effective, we aim at the characteristic of students in computer science major and form diversification of main part of ideological and political education to change the single problem in main part of traditional ideological and political education.

1. Exert the professional advantage of teachers in computer science major. Professional teachers collect hot issues with common attention online and discuss hot issues on form. By building communication platform with students, they can trace forms and networks students always logged in and comprehend the mind and opinions of students. The teachers can also have activities like virtual community and virtual service online, which makes students experience different trouble and happiness of different identities and experience the dedicated happiness from virtual service. Make students be interested in studying by projects and let them have cooperation spirit so as forming unity atmosphere.
2. Strengthen the work of ideological and political counsellor. Counsellor plays an important role in improving students' quality and holding right thought

direction. They answer questions for students in normal study and life and help them overcome obstacles. They are accompanys of hearts of students.

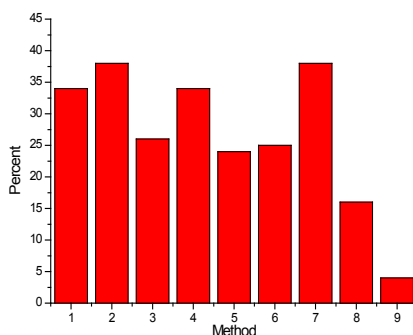


Figure 2 – Improve the level of basic computer education measures

3.2.Source of pattern (diversification of educational pattern)

Aiming at characteristics of students whose major is computer science, we change the traditional working pattern which is unidirectional instilling and constantly create the pattern and method of the work to increase effectiveness of ideological and political work.

1. Build the platform for communication between teachers and students

By a series of activities, we should emphasize “people first”, fully use the subjectivity of students, guide students to participate all kinds of academic lecture, broaden their horizons and increase their talents. Actively encourage students participate all kinds of technological activities and tests through building technology and creation platform, such as ISN International Program Design Competition for College Students, Freescale Competition for Smart Car, especially technological activities of college students which represent is “Challenge Cup”. They promote both the body and heart of students to feel technological creation. Broaden students’ width and depth of knowledge by actively set up elective class aiming at students whose major is computer science, such as Android operating system and second generation International technology. Start admonishing activities between teachers and students and let teachers fully play their roles in helping, supporting, promoting and guiding. In this way, teachers and students can have harmonious relationship and teachers can give help and guidance to students in study and in the mind.

2. Build early warning and intervention mechanism for students addicted in network

Increase supervision and education of college students surfing online and build discipline committee of students on surfing Internet with civilization which is

guiding by political counsellor and participated by students leaders and student party members. In this way, students who is addicted in network can be found in time and evaluate precisely. Consultative service center for college students should be built. Actively culture students who addicted in network through psychological guidance, psychological consultation and service hotline. For example, the emerging of online counsellor in Fudan University is an active try and it has significant effect. We should actively guide students addicted in network to participate in all kinds of social activities and social practice associations, actively culture their abilities of communication and let them know more about society and new technology. We should experience the real feeling in society, stimulate students' passion and get rid of computer. Actively organize and encourage students to participate all kinds of professional qualification exams of computer science, such as software engineer qualification and so on, setting higher goals and enrich the life of students. In a word, the pattern of ideological and political work should change from single instilling to two-way communication, from single educational pattern to composite working pattern and from explicit working pattern to explicit with recessive integrated pattern. Build the multi-demission source of pattern of ideological and political work for college students whose major is computer science.

3. Source of information (real-time information of education)

Speed up the development of information source of ideological and political work and fulfil requirements of students in computer science with information. For example, enrich information source of campus home, build online youth league, online party league, and online classes and so on.

Aiming at most of students in computer science major have characteristics such as introverted, dislike communication and lack of social experience, we offer bridge for online communication with teachers and students and build forms. At the same time, build a teamwork of information officer on network including teachers in school online centre, online information officers in units and some of backbone in students, sort out regularly the discussion of hot issues and main views on forms, find and feedback important information, grasp online dynamic and answer related answers. So we can manufacture and put out active information in appropriate ways, refute and balance negative information.

3. Strengthen control of online information and build and complete all kinds of management system of local network. Using online communication information form of campus users and execute real-time system on campus online strictly. Every day there is someone control and clear rubbish and unpleasant sight and standardize online behaviour.

4. Digital operating platform of ideological and political work of students in computer science major

The combination of BIM modelling technology with numerical simulation can make full use of the modelling accuracy by BIM technology. With numerical simulation, the simulation analysis and forecasting can be made on engineering problems. The numerical simulation and analysis results of BIM model are shown below. (Figure. 3)

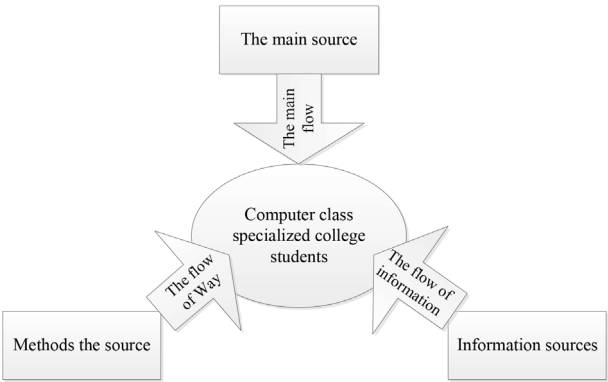


Figure 3 – Computer professional students in colleges and universities education work mode model diagram

A substantial basic working platform is needed to ensure effective operation of working model of college students whose major is computer science of ideological and political working. Therefore, to solid the working basis of students in computer science major, we should actively use subject resources of computer science department to build digital operating platform of ideological and political work of students in computer science major.

Number	Method	Percent
1	Leadership attaches	34
2	teachers troop	38
3	improve conditions	26
4	teaching methods	34
5	Construction of teaching material	24
6	Education technology	25
7	curriculum reform	38
8	Professional support	16
9	others	4

Table 1 – Improve the level of basic computer education measures

This digital operating platform can base on vertical organization level and lateral division of function, which is basically covering all aspects of students’ work.

First, vertically speaking, it should cover every organization in every level from school to class. Laterally speaking, it should cover every function of ideological and political work, including several information warehouse, such as information warehouse of poor students, information warehouse of students with study problems (including students with network addiction), information warehouse of students leader, information warehouse of students party building and so on. Moreover, every information warehouse should be interrelated with each other to have a total knowing of students' basic information and realize the automation and effectiveness of students' information management.

At the same time, the digital operating platform of students' information must be layered and dynamic. The layer means that the digital operating platform of students' information except for overall platform, every class should have their own digital platform of class information. A sounder digital platform will form through connection with each other of digital platform of class information. The dynamic means that the digital platform of students' information is not static, but change with time moving on and the development of everything to form a dynamic digital platform of students' information. Through this digital platform, we can accurately know the students' work, find problems in management timely and increase the effectiveness of ideological and political work of students. The digital platform of students' information is showing in Figure 4.

5. Conclusion

A substantial basic working platform is needed to ensure effective operation of working model of college students whose major is computer science of ideological and political work. Therefore, to solid the working basis of students in computer science major, we should actively use subject resources of computer science department to build digital operating platform of ideological and political work of students in computer science major.

There is contradiction between social need of ability and quality of students whose major is computer science and the actual ability of the students. In a sense, it is a challenge to ideological and political work, but it is also an opportunity to ideological and political work of students. Therefore, on the basis of absorbing essence of traditional ideological and political work, ideological and political work of students whose major is computer science must constantly explore the suitable model of ideological and political work to get the good educational effect and educate qualified talents of computer science suiting the need of society.

The computer science major in college can offer suitable support on technology in building operation platform of students in computer science major of model of ideological and political work. Therefore, we should analyse the unsuitable status of characteristic of students in computer science major and build obvious characteristic of ideological and political education of college students in computer science major through building stereoscopic and multi-demission working platform of ideological and political work.

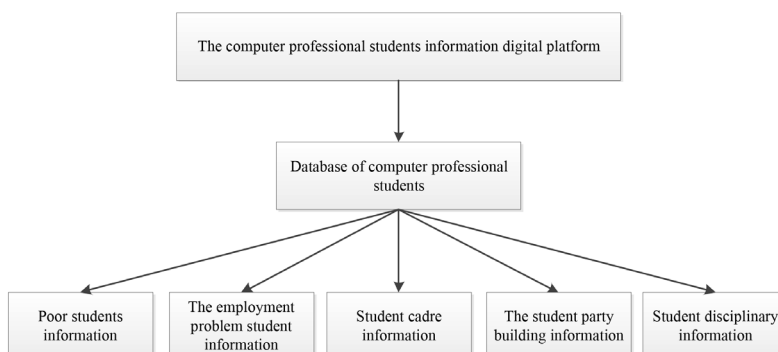


Figure 4 – Student disciplinary information

It is an effective way to do the job of ideological and political work of college students whose major is computer science.

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The Evaluation System of College Students' Occupational Ability Based on DHMM

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Pages: 18–29

Abstract: In order to improve the professional competence of college students, we established a multi-dimensional occupational ability model and a vocational competence evaluation system that was based on sequence clustering and hidden Markov chain theory. Through data mining technology, this paper anticipated the development tendency of vocational capability, which is aimed at providing students with more professional training guidance in terms of vocational ability.

Keywords: college students' vocational ability, sequence clustering, hidden Markov chain, data mining, evaluation system

1. Introduction

In recent years, the expanding enrollment of college students reflects the gradual entrance into a popularization stage of higher education in China. Nevertheless, employment situations remain grim. Employment problems still haunt many students despite the school's efforts to launch career planning courses, to provide more internship opportunities, to cooperate with recruitment units so that organizing job fairs in campus, etc. How to cultivate in-school students' outstanding professional ability as a necessity to cope with grave job-hunting conditions is a subject that we have been studying (Abreu et al. 2015). In this paper, we first established a multi-dimensional occupational ability model and a vocational competence evaluation system. On this platform, we carried out professional competence test on student specimens, and established a professional competence information database before sampling and pre-processing test data. The evaluation system that was based on sequence clustering and hidden Markov chain theory was used in combination with the data mining technology and mathematic statistics to predict the development trend of students' employability (Lino et al., 2016). The analysis also served for the timely provision of cultivation and guidance opinions. Finally, according to analysis results, some employment promotion suggestions were offered in a way that consciously accumulated and took advantage of teaching resources, which enhanced job-seeking ability and views of employment.

2. System design

In this chapter, the author would construct a multidimensional vocational ability model before using it to establish the professional competence evaluation system. With the

hidden Markov model, data parameters were trained and calculated to predict the level of occupational capacity.

2.1. The construction of the index system of college students' occupational ability

2.1.1. Construction of the professional competence model

By investigating general job-related expectations of applicants and referring to related research findings at home and abroad, we summarized the five dimensions of professional competence of university students, including professional ability, interpersonal skills, job-seeking ability, self-development ability and emotional adjustment. Accordingly, we built up the college student professional competence model, with Michigan model as the index integration core. In terms of obtaining research achievements, the Michigan model is different from other models mainly in that it describes the abstraction of skills, abilities and the like with behavioral indicators easy to operate at the educational level.



Figure 1 – The professional competence model of college students

2.1.2. Construction of professional evaluation indices of college students

Through the investigation and analysis of massive employers, we constructed 30 professional evaluation indices of college students based on the Delphi method.

By using SPSS13.0 statistical software, we analyzed these data and calculated the Cronbach Alpha $\alpha = 0.84$. According to de Velis study, the α coefficient is minimum acceptable within the interval of 0.60 ~ 0.70, fairly good in between 0.70~0.80, and excellent between 0.80 and 0.90. Under this standard, the above indicators meet the experimental requirements.

With 10.000 sophomores as the sample space, we collected their scores for the vocational ability tests per week. The samples are in accordance with the research condition,

Item	Score	Standard deviation
To master professional and technical knowledge	4.45	0.263
With strong learning ability	4.45	0.190
Ability for systematic thinking	4.38	0.122
Ability for creative thinking	4.35	0.118
To be effective in developing career	4.35	0.116
To be effective in problem-solving practice	4.30	0.191
To be effective in time management	4.30	0.257
Ability to identify the core contributive factors to success in businesses	4.25	0.147
Ability to express complex thoughts in a useful way	4.23	0.268
Ability for strong self-management	4.21	0.154
Self-confidence	4.21	0.234
Ability for accurate self-evaluation	4.20	0.177
Ability for precise self-recognition	4.19	0.156
Ability for see through behaviors to perceive the essence	4.17	0.543
To be effective in oral communication	4.17	0.183
To be effective in listening	4.17	0.196
Interpersonal skills	4.15	0.285
Ability to influence or negotiate with others	4.15	0.254
Ability for mutual support	4.15	0.214
Easiness of mutual support	4.13	0.256
The ability to focus on key issues	4.13	0.185
Ability to withstand stresses	4.13	0.176
To be honest in treating people and handling matters	4.10	0.225
To be effective in estimating the needs of organizations	4.09	0.198
Ability for quality management	4.09	0.245
To be effective in operation and control	4.05	0.187
Ability to translate visions into actions	4.05	0.152
With strong flexibility	4.04	0.176
To plan career in a targeted manner	4.04	0.106
With a keen eye & hand for opportunities	4.00	0.165

Table 1 – Occupational capacity evaluation indicators of much importance

because the employment choices are imminent and each of their job-hunting indices is entering the mature age. By averaging the scores of a single index, the performance of student specimens in this index is perceivable. For example, we first conducted a survey on the degree to which college students master professional and technical knowledges, and then computed its mean score, so that revealing the specific index level. The general

level, if applied to individual students, facilitates the process of seeking ability gap and directions towards improvement.

A single index was evaluated by its average score A_j , i.e.

$$A_j = \frac{1}{n} \sum_{i=1}^n b_{ij} \quad (1)$$

Where A_j was the score of the j th index, b_{ij} was the i th specimen's score of the j th index, n was the sample size, also known as the total number of survey objects.

On the whole, the mean score of graduates' overall employability is 3.520, which displays the average level (as shown in Figure 2); among them, the ability of emotional adjustment is the strongest and the professional ability is the weakest (as shown in Figure 3).

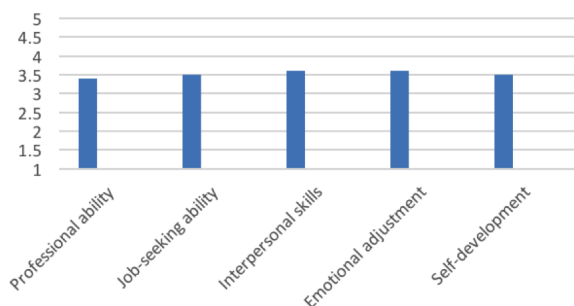


Figure 2 – Assessment of graduates' overall employability

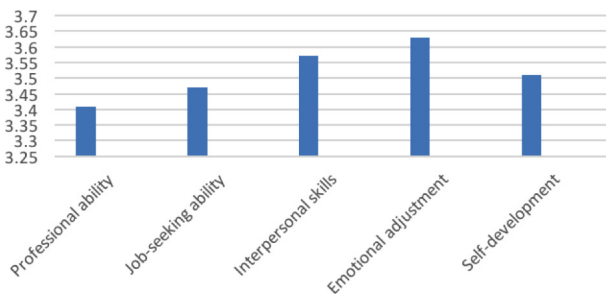


Figure 3 – Classified assessment of graduates' employability

2.2. Sequence clustering of vocational competence of college students

By constructing the index system of college students' vocational ability, the weight of every occupational ability index was determined according to the proportion of scores obtained through the Delphi score method. The weights of "to master professional

and technical knowledge" and "with strong learning ability" were the maximum, being showcased by all previous test results of courses taken. In order for a more accurate assessment on the development level of professional competence of college students, i.e. clustering and analyzing existing data, we introduced the concept of penalty clustering to partition ability development conditions on the foundation of data sequence pattern decomposition.

First, hierarchical states of data sequence pattern were divided with the sequence clustering method. Figure 4 shows the model establishment framework.

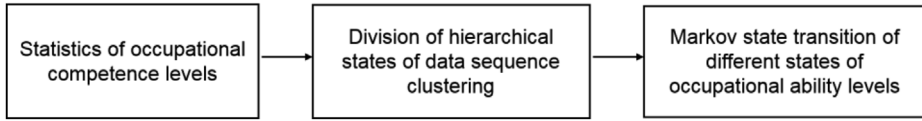


Figure 4 – The basic framework for the assessment of vocational competence of college students

The basic probabilistic framework of the problem was a finite mixed distribution:

$$p(S) = \sum_{j=1}^k p_j(S | \theta_j) w_j \quad (2)$$

Where S denoted a sequence; w_j was the weight of the j th pattern, $p_j(S | \theta_j)$ represented the distribution density of S sequence in the j th sequence pattern, θ_j was the j th pattern. Each pattern displayed a typical ability development state that decides ability development transition and characteristics of each ability core via a hidden Markov chain.

We defined the six prominent types of student samples, i.e. $k = 6$: rising type (s_1), decreasing type (s_2), inverted U type (s_3), jumping type (s_4), stable type (s_5), and U type (s_6).

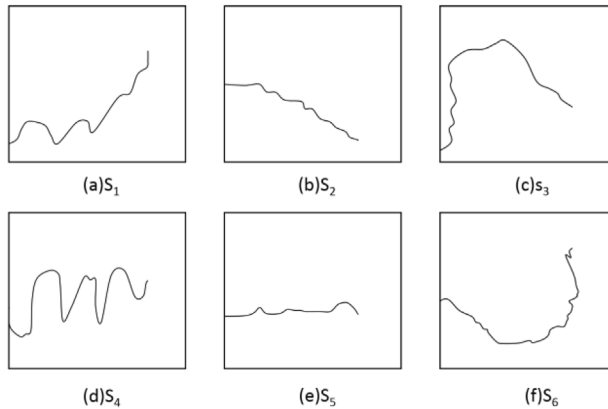


Figure 5 – Schematic diagram of six typical models of vocational competence assessment sequence pattern of college students

S_1 and S_2 feature the respective time-increasing and time-decreasing trends of occupational ability; S_3 is characterized by the n-shaped trend of increasing first and then decreasing, while S_6 witnesses the inverted one; S_4 mainly shows the trait of volatility; S_5 captures the tendency of levelling off. We supposed that there is no interaction between the six sequence states, and thus the core information of θ_j could be represented by a matrix X

$$X = \begin{bmatrix} X_1 & 0 & 0 & 0 & 0 & 0 \\ 0 & X_2 & 0 & 0 & 0 & 0 \\ 0 & 0 & X_3 & 0 & 0 & 0 \\ 0 & 0 & 0 & X_4 & 0 & 0 \\ 0 & 0 & 0 & 0 & X_5 & 0 \\ 0 & 0 & 0 & 0 & 0 & X_6 \end{bmatrix}$$

In which the sub-matrices $X_1, X_2, X_3, X_4, X_5, X_6$ on the diagonal of X displayed six independent hidden Markov chains.

2.3. Consumer behavior anticipation based on hidden Markov chain

2.3.1. Hidden Markov chain and its definition

The hidden Markov chain embraces widespread applicability without overmuch theoretical limitations set on data distribution types. The practice of discrete state space and chain observation broadens research perspectives of sequence data in essence, lifting the utilization rate of sequence information. By constructing reasonable hidden Markov chains, data update in the state can be rendered more prudent, while between-class patterns can be discriminated more sensitively. According to differences between observation probability values and state transition description modes, hidden Markov chains (HMM) can be classified into discrete HMM (DHMM), semi-continuous hidden Markov model (SCHMM) and continuous hidden Markov model (CHMM).

DHMM was used in this paper, written as $\lambda = (S, V, \pi, A, B)$, where the state set $S = (s_1, s_2, \dots, s_i, \dots, s_N)$ consists various state modules, N was the number of states. X represented the random discrete variable in S , also known as the state sequence, among which s_i corresponded to a pattern in the state module. The state transition matrix $A = (a_{ij})_{N \times N}$ was a state-state probability transition matrix that reflected the probability of transition from s_i to s_j , i.e. $a_{ij} = P(X_{t+1} = s_j | X_t = s_i)$, $1 \leq i, j \leq N$, $\sum_{j=1}^N a_{ij} = 1$. $\pi = (\pi_1, \pi_2, \dots, \pi_N)$ was the initial state probability vector, and

$V = (v_1, v_2, \dots, v_M)$ included a variety of observations, M denoted the number of observation. $B = (b_j(v_k))_{N \times M}$ was the conditional probability matrix of observed values in the state j , where $1 \leq j \leq N$, $1 \leq k \leq M$, $b_j(v_k) \geq 0$, $\sum_{k=1}^M b_j(v_k) = 1$.

The basic compositions of vocational ability training of Chinese college students was in balance: for certainty, this school-based ability training mode is supplemented by the self-made selection of campus clubs or positions on a work-study basis; some uncertain factors are family gaps and social conditions. In order to allow for the balanced proportion of classification results, we divided the level of professional competence of college students into four levels: (1) low level, which refers to the professional capacity level lower than 25% of the average; (2) medium low level, which refers to the professional capacity level in between 25%~50% of the average; (3) medium high level, which refers to the professional capacity level between 50% and 80% of the average; (4) high level, which refers to the professional capacity level exceeding 80% of the average. The four levels were composed of four levels of distribution:

A: $Normal(\mu_1, \sigma_1^2)$, $\mu_1 > 0$

B: $Normal(\mu_2, \sigma_2^2)$, $\mu_2 > \mu_1$

C: $Lognormal(\mu_3, \sigma_3^2)$, $\mu_3 > \mu_2$;

D: $Lognormal(\mu_4, \sigma_4^2)$, $\mu_4 > \mu_3$;

A-D reflected the low level, the medium low level, the medium high level and the high level, respectively. According to data distribution characteristics, the logarithmic normal distribution was applied to structural description. The four states can be transformed into each other, as shown in Figure 6.

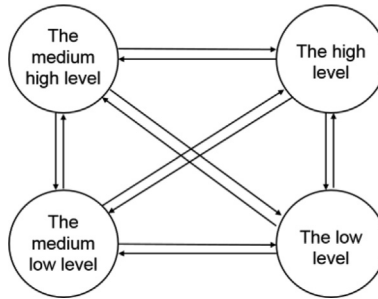


Figure 6 – Transformation between the four states

2.3.2. HMM-based prediction and parameter estimation

We raised hypotheses on the basis of HMM:

$$P(Y | X, \lambda) = \prod_{t=1}^T P(Y_t | X_t, \lambda) \quad (3)$$

Where $P(Y|X, \lambda)$ denoted the probability of the observed sequence to be Y_t at the moment t and the DHMM parameter of λ ; T referred to the total time. The Viterbi algorithm for state estimation was used to calculate λ^* ; With a given observed sequence, the optimal state distribution and its transition law of a state that the most likely matched to the given sequence was found, i.e. finding the optimal λ that let

$$\lambda^* = \arg_{\lambda} \min[\ln(P(Y, X | \lambda))] \quad (4)$$

In which

$$P(Y, X | \lambda) = P(Y | X, \lambda)P(X | \lambda) = \pi(X_1)b_{x_1}(Y_1)a_{x_1x_2}b_{x_2}(Y_2)...a_{x_{T-1}x_T}(Y_T) \quad (5)$$

We let

$$l_t(X_1, X_2, ..., X_t) = -\ln(\pi(X_1)b_{x_1}(Y_1)) + \sum_{i=2}^t \ln(a_{x_{i-1}x_i}b_{x_i}(Y_i)) \quad (6)$$

Such being the case, we took three steps to obtain the optimal route X , for the sake of finding solution to state transition and state observation distribution.

Step 1: initialize $l_t(i)$; for an arbitrary $1 \leq i \leq N$, there is $l_t(i) = -\ln(\pi(X_i)b_{x_i}(Y_i))$.

Step 2: recursively compute $l_t(i)$; for an arbitrary $1 \leq i \leq N$, there is $l_t(i) = \min_{1 \leq j \leq N} [l_{t-1}(j) - \ln(a_{x_jx_i}b_{x_i}(Y_i))]$ from $t=2$ to $t=T$.

Step 3: minimize $\min[l(X)] = \min_{1 \leq j \leq N} [l_T(i)]$ to obtain the optimal route $X = (X_1, X_2, ..., X_T, X_1, X_2, ..., X_T)$.

Afterwards, we adopted the BaumWelch forward-backward method to calculate HMM. Specifically, we decomposed the solutions of state transition and state observation distribution into the forward process α_T and the backward process β_T , which was detailed as

Step 1: $\alpha_T(j) = P(Y^{(t)}, X_t = j | \lambda)$, which is, for a given pattern parameter λ , the probability to be simultaneously under state j and with the observed sequence of $Y_1, Y_2, ..., Y_t$ at the moment t . The probability is estimated by using the iterative method below:

$$\begin{cases} \alpha_t(j) = \sum_{i=1}^N [\alpha_{t-1}(i)a_{ij}]b_j(Y_t) \\ \alpha_t(j) = P(Y_1, X_t = j) = \pi_j b_j(Y_1) \end{cases} \quad (7)$$

Step 2: to find solutions with the use of the iterative method below:

$$\beta_T(i) = P(Y_{t+1}, Y_{t+2}, ..., Y_T | X_{t=i}, \lambda) \quad (8)$$

$$\begin{cases} \beta_t(i) = \sum_{j=1}^N \beta_{t+1}(j) \cdot a_{ij} \cdot b_j(Y_{t+1}) \\ \beta_T(i) = 1; 1 \leq i \\ P(Y_1, Y_2, \dots, Y_T | \lambda) = \sum_{i=1}^N \pi_i b_i(Y_1) \beta_1(i) \end{cases} \quad (9)$$

Where $\beta_t(i)$ was, for the given pattern parameter λ , the probability to be simultaneously under state j and with the observed sequence of $Y_1, Y_2, \dots, Y_t$ at the moment t .

Step 3: according to the observed $Y_1, Y_2, \dots, Y_T$ and the transition structure λ , the transition probability from state I at the moment t to state j at the moment $t+1$ is calculated as

$$\xi_t(i, j) = P(X_t = i, X_{t+1} = j | Y_1, Y_2, \dots, Y_T, \lambda) = \frac{\alpha_t(i) a_{ij} b_j(Y_{t+1}) \beta_{t+1}(j)}{P(Y_1, Y_2, \dots, Y_T | \lambda)} \quad (10)$$

Similarly, according to the observed $Y_1, Y_2, \dots, Y_T$ and the transition structure λ , the probability $\gamma_t(i)$ of the state I at the moment t is

$$\gamma_t(i) = P(X_t = i | Y_1, Y_2, \dots, Y_T, \lambda) = \frac{\alpha_t(i) \beta_t(i)}{P(Y_1, Y_2, \dots, Y_T | \lambda)} \quad (11)$$

Step 4: find solutions to π_i , a_{ij} and $b_j(k)$: a_{ij} and $b_j(k)$:

$$\hat{\pi}_i = \gamma_1(i) \quad (12)$$

$$\hat{a}_{ij} = \sum_{t=1}^{T-1} \xi_t(i, j) / \sum_{t=1}^{T-1} \gamma_t(i) \quad (13)$$

$$\hat{b}_j(k) = \sum_{t=1, Y_t=v_k}^T \gamma_t(j) / \sum_{t=1}^T \gamma_t(j) \quad (14)$$

Where $\gamma_1(i)$ was the expected frequency of states when $t=1$, the numerator of $\hat{a}_{ij}$ was the expected steps for transformation from state I to state j , the denominator of $\hat{a}_{ij}$ denoted the expected number of transition with the state I as the starting point, the numerator of $\hat{b}_j(k)$ represented the expected time required for discovering v_k in state j , and the denominator of $\hat{b}_j(k)$ referred to the expected route with the state I as the starting point.

3. Data analysis

By testing the professional ability indices of 10,000 sophomores, we observed the changes of their ability index sequences and listed them in Table 2 as follows.

Occupational ability level	Rising type (s_1), n=2256				Decreasing type (s_2), n=824			
	Low	Medium low	Medium high	High	Low	Medium low	Medium high	High
Low	0.45	0.28	0.17	0.10	0.62	0.28	0.09	0.01
Medium low	0.17	0.18	0.22	0.43	0.36	0.49	0.12	0.03
Medium high	0.08	0.24	0.37	0.31	0.27	0.35	0.38	0.00
High	0.02	0.21	0.41	0.36	0.05	0.27	0.33	0.35

Occupational ability level	Inverted U type (s_3), n=329				Jumping type (s_4), n=1407			
	Low	Medium low	Medium high	High	Low	Medium low	Medium high	High
Low	0.25	0.41	0.33	0.01	0.26	0.34	0.35	0.05
Medium low	0.32	0.21	0.37	0.10	0.29	0.28	0.32	0.11
Medium high	0.28	0.33	0.18	0.21	0.19	0.32	0.16	0.33
High	0.05	0.16	0.44	0.35	0.12	0.17	0.37	0.34

Occupational ability level	Stable type (s_5), n=4503				U type (s_6), n=98			
	Low	Medium low	Medium high	High	Low	Medium low	Medium high	High
Low	0.02	0.02	0.01	0.01	0.43	0.34	0.22	0.01
Medium low	0.17	0.71	0.12	0.00	0.25	0.36	0.28	0.11
Medium high	0.01	0.03	0.85	0.11	0.29	0.48	0.19	0.04
High	0.02	0.02	0.14	0.82	0.10	0.28	0.39	0.23

Table 2 – The HMM transition matrix of professional ability indices of 10,000 sophomores

The above data reflects several characteristics of vocational capacity development of several college students:

1. Both the transition matrix and the state transition of HMM chains vary greatly in different development tendencies or sequences.
2. Different sequence patterns have different effects on state transition of college students' professional competence. According to sequence proportion constitutions, the major states in the data are the stable type and the inverted U type, which occupies around 71.8% of the whole data, with 47.8% memory consumers and 24% growth consumers. This phenomenon fully reveals the mainstream feature of occupational ability training of sophomores as stably increasing type and stable type. That students in the rising type present the absorptive state of medium high level and high level, is a full reflection of the school's provision of plentiful powerful support in helping students to raise professional ability levels.
3. The jumping type accounts for 15% of the total data volume. Student specimens with high level of professional ability have better chances of turning to medium

high level. Such being the case, the university should, as soon as possible, remind those of downward occupational levels to maintain their own edges and to strive for upstream performance.

4. The proportion of the inverted U type is 1%. There is great potential for groups of medium-high-level vocational ability to gain high-level capabilities. Universities should target their efforts of development and cultivation at the students' potential fields.
5. The proportion of the decreasing type and the inverted U type is 8.7%. Among them, the probability to lower down from high level to medium high level is 35%, while the one from medium high level to levels below may exceed 60%. We suggest that the universities should be sensitive to and timely eliminate the causes to such setbacks as well as urging students to improve their professional levels.

4. Conclusion

Through the establishment of occupational competency model and its evaluation index, we design the DHMM-based evaluation system of college students' professional competence. This system provides multi-facet technical guidance for vocational education of college students, and broadens the mind of cultivation. It also serves as preventive measures which guard the university against negative acceptance of employment rates. Meanwhile, in terms of campus students, the research results help them analyze the all-around advantages and disadvantages of professional ability. With these analyses, students are expected to not only accentuate strengths and bypass weaknesses, but also find their own development paths.

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The Personalization Willingness Paradox: An Empirical Evaluation of Sharing Information and Prospective Benefit of Online Consumers

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Abstract: Online enterprises today use information about customers to improve service and design personalized offerings. To do this successfully, however, enterprises must collect consumer information. We examine the relationship between prospective benefit and consumer willingness to share information for online personalization. Based on a survey of over 800 online consumers, we examine the question of whether customer perceived information valuable is associated with consumer willingness to be profiled online. Our results indicate that customers who desire greater profits will have a greater level of trust, and then more willing to be profiled. This result poses a dilemma for firms, is the bought information accurate and reliable? In order to manage this dilemma, we suggest that enterprises build trust for the core values and knowledge management systems that address the needs of consumers, and adopt a strategy of providing personalization features accepting that the privacy sensitive minority of consumers.

Keywords: information sharing, online privacy, trust, online personalization

1. Introduction

Organizations need complete and accurate data in order to respond to their customers' needs. One important source of data is consumers themselves. However, consumers typically react negatively to being profiled (especially if without their permission) and to having their data used in other unanticipated ways. Culnan & Armstrong (1999) demonstrated that, companies depend on vast quantities of information to build rapport with existing customers and attract new business in order to survive.

On the other hand, online consumers will evaluate the risk of providing personal information besides the trust on enterprises. Stone and Stone (1990) considered that consumers would focus on whether the information can be fair use and then suffer some negative consequences. Online consumers consider the personal information collection as an investment, and in return they hope to gain some benefits.

2. Theoretical framework

2.1. Trust

Trust has been defined as “confidence in a person or thing because of the qualities one perceives” in New Webster’s Dictionary. In the latter literature, the definition has been taken a step further. Mayer (1995) proposed a widely accepted concept of trust. McKnight (2002) was consistent with the Mayer’s theory, and trust is broken down and measured along three dimensions: ability, benevolence and integrity. Greater levels of trust often lead to greater margins, more sales, and higher profits; these are crucial for the survival and prosperity of online business.

In this study, trust in e-commerce refers to the willingness of a party trust another party, including its ability, benevolence and integrity, and inclination of sharing information or part of the privacy with the other party, in the uncertainty (or risky) environment.

2.2. Privacy

“Privacy” was first used in a famous paper Right of Privacy published by American jurist Louis Brandeis and Samore Warren in 1890. They specifically targeted at the phenomenon that the media invaded people’s private lives at every turn, and considered individuals should have the right to be let alone, that is the privacy. It has become a recognized independent personality even now.

The privacy of e-commerce customers is the legitimate rights of private information, including right to contacts, modify, delete, and dissent. Based on the privacy literature, Phelps et al. (2000) suggested that most of the individual-specific consumer information used for marketing purposes fell into the five broad categories of demographic characteristics, lifestyle characteristics (including media habits), shopping/purchasing habits, financial data, and personal identifiers (e.g., names, addresses, social security numbers).

In this study, the willingness of sharing information refers that online consumers are willing to disclose their privacy to the enterprise, and agree that the information is used knowingly and reasonably.

3. Research model

Consumer willingness to share information online involves evaluating the outcome of online profiling. Hence, consumers must determine the degree to which they will allow online profiling. A classic framework used to understand this consumer decision, from an economic perspective, is utility maximization theory. In previous research, utility maximization applied to examine the market for consumer privacy by Rust et al. (2002).

However, other online privacy researchers have pointed out the shortcomings of utility maximization theory. For example, the theory postulates the consumer’s goal of maximizing personal economic utility; however, Hoffman et al. (1999) believes that consumers tend not to make a financial cost-benefit analysis of social contracts with unpredictable outcomes.

Despite acknowledged theoretical weaknesses, Milne and Gordon (1993) suggested that while consumers do not compute an exact cost-benefit analysis for each information exchange, they do weigh the involved tradeoff. This tradeoff has been directly studied offline as the privacy calculus, which measures the usage of personal information against the potential negative consequences of disseminating personal information. This study examines this specific trade-off that consumers make in the online setting as we draw upon utility maximization theory to examine this apparent tradeoff.

The consumer's utility function is the following:

$$U(X) = \text{Benefit} - \text{Cost} \quad (1)$$

Where Benefit is derived through the degree of personalization received and Cost is a function of consumer privacy concerns, previous privacy invasion experience, and privacy policies. Thus, we propose an implicit cost function as follows:

$$\text{Cost} = f(\text{consumer privacy concern, previous privacy invasion, consumer-rated importance of privacy policies}) \quad (2)$$

We control for consumer online shopping habits, including frequency, transaction and demographic variables, when testing this model, as it is likely that the effects positing in the model may vary with certain habits variables. Thus, overall the net utility is based on the individual elements of the cost function.

This study focuses on whether prospective return has an effect on consumer willingness to share information. The overall research model for this paper is illustrated in Figure 1.

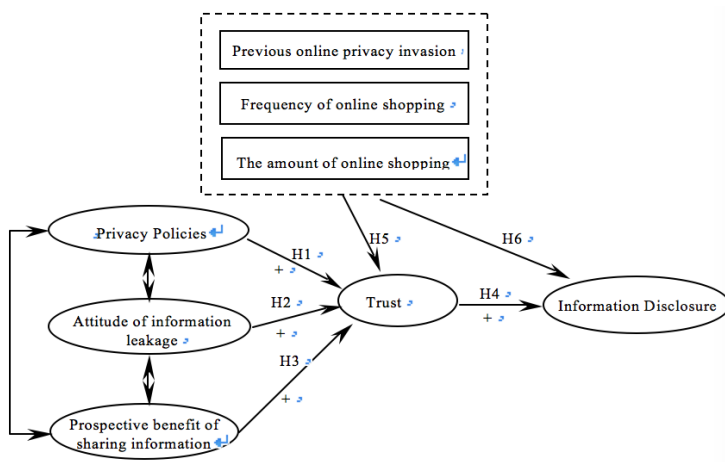


Figure 1 – Hypothesis model

Privacy Policy of enterprises is the online consumer perceived privacy protection to the website of the relevant personal information, including how to use the consumer information and the perception of website security measures. Meinert et al. (2006) showed that privacy notice provided more protection and consumers more trust website. And then they are more willing to provide the required personal information to enterprises. Therefore we put forward the following hypothesis:

H1: Perceived more perfect privacy protection policy, online consumers will be more confidence in the enterprise

Most of the privacy disclosure risk comes from the leakage of personal identity information (phone number, identity card number, credit card and bank account number, etc.) (SOHU IT, 2009). The online consumers' attitudes towards risk determine their willingness to share personal information. Consumers' attitudes for different risk may affect their trust. In the premise of the same risk, risk-preference consumers are more likely to conduct online transactions than risk-averse consumers. In order to test the relationship between them, we put forward the following hypothesis:

H2: Customers who perceive themselves as having positive attitude treating the risk of information leakage with an organization will have a greater level of trust in the organization

Social exchange theory suggests that consumers perceived their information valuable for online enterprises (Hoffman et al., 1999). The information exchange should be compensated for consumers, and they may be willing to share more personal information in order to get more profits in the future exchange. If this exchange has occurred many times, the consumers received the benefits outweigh the possible loss, and then they will increase the trust on enterprises. Therefore we put forward the following hypothesis:

H3: Customers who received more profits from sharing personal information will have a greater level of trust in the organization

Trust is a complex variable, this study concentrates that the trust relations between consumers and specific web sites in the transaction process. The consumers would have more confidence in the enterprises if enterprises strictly enforce privacy statement, furnish shopping services and delivery services, and adjustment strategy and website design for consumer satisfaction, and thus are willing to provide more detailed and accurate information to the enterprises. This leads us to the formulation of the following hypothesis:

H4: Greater levels of trust will lead to more information disclosure

Bottom (1990) found that the building trust was priori, in other words, different people perceived differently faced with the same trust situation. This trust depended on the previous decisions, and consumers used their own experiences to update the relevant information to change the perception of trust, and guide their future selections. There are many behavioral variables affecting consumers' shopping experience. This study selects the past experience of the information disclosure, frequency of online shopping and amount of online shopping as control variables of the model, and verifies the

relationship between trust and information disclosure, then puts forward the following hypothesis:

H5a: Customers who have more previous online privacy invasion will have a lower level of trust

H5b: Customers who have higher frequency of online shopping will have a greater level of trust

H5c: Customers who have higher transaction amount will have a greater level of trust

H6a: Customers who have more previous online privacy invasion will lead to less information disclosure

H6b: Customers who have higher frequency of online shopping will lead to more information disclosure

H6c: Customers who have higher transaction amount will lead to more information disclosure

It is noted that the above three variables may play a role independently, or an interaction as well, and then we will examine their combined effect.

4. Data collection

4.1. Samples selection and data collection

In order to conduct in-depth research, we adopt the questionnaire survey, which is separated into three parts. The first one is about respondents' B2C business familiarity degree. The second part consists with a seven-point Likert scale, ranging from strongly disagree (0) to strongly agree (6), for a particular and most familiar B2C business of respondents. The last part is the personal information and their attitude toward risk. The enterprises involved in the questionnaire are carefully selected. We considered several factors, including market share, popularity among online consumers, specialization degree, and customer service efficiency. Also most of the issues in the second part are from related literature, as in ZHAO et al. (2012), Joseph et al. (2007) and Awad et al. (2006).

Considering occupational structure of online customers, we sent 900 questionnaires to help complete this survey got by paper questionnaires and network survey. Finally, we receive 821 valid questionnaires.

4.2. Descriptive analysis

By descriptive analysis, we get lifestyle statistics purchasing habits and of samples, including frequency of online shopping, online buying-propensity, and attitude toward risk and so on.

		Frequency	Percent
The Frequency of online shopping per week (Last 3 months)	Never	123	15.0
	1	509	62.0
	2	132	16.1
	3	36	4.4
	4	18	2.2
	5	3	0.4
	>6	0	0
The time for searching online shopping information per week (Last 3 months)	<30min	301	36.7
	30min–one hour	192	23.4
	one-two hour	124	15.1
	Two- three hour	88	10.7
	Three- four hour	77	9.4
	Four-five hour	28	3.4
	>Six hour	11	1.3
Are there going to unknown information disclosure?	Yes	111	13.5
	No	247	30.1
	Not necessarily	463	56.4
Are you willing to fill out personal information before shopping or registered?	Very Strongly Disagree	65	7.9
	Strongly Disagree	101	12.3
	Disagree	361	44.0
	Neither Agree nor Disagree	225	27.4
	Agree	40	4.9
	Strongly Agree	29	3.5
	Very Strongly Agree	0	0
Will you search related online information before going shopping?	Very Strongly Disagree	1	0.1
	Strongly Disagree	76	9.3
	Disagree	108	13.2
	Neither Agree nor Disagree	141	17.2
	Agree	261	31.8
	Strongly Agree	190	23.1
	Very Strongly Agree	44	5.4
Which one is most familiar B2C website with you?	Amazon(www.amazon.cn)	112	13.6
	Dangdang.com	107	13.0
	ShangPin.com(www.shangpin.com)	4	0.5
	360buy(www.360buy.com)	154	18.8
	The brands direct sales website (i.e. SuNing Tesco, Gome, and so on)	69	8.4
	VANCL (www.vancl.com)	139	16.9
	Tmall (Taobao B2C business-specific and www.tmall.com)	197	24.0
	M18 (www.m18.com)	19	2.3
	Other	20	2.4

Do you easily trust others?	Very Strongly Disagree	41	5.0
	Strongly Disagree	124	15.1
	Disagree	191	23.3
	Neither Agree nor Disagree	265	32.3
	Agree	129	15.7
	Strongly Agree	63	7.7
	Very Strongly Agree	8	1.0
Are you a risk-averse person?	Very Strongly Disagree	11	1.3
	Strongly Disagree	30	3.7
	Disagree	75	9.1
	Neither Agree nor Disagree	281	34.2
	Agree	232	28.3
	Strongly Agree	172	21.0
	Very Strongly Agree	20	2.4

Table 1 – Samples’ descriptive statistics

Table 1 shows the results of online shopping time and shopping habits of all the respondents. We can see that length of surfing the Net of 80% of them is more than four years. In this study, online consumers of longer net age have more stable shopping habits and prominent shopping preferences. During the investigation, the average of online ordered is one times weekly (62% of respondents), and 75% of them spend at least 0~2 hours every week in searching related online information. The samples of this survey are frequent and stable on online shopping behavior, and thus the results could be basic for in-depth study.

About 70% of the respondents will search related online information before going shopping, this phenomenon indicates that most consumers could get the information they want to know from the internet, and they are willing to adopt this information to guide their purchases. The investigation of “unknown information disclosure”, half of them said “Not necessarily” or “do not know”. Only about 35% of the samples were willing to fill out some or all of their own personal information in the registration or before shopping. China online consumers for personal information protection degree are high, and most of them will pay more attention to the privacy disclosure risk due to unaware information disclosure.

Table1 also shows the respondents’ attitudes towards trust and risk particularly. The results demonstrate that most respondents do not easily trust others, and they are risk –averse. That is, they will make a decision that could reduce their actual and potential loss.

According to the China Electronic Commerce Research Center (2010), the top five distribution of e-business industry include textiles and clothing (12.20%), digital products (10.30%), packaging and printing products (4.89%), Food (4.38%), Gift and trinkets (3.56%). And so in the later comparison and analysis, we selected three online companies of Tmall, 360buy and Vancel as typical enterprises to do in-depth research.

5. Results and discussion

Scales were subjected to factor analysis for validation. As shown in Table 2, the selected variables load on distinct latent factors.

Latent Factor	ID	Description	1	2	3	4	5
Policy	P1	Confidentiality or security agreement will be carefully read before I registered the site	0.127	-0.039	0.081	0.661	0.299
	P2	My shopping experience and habits are willing to be tracked and analyzed by website	0.107	0.295	0.111	0.742	-0.116
	P3	I believe that registered personal information will not be leaked or misuse by the website	0.391	0.342	0.135	0.550	-0.016
Attitude	AT1	I am willing to fill out the partial or complete personal information before registration or shopping	0.082	-0.154	0.028	0.025	0.338
	AT2	If information was leaked or gained by bad attempt, I would get loss or injury seriously	0.106	0.098	0.036	0.022	0.831
	AT3	I am worried that the site had collected too much information, and might misuse or put to an unknown purpose	0.132	-0.053	0.160	0.087	0.785
Benefit	BE1	I will select the website because of virtual incentive measures, i.e. credits	0.048	0.217	0.686	0.292	-0.032
	BE2	I will be attracted by the site 's promotional strategies and then make a purchase decision	0.228	0.202	0.778	-0.036	0.118
	BE3	I will buy the other commodities on the website because of free gifts or trial products	0.092	0.093	0.813	0.184	0.050
	BE4	I will purchase goods on the site due to the discount or monetary incentive	0.278	0.100	0.785	0.009	0.074
	BE5	I will always choose the site due to the delivery service and returns terms provided by the website	0.426	0.118	0.506	-0.086	0.138

Latent Factor	ID	Description	1	2	3	4	5
Trust	T1	This organization is trustworthy	0.833	0.122	0.150	0.035	0.064
	T2	The professional services and business philosophy of this organization have won my trust	0.803	0.104	0.195	0.107	0.063
	T3	Browsing and shopping at this site is really pleasant and assuring	0.766	0.122	0.121	0.104	0.083
	T4	The service and customer privacy disclosure of this organization is trustworthy	0.798	0.178	0.150	0.141	0.057
	T5	The network security measures of this organization can be trusted	0.789	0.207	0.147	0.136	0.070
Information Disclosure	INF1	I would give this organization my full name when I register	0.068	0.682	0.131	0.260	-0.011
	INF2	I would give this organization my email address and permission to send updates about important issues	0.165	0.595	0.090	-0.061	0.114
	INF3	I would give this organization my address and permission to send me updates about important issues	0.179	0.754	0.131	0.094	0.006
	INF4	I would give this organization my cell phone number and permission to contact me about important issues	0.163	0.812	0.142	0.018	0.107
	INF5	I would give this organization my telephone number (e.g. home or office phone number) and permission to contact me about important issues	0.043	0.768	0.148	0.218	0.044

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization
 The bold data have relatively higher loadings and hence are selected for each latent factor.

Table 2 – Variable definitions and Rotated factor matrix for all data

It is interesting to note that the five questions loading on the latent construct of information disclosure are all related to contact information, which is potentially the most valuable information to companies.

To further confirm the reliability of the scales, we also compute and present the Cronbach alpha coefficients in Table 3. It is recommended that the acceptable reliability for the Cronbach alpha coefficient be 0.70 or greater (Peterson, 1994).

Construct	Variables	No. of cases	Cronbach's α
Policy	P1, P2	821	0.668
Attitude	AT2, AT3	821	0.675
Benefit	BE1, BE2, BE3, BE4	821	0.829
Trust	T1, T2, T3, T4, T5	821	0.896
Information Disclosure	INF1, INF2, INF3, INF4, INF5	821	0.816
Total		821	0.856

Table 3 – Cronbach alpha coefficient

In our case, most coefficients are greater than 0.70 in additions to Policy and Attitude factor, basically indicating the consistency and reliability of our variables and constructs. Let's look at these two factors. Their Cronbach alpha coefficient is lower than 0.70, indicating that there are some differences between the scale design elements and the views of respondents. Variable "P2" is "My shopping experience and habits are willing to be tracked and analyzed by website", and Variable "AT1" is "I am willing to fill out the partial or complete personal information before registration or shopping", and according to the results of Table 4, their mean are lower. And thus it just reflects the online consumers' willingness to share information for shopping, their preferences and personal information. These variables are the sensitive part of personal information precisely. The lower Cronbach alpha shows that their willingness to sharing information is very different. However, we believe that how to meet the needs of different consumers, which will become an important issue for online enterprises in the future.

Table 4 presents the descriptive statistics for all data and for three enterprises need to study (Tmall, 360buy and Vanc1). Tmall is the representatives of large market share, high profile but consumers are not very stable. Vanc1 and 360buy are the representatives of good reputation and word of mouth and relatively fixed followers. All data are based on a 0 to 6 point Likert scale. For the sample size of three typical enterprises is different, it is difficult to get a precise conclusion through mean and standard deviation. But on the whole, the results of this experiment show a lower degree of dispersion, and greater than 3 indicate that the attitude of respondents is basically agreement. Therefore, this investigation has some practical significance and research values.

A necessary, but not sufficient condition for obtaining significant coefficients in Structural Equation Modeling is that there is variability in the latent constructs. This can be concluded through the standard deviations indicators of Table 4.

And Table 4 leads one to believe that there would be substantial variability in the Policy, Attitude or Benefit and trust constructs for Vanc1, but there probably would not be substantial variability in the Information Disclosure construct or Benefit constructs for Tmall and 360buy. This explains the results in Table 5.

Figure2 shows the operating results for Tmall of the structural equation. The Policy and Information Disclosure factor dispersion vary greatly in the Tmall data, which means that consumers in the related items in the scale scores were different. The lowest

Variables	Aggregate data		Tmall		360buy		Vancel	
	Mean	Std. deviation	Mean	Std. deviation	Mean	Std. deviation	Mean	Std. deviation
P1	3.36	1.65	3.43	1.70	3.50	1.57	3.35	1.56
P2	2.57	1.60	2.40	1.57	2.93	1.49	2.71	1.63
P3	3.16	1.27	3.08	1.31	3.45	1.14	3.04	1.35
AT1	2.20	1.09	2.06	1.14	2.34	1.08	2.19	1.02
AT2	4.19	1.51	4.19	1.55	4.18	1.32	4.08	1.66
AT3	4.00	1.34	4.02	1.32	3.99	1.26	4.13	1.35
BE1	3.08	1.33	3.09	1.24	3.23	1.40	3.00	1.33
BE2	3.74	1.15	3.69	1.16	3.82	1.11	3.73	1.18
BE3	3.38	1.22	3.44	1.22	3.49	1.25	3.46	1.23
BE4	3.77	1.17	3.68	1.26	3.81	1.16	3.88	1.15
BE5	3.95	1.11	3.81	1.15	4.06	1.04	4.04	1.09
T1	4.01	1.01	3.87	1.03	4.09	0.96	4.08	0.93
T2	3.90	1.01	3.86	1.04	3.92	0.91	4.01	0.98
T3	4.06	1.02	3.93	0.99	4.01	0.96	4.24	0.99
T4	3.74	1.01	3.61	1.02	3.92	0.96	3.78	0.94
T5	3.82	1.00	3.70	0.96	3.93	0.94	3.85	1.03
INF1	2.83	1.60	2.68	1.59	3.18	1.50	2.63	1.67
INF2	3.86	1.58	3.69	1.23	4.18	2.58	3.76	1.26
INF3	3.22	1.47	3.18	1.46	3.39	1.39	3.17	1.41
INF4	3.30	1.43	3.13	1.53	3.51	1.36	3.26	1.34
INF5	2.76	1.47	2.65	1.52	2.92	1.42	2.80	1.45
	N=821		N=197		N=154		N=139	

Table 4 – Descriptive Statistics

mean item is AT1, which imply that most consumers' willingness to fill in the personal information is very low, just because of the need of registration requirements or delivery service. And thus voluntary sharing information and helping enterprises improve the personalized service are difficult and improbable.

The same results as Tmall appear in 360buy (Fig.3) also. Even INF2 (I would give this organization my email address and permission to send updates about important issues) is the largest standard deviation, which is 2.58 on all the data. It is thus clear that

Hypothesis	Aggregate data		Tmall		360buy		Vanc1	
	Effect	supp	Effect	supp	Effect	supp	Effect	Supp
H1: Privacy Policies on trust On	0.35	Yes	-	-	0.26	Yes	-	-
H2: Attitude of information leakage on trust	0.11	Yes	0.24	Yes	-	-	-	-
H3: Prospective benefit on trust	0.28	Yes	0.35	Yes	0.27	Yes	-	-
H4: Trust on Information Disclosure	0.52	Yes	0.62	Yes	0.41	Yes	0.83	Yes-
Total effect for H1= sum of component effects; “-” represents that results are not significant.								

Table 5 – Hypothesis results summary

online consumers have begun to pay attention to e-mail security and filtering under the influence of marketing and personalized advertising.

Risk and return of personal information disclosure are out of step with trust in Vanc1 case. In other words, consumers are not concerned about the privacy statement of Vanc1, and subsequent effects are not sensitive and careful after sharing information with Vanc1. If they are willing to fill in personal information, consumers just consider the comprehensive “trust” factor (as shown in the result of Fig.4). The entire results have a direct relationship with the marketing strategy of Vanc1.

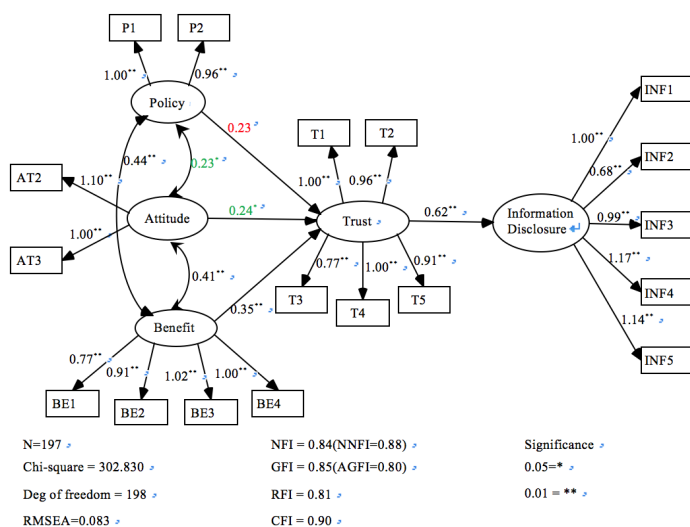


Figure 2 – Results for Tmall

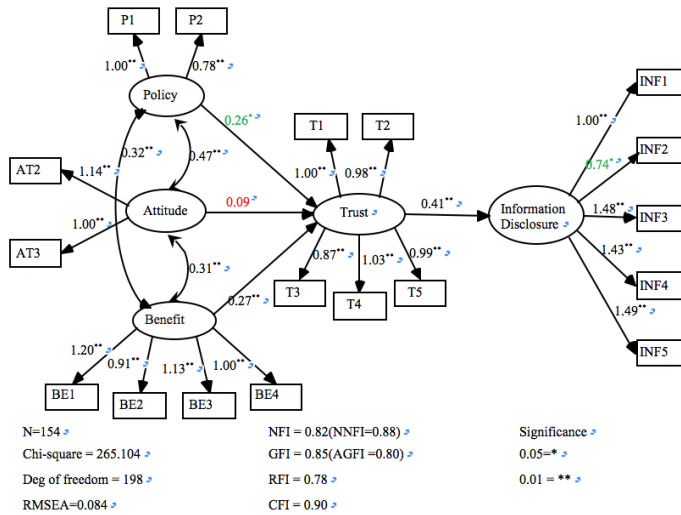


Figure 3 – Results for 360buy

Only one hypothesis does not pass the test in Tmall and 360buy cases, by contrast, only one hypothesis (H4) is supported in Vancle case. This phenomenon indicates that a network bubble is really existed along with fast-growing ecommerce economic. Online consumers are attracted by promotion and sensory stimulation by the websites. When the new marketing concept was coming up, non-substitutability of sites would be reduced, and then the transition from the old to the new would be intensified.

In addition, we estimated the role of individual factors and their interactions affect of consumer online shopping habits, then considered the frequency and amount of online shopping and previous experience online privacy invasion as control variables finally. Further, the full details of these questionnaire items are “a02: Frequency of online shopping per week in last 3 months”, “a03: The time for searching online shopping information per week in last 3 months”, “a06: Are there going to unknown information disclosure?”, “a09: bad experience after disclosing personal information to the website” and “a65: Amount for online shopping per month in last 3 months”. The obtained results show that the combined control variables have significant influence for building trust and sharing information, such as “a09*a65” and “a06 * a65 * a03” support H5, and “a02*a06*a09*a65” supports H6. But the independent effects of each factor (i.e. only a02) didn’t pass the test. The conclusion shows that the composite background characteristics of online consumers are why they ordered at a fixed site, thereby established trust and shared information.

6. Conclusions, limitations and future research

This research demonstrates that the influence of prospective benefit cannot be ignored with the approach of questionnaire while online consumers build trust and share

information. The survey results show that the shopping habits of online consumers have gradually become mature and stable from the behavior searching shopping information and the average frequency of shopping. More than 70% of respondents will search related online information before going shopping, and nearly 20% of them are willing to share the information to the favorite and trusted sites, in contrast, only about 3% of them are not willing to fill in personal information. On the other hand, over 75% of consumers considered that website would disclosure or misuse their personal information, and only about 10% of them said that they would help to improve the accuracy of personalized service. This is a strong contrast to remind the enterprises and relevant departments. They should pay attention to cultivating consumer trust emotions and strengthening privacy protection.

The analysis of self-perception and risk-sensitive of online consumers seals that most of them do not easily trust enterprises, and then sensitive information (such as name, phone number) is protected consumingly. Most respondents are risk-averse, and they would choose to reduce the actual and potential loss of their strategy. This conclusion suggests that sharing information voluntarily is both difficult and important.

The consumers and the enterprises are an inseparable and interactive whole in B2C E-business. Online consumers identify with the core value concept, political view and moral standards of enterprises in China (ZHAO et al., 2012). Influenced by marketing strategy and reciprocity policy, consumers will balance the risks and benefits of sharing information from the angle of the utility maximization. Having consumers who are willing to share private personal information is very crucial to companies that are trying to build reliable knowledge bases about their customers and in order to deploy knowledge management systems. An increase in willingness to share can lead to information that is more accurate, increasing the chances of a successful deployment of secure knowledge management systems by reducing the risk of gathering falsified or misleading data.

Another related danger is the commoditization of values and information, pre-packaged and sold with clever marketing gimmicks and no real substance. Information commercialization will bring both consumers and companies to short-term gains, and this behavior does not actively promote for long-term development. Sharing information should have grown healthily and sustained stably combining with trust. And thus they would become an important basis for both consumers and businesses.

Acknowledgements

This research was supported by the National Natural Science Foundation of China under Grant 71271207, and Statistical Research and Key Research Project in Shandong Province of 2012, NO. KT12040.

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A Formal Model of Events Reconstruction for Cloud Forensics

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Abstract: Cloud computing is increasingly gaining attention and rising in in popularity. However, in the early development of cloud computing, cloud forensics lacks a standard practice, which in turn allows a criminal activity to go undetected. To alleviate this situation, this paper proposes a formal model based on timed automata (TA) for reconstructing the system under investigation. Firstly, we briefly illustrate the concept of trusted cloud digital forensics and TA. We then describe the behavior process model and processes composition model in the cloud environment using TA in detail. Finally, a process refinement algorithm is used to find the digital evidence by detecting the illegal actions or incorrect interaction during the composition.

Keywords: Cloud Forensics, Timed Automata, Digital Evidence, Process Model.

1. Introduction

With the development of computing networks, people are paying increasing attention to the electronic criminal activities. Scientific methods and techniques, known as digital forensics, must be applied in investigations where these crimes have occurred. Cloud digital forensics (Ruan et al, 2011) is digital forensics applied on cloud computing that focuses on maximizing the effectiveness of the shared resources. A cloud consists of multiple computer nodes, which means that cloud forensics contains both computer digital forensics and network digital forensics, which complicates the digital forensic investigation process (Kohn et al, 2013). In order to solve this problem, formal methods are needed to reconstruct the complex processes formed on a cloud to analyze the investigation of evidence advantageously.

This paper, therefore, proposes an extensible semantic model for the dynamic behavior of cloud digital forensics. The remainder of the paper is organized as follows. Firstly, brief introduction is given to the concept of trusted cloud digital forensics and timed automata. Secondly, we discuss the details of modeling the cloud forensics behavior

process is discussed, and its reconstruction is analyzed using timed automata (TA) (Larsen et al, 1997). Lastly is the paper's conclusion.

2. Overview

2.1. Cloud computing

Cloud computing is a model for enabling ubiquitous and continuous network access to a shared pool of configurable computing resources, comprised of massive amounts and various types of computing resources, virtual machine monitors, and data. Cloud computing and storage solutions provide users with various capabilities to store and process their data in third-party data centers. It relies on the sharing of resources to achieve coherence and economies of scale, similar to a utility, such as the electricity grid, over a network. At the foundation of cloud computing is the broader concept of converged infrastructure and shared distributed services. It generates a substantial amount of data every day. Moreover, applications used by enterprises such as e-mail, the World Wide Web and some other online services increasingly require high-performance for data querying and processing.

2.2. Trusted cloud digital forensics

Trusted computing is a recent industry initiative that aims to implement the root of trust in a software or hardware component as the trusted platform module. With trusted computing, a computer will consistently behave in predictable and expected ways (Wang et al, 2014; Lino et al., 2016). Trusted cloud digital forensics addresses the investigating evidence issue of trust in public cloud environments by examining the state of security within the cloud computing environment. In the process of digital forensics, a trusted evidence theory system can be established referring to the idea of trust and trusted computing. Digital forensics can be divided into two aspects: one is the trust of static property, namely to ensure that the static semantic features in the process of trusted discovery and trusted fixation is trusted; the other aspect is the trust of dynamic behavior, namely to make the process of trusted behavior of digital data transformed into evidence from trusted extraction, trusted reconstruction, trusted analysis, and trusted expression. This paper mainly focuses on the trust of dynamic behavior.

2.3. Timed automata

An atomic constraint compares a clock value with a time constant, and a clock constraint is in conjunction with atomic constraints. Any value from Q , the set of nonnegative rationals, can be used as a time constant.

Formally, for a set X of clock variables, the set $\Phi(X)$ of clock constraints ϕ is defined as:

$$\phi := x \leq c \mid c \leq x \mid x < c \mid c < x \mid \phi_1 \wedge \phi_2,$$

where x is a clock in X , and c is a constant in Q .

A clock interpretation ν for a set X of clocks assigns a real value to each clock; that is, it is a mapping from X to the set R of nonnegative reals, and we say that a clock

interpretation ν for X satisfies a clock constraint ϕ over X if ϕ evaluates to be true according to the values given by ν .

Definition 1 (Timed automaton). A timed automaton A is a tuple $\langle L, L^0, \Sigma, X, I, E \rangle$, where:

- L is a finite set of locations,
- $L^0 \subseteq L$ is a set of initial locations,
- Σ is a finite set of labels,
- X is a finite set of clocks,
- I is a mapping that labels each location s in L with some clock constraint in $\Phi(X)$,
- $E \subseteq L \times \Sigma \times 2^X \times \Phi(X) \times L$ is the set of switches. A switch $\langle s, a, \phi, \lambda, s' \rangle$ represents a transition from location s to location s' on symbol a . ϕ is a clock constraint over X that specifies when the switch is enabled, and the set $\lambda \subseteq X$ gives the clocks to be reset with this switch.

The semantics of a timed automaton A are determined by associating with it a transition system S_A . A state of S_A is a pair (s, ν) such that s is a location of A and ν is a clock interpretation for X such that ν satisfies the invariant $I(s)$. The set of all states of A is denoted as Q_A . A state (s, ν) is the initial state where s is the initial location of A and $\nu(x)=0$ for all clocks x .

Two types of transitions in S_A :

1. A state can change with the elapse of time: for a state (s, ν) and a real-valued time increment $\delta \geq 0$, $(s, \nu) \xrightarrow{\delta} (s, \nu + \delta)$ if for all $0 \leq \delta' \leq \delta$, $\nu + \delta' \in I(s)$ satisfies the invariant $I(s)$.
2. A state can change with a location-switch: for a state (s, ν) and a switch $\langle s, a, \phi, \lambda, s' \rangle$ such that ν satisfies ϕ , $(s, \nu) \xrightarrow{a} (s', \nu[\lambda := 0])$.

Thus, S_A is a transitional system with the label set $\Sigma \cup \mathbb{R}$.

3. Formalism of events

3.1. Behavior process formalism

Many digital systems in a realistic world, such as digital circuits, computer programs, or internet protocols, can be described mathematically as finite state machines. A finite state machine can be depicted as a graph, in which nodes symbolize every possible system state, and arrows symbolize every possible state transitions (Chakrabarti et al, 2002). All possible computations resulting in a special state can be determined by back-tracing transitions leading to that state. In this paper, the investigator could perform behavior process reconstruction within the cloud using TA as follows:

Definition 2 (Behavior process). A behavior process of an event M can be reconstructed as a 3-tuple $\langle B_M^I, B_M^O, B_M^H \rangle$, where

B_M^I, B_M^O, B_M^H denote the sets of input, output and latent behavior actions of the event respectively. Input behavior actions can model event methods that can be called and received at the end of communication channels. Output behavior actions can model

method calls and transmit messages. These sets must be detached from each other and detached from the time domain. Input behavior actions and output behavior actions denote the event interactions with other events or its circumstances. Latent behavior actions mean that the behavior actions are the internal behavior ones of an event, which are not directly related to its environment.

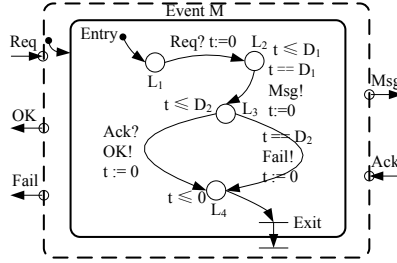


Figure 1 – Example of a behavior process

Figure 1 shows a simple example of a behavior process. The behavior process has six states or locations: *Entry*, L_1 , L_2 , L_3 , L_4 and *Exit*. It is encapsulated in a box including input ports and output ports. The behavior process can be illustrated to send the signal *Msg* to its circumstance after receiving the signal *Req*, also await a response signal from its circumstance. It returns the signal *OK* after receiving the signal *Ack* within some time delay or returns *Fail* when it comes to a timeout. According to definition 2, the collection of corresponding behavior processes are:

$$B^I = \{Req, Ack\}, B^O = \{Msg, OK, Fail\}, B^H = \emptyset$$

3.2. Merging behavior process

Merging behavior process means that multiple behavior processes can be assembled into a more complicated composite behavior process. Two types of behavior process merging can be distinguished as *binding composition* and *connection composition*, depending on whether the behavior processes have any mutual information called shared behavior actions.

So it can be established that we can call these two behavior processes *composable* if there is no collision of behavior actions; i.e., they only possess common behavior actions that move the product automaton along shared steps.

Definition 3. Behavior process M and behavior process N are composable i:f

1. $B_M^H \cap B_N^H = \emptyset$
2. $B_N^H \cap B_M^H = \emptyset$
3. $B_M^O \cap B_N^O = \emptyset$
4. $B_M^I \cap B_N^I = \emptyset$

The shared behavior actions of M and N are: $\text{shared}(M, N) = B_M \cap B_N$ where, $B_M = B_M^I \cup B_M^O \cup B_M^H$, $B_N = B_N^I \cup B_N^O \cup B_N^H$.

If M and N are composable, then $\text{shared}(M,N) = (B_M^I \cap B_N^O) \cup (B_M^O \cap B_N^I)$.

A1. Binding merging

Definition 4 (Binding merging). Binding merging of behavior process M and behavior process N generates a new composite behavior process, denoted $M \perp N$, by merging the two non-coupling behavior process ($\text{shared}(M,N) = \emptyset$) to enhance the functionality of behavior process in a continuous or inter current way. $M \perp N$ can be depicted as a 4-tuple $\langle B_{M \perp N}^I, B_{M \perp N}^O, B_{M \perp N}^H, B_{M \perp N} \rangle$, where:

1. $B_{M \perp N}^I = B_M^I \cup B_N^I$.
2. $B_{M \perp N}^O = B_M^O \cup B_N^O$.
3. $B_{M \perp N}^H = B_M^H \cup B_N^H$.

The new TA composes behavior processes M and N in a continuous or inter current way, as shown in Figure 2.

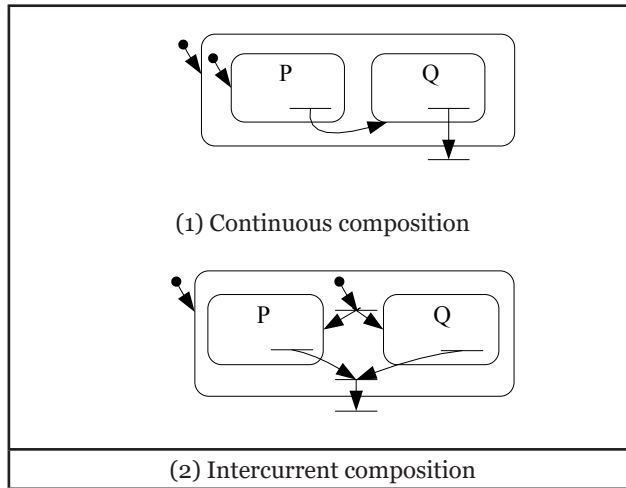


Figure 2 – Binding merging

Binding merging retains all the ports of the individual behavior processes. In the continuous way, the new behavior process after binding continuously executes the behavior of the individual sub behavior processes. Thus, the next location of the *exit* of one sub behavior process can be modeled as the *entry* of the other one in the new behavior process. Different from the above binding merging, intercurrent merging can invoke all the contained behavior processes in parallel.

A2. Connection Merging

Definition 5 (Connection merging). Connection merging of behavior processes M and N produce a new complicated behavior process, labelled as $M \parallel N$, which integrates two coupling behavior processes ($\text{shared}(M,N) \neq \emptyset$) in a parallel way. $M \parallel N$ can be described as a 4-tuple $\langle B_{M \parallel N}^I, B_{M \parallel N}^O, B_{M \parallel N}^H \rangle$, where:

1. $B_{M-||-N}^I = (B_M^I \cup B_N^I) - (B_M \cap B_N)$
2. $B_{M-||-N}^O = (B_M^O \cup B_N^O) - (B_M \cap B_N)$
3. $B_{M-||-N}^H = B_M^H \cup B_N^H \cup (B_M \cap B_N)$

The new TA that combines behavior process M with N in a logical “AND” way.

Different from binding merging, connection merging requires the compatibility of the behavior actions of the composite behavior processes. The matched behavior actions of the individual behavior processes become inner behavior actions of the new behavior process, and input and output behavior actions are the union of those of the sub behavior processes. Take the behavior process shown in Figure 3 as an example. The behavior process waits for an input signal Msg , and if received, sends back an output signal Ack . These interfaces are compatible with the ones of the behavior process shown in Figure 1. Thus, these two behavior processes are compatible, and the combination of them is connection merging. These two behavior processes run inter currently. The matched actions, Msg and Ack , become inner behavior actions of the composite behavior process after connection merging.

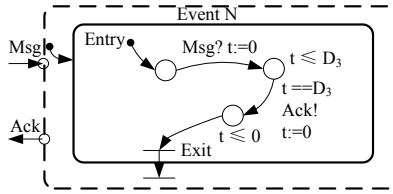


Figure 3 – Connection merging

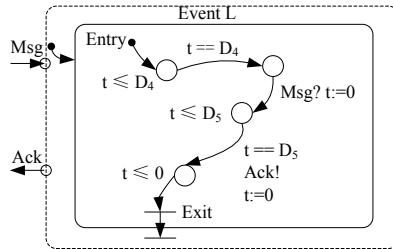


Figure 4 – Behavior process L

3.3. Behavior processes merging analysis

In the normal course of behavior processes, the interaction between two behavior processes within a cloud environment should follow some principles. In case some behavior processes happen to invade the system under investigation, behavior process merging may lead to illegal states. Under the circumstances, one behavior process generates an output behavior action, while the other behavior process does not accept it; thus, the matching input behavior action of the other behavior process will be disabled, or vice versa.

Definition 6 (Illegal location states). The set of illegal location states in the composition of behavior processes M and N are defined as:

$\text{Illegal}(M, N) = \{(x, y) \in S_M \times S_N \mid \exists a \in \text{shared}(M, N), (a \in B_M^O(x) \wedge a \notin B_N^I(y)) \vee (a \in B_N^O(y) \wedge a \notin B_M^I(x))\}$ where

1. S_M and S_N denote the location states sets of M and N , separately.
2. $B_M(x)$ and $B_N(y)$ denote the sets of the actions which are transformed from the location states x and y , respectively.
3. The superscripts I and O represent the input and output of behavior actions in the set, respectively.

Definition 7 (Behavior process compatibility). Two behavior processes, M and N , are considered compatible if no illegal location states in the behavior process automaton can be reached from the initial states.

That is, if there are no illegal states in $M \parallel N$, then $\text{illegal}(M, N) = \emptyset$. In [5] an algorithm for checking the compatibility of two interface automata is proposed. This algorithm first determines the set of shared behavior actions between the two automata. Based on this set, two interface automata are compatible if none of the automata produces an output behavior action that is not accepted as an input behavior action of the other automaton. To prove this, the product automaton is constructed and checked to verify that it does not contain any illegal states.

However, when analyzing timing properties of a real-time system within the cloud, a central aspect is the timeliness of the exchange of signals. Thus, it is essential to include timing aspects with interface descriptions of behavior processes. Similar to traditional checking, analyzing timing consistency allows for the establishment of basic soundness properties of a system. Additionally, the checking procedure can be automated using model checkers such as UPPAAL (Larsen et al, 1997). Since model-checking has the defect of state space explosion, an alternative technique of compositional verification is used to prove the timing consistency of merging behavior processes in the following section.

4. Merging behavior processes compatibility

According to the domain of clocks, the state space of TA is infinite. To reduce the number of states, the approach of clock regions is adopted to transform a timed automaton to a region graph, also called a labeled transition system (LTS) (Chakrabarti et al, 2002).

Definition 8 (Labelled transition system, LTS). A LTS is a quadruple $\langle S, A, E, s_0 \rangle$, where

- S is the set of states. We can represent a state of the LTS by the tuple $\langle n; v; ch \rangle$, where v assigns a nonnegative real number to each clock, and ch is a tuple whose i th entry denotes the number of messages held in the asynchronous internal channel ch_i .
- A is the set of actions (transition labels),
- E is the transition relation $E \subseteq S \times A \times S$, and
- $s_0 \in S$ is the initial state of the system.

LTSs have been extensively used as a state space model in the family of process algebra. We use the technique introduced in (Larsen et al, 1997); namely, the multiset labeled

transition system (MLTS), an extension of traditional LTS, to represent the state space of TA and perform merging verification.

Definition 9 (Multiset). Let $\mathcal{S}$ be the set of positive integers. A multiset MS, over a nonempty basis set X , is a function $MS: X \rightarrow \mathcal{S}$ which associates a multiplicity, possibly zero, with each of the basis elements of X . The set of multisets over X is denoted by M_X .

Definition 10 (Multiset labelled transition systems, MLTS). A MLTS is a quadruple $\langle S, B, T, s_{in} \rangle$, where

- S is a set of states; s_{in} is the initial state. Note that a state $s \in S$ is a tuple $\langle n, r, ch \rangle$ if the MLTS represents the state-space of a single flatten timed automata, and with a tuple $\langle n_1, \dots, n_m, v_1, \dots, v_m, ch \rangle$ if the MLTS represents the composed state-space of TA composed by m timed automata.
- B , which is a set of behavior actions (transition labels), comprising internal, input and output behavior actions.
- $T \subseteq S \times M_B \times S$ is a set of transitions such that $\forall (s, m_s, s') \in T$: m_s is a nonempty multiset of B .

To determine whether two MLTSs are behavior process compatible, first the product of the two MLTSs is computed, and then the set of internal actions is hidden, making it invisible from the environment, as shown in Algorithm 1:

Input: 2 MLTSs: $MLTS_1 = (S_1, B_1, T_1, s_{in1})$ and

$MLTS_2 = (S_2, B_2, T_2, s_{in2})$

Output: Resultant MLTSs (S, B, T, s_{in}) composed from $MLTS_1$ and $MLTS_2$.

1. Add $initState = (s_{in1}, s_{in2}, sach_{o1}, \dots, sach_{om})$ to S .
 2. Set all clock constraints in P to zero,
 $SoldList = SList := \{(initState, R)\}$.
 3. **while** ($SList$ is not empty) **do**
 Remove a state $s = (s_1, s_2, sach_1, \dots, sach_m)$ and R from the head of $SList$.
for (each out-transition t of s_1 or s_2) **do**
if i) t is enabled under s by a pair of dependent transitions (t_1, t_2) , $t = t_1$ or t_2 ,
 ii) (t_1, t_2) has not fired under s yet), and
 iii) the clock regions of s_1' and s_2' overlap under R **then**
 (Suppose $t_1 = s_1 \rightarrow s_1'$ and $t_2 = s_2 \rightarrow s_2'$) derive next state s' reached by firing (t_1, t_2) .
Else if (t is an enabled independently transition and has not fired under s yet) **then**
 derive next state s' by firing t .
 Set the new clock relationship R'
if ($\exists s'$ along the path from $initState$ to S such that
 $\forall s'_i, sach'_i \in s' (1 \leq i \leq 2) (1 \leq j \leq m): s'_i = s''_i$ and $sach'_i \geq sach''_i$) **then**
 replace $sach'_i$ by o for each $sach'_j$ with $sach'_j > sach''_j$, and add s' to S
else if ($s', R' \notin SoldList$) **then**
 add s' to S , add (s', R') to $SoldList$, and add (s', R') to the head of $SList$.
 Add $t_{new} = (s, b_{s'}, s')$ to T where $b_{s'}$ is equal to
 i) the union of the *synchronously communicating behavior actions* in transitions ts , and
 ii) the sum of the *asynchronously communicating behavior actions* in transitions ts .
 4. $B := B_1 \cup B_2$;
 5. Hide the invisible behavior actions of (S, B, T, s_{in}) .
-

(Note:

- Two transitions $t_1 = (s_1, b_{s_1}, s'_1)$ and $t_2 = (s_2, b_{s_2}, s'_2)$ in ML_1 and ML_2 , respectively, are called a pair of *dependent transitions* if there is one synchronous behavior action $\bar{a}$ such that $\bar{a} \in b_{s_1} \cap b_{s_2}$. In this case, t_1 and t_2 are also called a pair of synchronous transitions.
 - A transition t in one behavior process MLTS is called an *independent transition* if there is no corresponding synchronous transition in another behavior process MLTS.)
-

Algorithm 1 – Merging of two MLTSs

Input: A MLTS $T=(S, B, T, s_{in})$ and its set of internal behavior actions B_{inv} .

Output: A MLTS $T'=(S, B', T', s_{in})$.

1. $B' := (B - B_{inv}) \cup \{\tau\}$
 2. Set $T' := T, \forall (s, (b_1 \dots b_n), s') \in T'$
for each $b_i (1 \leq i \leq n)$:
if $b_i \in B_{inv}$, **then** $b_i := \tau$
(replace internal behavior actions with τ); and
if $\forall 1 \leq i \leq n: b_i = \tau$, **then** $(b_1 \dots b_n)$ are replaced by one τ (replace a set of τ s by one τ);
else $\forall 1 \leq i \leq n: b_i$ and its transition with end state are removed if $b_i = \tau$.
-

Algorithm 2 – Hiding internal behavior actions

Thus, if all shared actions, $\text{shared}(M, N) = (B_M^I \cap B_N^O) \cup (B_M^O \cap B_N^I)$, are removed, then the two behavior processes are compatible. Otherwise there is at least one illegal state of the merging behavior process, which means that the two behavior processes are incompatible.

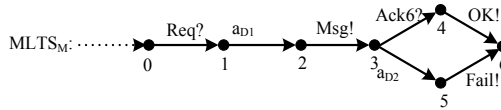


Figure 5 – Behavior process M and its MLTS

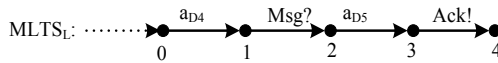


Figure 6– Behavior process L and its MLTS

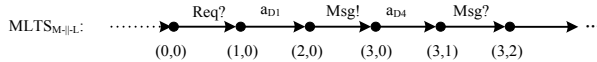


Figure 7 – The merging MLTS of behavior processes M and L

Taking behavior process M shown in Figure 1 and behavior process L shown in Figure 4 for example, to translate from TA models to MLTSs, the delay time D_1 , D_2 , D_4 and D_5 (supposing $D_4 > D_1$) in the TA model, as shown in Figure 4, is considered as synchronously communicating behavior actions or blocking behavior actions, marked as a_{D1} , a_{D2} , a_{D4} and a_{D5} . Figures 5 and 6 show their MLTSs respectively. In the graphic

representation of MLTSs, a state is denoted by a shaded circle and a transition by a solid arrow labelled with actions. The initial state is denoted by a dotted arrow. To check if two MLTSs are compatible, the product of the two MLTSs is first computed, and then the set of invisible actions is built. The MLTSs merging results using the algorithms 1 are indicated in Figure 7. In the merging MLTS, the shared action *Msg* cannot be merged into the internal (invisible) actions. Therefore, the two MLTSs are incompatible, which means that the illegal behavior action is detected.

In this way, the behavior processes can be constructed in a formalized manner, and the behavior actions can be analyzed to determine the illegal behavior actions.

4. Conclusions

Researchers have noticed the importance of analyzing digital evidence in the formal forensic method (Larsen et al, 1997; Promrit et al, 2011; Fang et al, 2011; Tsai et al, 2003; Arasteh et al, 2007; Brewer et al, 2006; Chang, 2012; Gladyshev and Patel, 2004; Jin and Yang, 2012). In this paper, we have proposed a novel approach to modeling behavior process reconstruction of the system under investigation using timed automata within cloud computing. Firstly, the definition of behavior process formalism is introduced. Secondly, how to use TA to describe the behavior process merging in detail is discussed. Finally, using the method above, the system under investigation can be constructed at various degrees of extraction by extraction, all using the united structure of TA. Further work, with the compositional verification technique using MLTSs, will aim to detect the suspect behavior actions concealed in the behavior processes and also avoid the state space explosion problem of model-checking.

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Gender differences in the influential factors of rural tourism behavior: Based on questionnaires in Wuhan, China

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Pages: 56–65

Abstract: Rural tourism has the potential to meet urban residents' leisure demand to return to nature while helping to increase farmers' incomes and develop the rural economy. The expanding rural tourism industry in China will further develop as urban residents' incomes increase. Research on the influential factors of rural tourism behavior and the gender differences has great practical significance, because it's useful for the marketing and promotion policy making of rural tourism. The empirical analysis indicates that, annual travel expense, familiarity with rural tourism and interest in rural tourism can significantly promote rural tourism behavior among both males and females. However, there are also obvious gender differences in the influential factors of rural tourism behavior. Place of residence and overtime are the factors that can significantly influence males' rural tourism behavior, while health status, household income and education level can significantly influence females' rural tourism behavior.

Keywords: gender difference, rural tourism behavior, questionnaire, demand.

1. Introduction

Rural tourism is a type of tourist activity that targets agricultural production, peasant life, rural scenery, historical sites, folk customs and ecological environments (He, 2003; Zhang, 2010). Rural tourism combines watching, investigating, studying, experiencing, having fun, shopping and taking group vacations (Zhang, 2010). In China, rural tourism relies on rural scenery and natural landscapes, and its services are provided in peasants' own courtyards (Zhang, 2010). As a result, it has adopted the mode of "eating farm-flavored food, living in farmer's houses, doing farm work, enjoying natural fun and purchasing farmer's wares". Rural tourism originated in Europe in the mid-19th century and has grown for more than a century in developed countries. It developed particularly rapidly in America, Canada and Japan after the 1970s (Zhang, 2010). In China, rural tourism is growing rapidly and has extensive development prospects.

Thus, there is a strong need to develop rural tourism in China that can meet urban residents' demand to return to and enjoy nature, to appreciate rural scenery and to learn folk culture (An, 2012). At the same time, rural tourism must also help to increase farmers' incomes, to develop the rural economy and to promote the coordinated development of urban and rural areas (Wan & Qiu, 2006). Urban residents are the main market for rural tourism market (e.g., He, 2001), so the study of their rural tourism behavior and the gender differences can provide important references for rural tourism-related marketing and policy.

The contents of this article are arranged as follows: the second section introduces the analytical framework, and the third section is a descriptive analysis of the investigation samples. The fourth section presents the regression results of the econometric models, and the fifth section is the conclusion.

2. Analytical framework

The utility maximization model when urban residents consume n items is as follows:

$$\max U = U(x_1, x_2, \dots, x_n)$$

$$\text{s.t. } p_1x_1 + p_2x_2 + \dots + p_nx_n = m$$

where x_i is the consumption quantity of the i^{th} commodity; p_i is the price of the i^{th} commodity; and m is the income.

To simplify the analysis, we assume that urban residents consume only two commodities: rural tourism and non-rural tourism. The utility maximization demand for the two commodities is at the tangent point of the budget line and the utility indifference curve (see Figure 1). The factors that influence demand for rural tourism are the following:

1. Preference, mainly determined by a consumer's personal characteristics. Previous studies find that age, education level, attitude to rural tourism, previous experience, and motivation have significant influence on rural tourism demand (Mathieson & Wall, 1993; Zhu & Wu, 2012; Yu et al., 2003). Yu et al. (2003), for example, find that the demand for rural travel and behavioral characteristics among the elderly are significantly different from those of other age groups. In addition, consumer perceptions of rural tourism, such as familiarity with rural tourism, may also affect preference and demand for rural tourism.
2. Rural tourism features, including the characteristics of a destination and of transportation. For example, Tang et al. (2008) find that product characteristic is an important determining factor in rural tourism consumption demand, and Mathieson & Wall (1993) find that distance, length of stay and predicted risks all have an impact on rural tourism.
3. Income. When price remains constant, a higher income and larger budget lead to a higher demand for rural tourism (Zhu & Wu, 2012; Mathieson & Wall, 1993), which indicates that rural tourism is a normal good.
4. Price. A higher rural tourism price in comparison to non-rural tourism prices leads to a steeper budget line and a decline in demand for rural tourism (e.g., Zhu & Wu, 2012).

5. Complement. A complement refers to a commodity that is consumed with the main commodity. It is free and convenient for urban residents to drive their cars when they travel to the countryside. In addition, a private car can seat several people, which means that the per capita transportation expenses are, generally speaking, less than the costs of a taxi or bus because of the scale economic effect. Thus, to a large extent, a private car is a complement to rural tourism. Theoretically speaking, the popularity of private cars is conducive to the development of rural tourism.

The dependent variable Rural Tourism (c) is a binary variable (not occur = 0, occur = 1), and we estimate a logic probability model of the following form:

$$\ln \frac{p(c=1)}{1-p(c=1)} = \alpha + \sum \gamma_i x_i + u \quad (1)$$

Where x_i is the i^{th} variable that may have an impact on rural tourism; α are the coefficients to be calculated; γ is the regression constant; and u is the error term.

In Model (1), the regression coefficient measures the variation of the natural logarithm of the ratio between rural tourism's occurrence probability and its non-occurrence probability when x_i changes by one unit and other factors remain unchanged, is the odds ratio (OR) that measures the ratio of the odds of rural tourism's occurrence when x_i changes by one unit to the odds before the change.

This article uses cross-sectional data from 2012 to conduct an empirical analysis and does not consider the influence of rural tourism features and price. The independent variables are as follows:

1. Complement, including private car ownership. The popularity of private cars is conducive to the development of rural tourism.
2. Personal characteristics, including gender, age, education level, marriage, health status, place of residence, overtime and annual travel expenses.

The closer a person lives to a city center and the further he/she is from country life, the more he/she should want to participate in rural tourism and experience country life.

Overtime reflects the leisure time that a respondent has at his/her disposal. The more a person works at weekends and on other legal holidays, the less leisure time he/she will have. Thus, his/her probability of participating in rural tourism will be lower.

The more the annual travel expenses a person reports the more he/she likes to travel. Travel-lovers are more willing to experience different ways of life, and their probability of participating in rural tourism is high.

3. The perception of rural tourism, including familiarity with it, interest in it, and attitudes towards rural tourism development. More positive perceptions of rural tourism will be associated with a higher probability of participating in it.
4. Household economic status, including household income, family size and young children.

Young children refer to children under the age of 18. The presence of young children in a family has two influences on rural tourism behavior. First, expenditure on young children will restrict a family's rural tourism behavior, and, second, taking young children to experience life in the country will promote demand for rural tourism. The influence of young children on rural tourism behavior will depend on the relative strength of the two aspects.

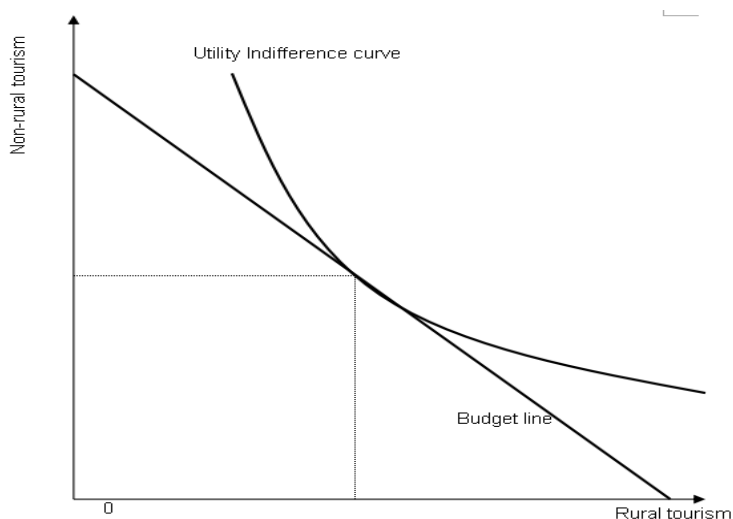


Figure 1 – The utility maximization demand for rural tourism

3. Descriptive statistic characteristics of the survey samples

This study used a questionnaire to conduct a personal survey. The questionnaire includes 30 questions, which are broken into four categories: first, private car ownership; second, personal characteristics, including gender, age, education level, marital status, health status, place of residence, overtime and annual travel expenses; third, perceptions of rural tourism, including familiarity, interest and attitude to rural tourism development; fourth, household economic status, including household income, family size and young children.

Non-probability samples were useful for obtaining information about people's opinions, motivations, behaviors and demographic characteristics (Wicks & Baldwin, 1997). We chose to distribute questionnaires in business districts, such as Jiangnan Road Pedestrian Street and Optics Valley Square, and recreational districts, such as Hankou Recreational Waterfront and East Lake Scenic Spot, over a period of three days in 2013 (January 1st-3rd). We distributed 800 questionnaires, and 723 (90.4%) were returned. Of these, 522 questionnaires were effective, which accounted for 72.2% of the returned questionnaires.

Table 1 shows the investigation results of rural tourism behavior. Of the 522 people surveyed, 147 respondents (28.2%) reported that they had experienced rural tourism

in 2012. Of the 247 male respondents, 83 (33.6%) reported that they had experienced rural tourism, and of the 275 female respondents, 64 (23.3%) reported that they had experienced rural tourism in 2012. The definitions, means and standard deviations of the independent variables are shown in Table 2.

Rural tourism behavior in 2012	Entire sample		Male sub-sample		Female sub-sample	
	Number	%	Number	%	Number	%
Not attended	375	71.8	164	66.4	211	76.7
Attended	147	28.2	83	33.6	64	23.3
Total	522	100.0	247	100.0	275	100.0

Table 1 – Investigation results of rural tourism behavior in 2012

Variables	Definition or Unit	Male sub-sample		Female sub-sample	
		Mean	Std. Deviation	Mean	Std. Deviation
Private car	Not have=0; Have=1	0.462	0.500	0.382	0.487
Age	≤24=1, 25-34=2, 35-44=3, 45-54=4, ≥55 =5	2.514	1.213	2.364	0.891
Education level	Junior high school student or below=1; Senior high school student or technical secondary school student=2; Junior college student=3; Undergraduate=4; Master or above=5	3.830	1.198	3.560	1.084
Marital status	Not married=0; Married=1	0.591	0.493	0.680	0.467
Place of residence	Outside the third ring road=1; Between the second and third ring road=2; Inside the second ring road=3	1.980	0.735	2.113	0.791
Household income	≤40000=1, 40000-60000=2, 60000-80000=3, 80000-100000=4, 100000-150000=5, ≥150000=6	3.636	1.369	3.313	1.336
Family size	Person	3.543	1.139	3.378	1.115
Young child	Not have=0; Have=1	0.368	0.483	0.513	0.501
Health status	Bad=1; General=2; Good=3	2.433	0.627	2.433	0.532
Overtime	None=1; A few=2; Many=3	2.105	0.820	2.084	0.723
Annual travel expense	≤1000=1, 1001-3000=2, 3001-5000=3, ≥5001 =4	2.567	1.109	2.516	1.144

Variables	Definition or Unit	Male sub-sample		Female sub-sample	
		Mean	Std. Deviation	Mean	Std. Deviation
Familiarity with rural tourism	Not familiar at all=1; Not familiar=2; General =3; Familiar=4; Very familiar =5	3.235	1.116	2.876	0.920
Interest in rural tourism	No interest at all=1; No interest=2; General =3; Interest =4; Keen interest=5	3.263	0.821	3.255	0.788
Attitude to rural tourism development	Strongly object=1; Object=2; General=3; Agree=4; Strongly agree=5	3.984	0.650	3.945	0.657

Table 2 – The definitions, means and std. deviations of independent variables

4. Regression analysis results

	Male sub-sample		Female sub-sample	
	Coefficient	OR	Coefficient	OR
Private car	0.975* (0.535)	2.650	1.120** (0.514)	3.065
Age	0.397 (0.248)	1.487	-0.066 (0.314)	0.937
Education level	-0.260 (0.180)	0.771	-0.435** (0.218)	0.647
Marital status	-0.816 (0.725)	0.442	0.236 (0.771)	1.266
Health status	0.558 (0.348)	1.747	0.678* (0.406)	1.969
Place of residence	0.588** (0.290)	1.801	0.268 (0.302)	1.307
Overtime	-0.677*** (0.255)	0.508	-0.044 (0.307)	0.957
Annual travel expense	0.645*** (0.230)	1.907	0.575** (0.248)	1.776
Familiarity with rural tourism	0.926*** (0.208)	2.523	0.699*** (0.240)	2.013
Interest in rural tourism	0.519* (0.312)	1.680	0.779** (0.358)	2.179
Attitude to rural tourism development	-0.317 (0.333)	0.729	0.320 (0.387)	1.377
Household income	0.319 (0.228)	1.376	0.437** (0.223)	1.548
Family size	0.097 (0.192)	1.102	0.058 (0.221)	1.059
Young child	0.464 (0.551)	1.590	-0.398 (0.577)	0.671
Constant	-9.085*** (2.067)	0.000	-12.024*** (2.559)	0.000
Chi-square	141.248		129.023	
-2 Log likelihood	174.106		169.380	
Cox&Snell R ²	0.436		0.374	
Nagelkerke R ²	0.604		0.566	
Prediction accuracy (%)	85.4		84.7	
Sample number	247		275	

Notes: ORs measure the ratio of the odds of rural tourism's occurrence when the independent variable changes by one unit to the odds before the change. Inside () are standard errors. *, **, *** Significant at 10%, 5% and 1%, respectively.

Table 3 – Regression results

Table 3 reports the regression results of Model (1) with the use of SPSS16.0 software. For the male sub-samples, the Chi-square statistic of this regression model is 141.248, and the degree of freedom is 14. The corresponding p value is 0.000 (significant at the 1% level), which implies that the model is significant as a whole. The -2 log likelihood equals 174.106, and the Cox & Snell R² and Nagelkerke R² are 0.436 and 0.604, respectively. Thus, the model is reliable. The prediction accuracy of the model is 85.4%, and its prediction effect is good (Freixo & Rocha, 2014).

Private car ownership is significantly positive at the 10% level, which indicates that an increase in private car ownership for male will improve the chances of participation in rural tourism. The coefficient for place of residence is significantly positive at the 5% level, which indicates that male residents who live near an urban center experience a high likelihood of participating in rural tourism because they are more willing to experience country life as an escape from urban life. The coefficient of overtime is significantly negative at the 1% level, which indicates that male residents who have little free time are less likely to participate in rural tourism. In other words, the extension of working hours will restrict rural tourism behavior. The coefficient of annual travel expense is significantly positive at the 1% level, which indicates that male residents who like to travel are more likely to participate in rural tourism than those who do not like to travel. The coefficients of familiarity with rural tourism and interest in rural tourism are significantly positive at the 1% and 10% level, respectively. This finding indicates that both higher interest in, and familiarity with, rural tourism increases the chances that a male will participate in it.

Table 3 also presents the odds ratios (ORs). The OR between rural tourism behavior and private car ownership is 2.650, which implies that the odds of engaging in rural tourism for a male respondent who owns a private car are 2.650 times as large as they are for a male respondent who has no private car. The OR between rural tourism behavior and place of residence is 1.801, which suggests that if the distance from the place of residence to the country increases by a notch (to a total of three notches, see Table 2), then the increase in the odds that the male will participate in rural tourism will be 0.801 times as great. The OR between rural tourism behavior and overtime is 0.508, which implies that if overtime moves up a notch (to a total of three notches, see Table 2), then the decrease in the odds that the male will participate in rural tourism will be 0.492 times as great. The OR between rural tourism behavior and annual travel expense is 1.907, which means that if interest in travel moves up a notch (to a total of four notches, see Table 2), the increase in the odds that the male will participate in rural tourism will be 0.907 times as great. The OR between rural tourism behavior and familiarity with rural tourism is 2.523, which suggests that if a male's familiarity with rural tourism moves up a notch (to a total of five notches, see Table 2), then the increase in the odds that he will participate in rural tourism will be 1.523 times as great. The OR between rural tourism behavior and interest in rural tourism is 1.680, which means that when a male's interest in rural tourism moves up a notch (to a total of five notches, see Table 2), then the increase in the odds that he will participate in rural tourism will be 0.680 times as great.

For the female sub-samples, the Chi-square statistic of this regression model is 129.023, and the degree of freedom is 14. The corresponding p value is 0.000 (significant at the 1%

level), which implies that the model is significant as a whole. The -2 log likelihood equals 169.380, and the Cox&Snell R² and Nagelkerke R² are 0.374 and 0.566, respectively. Thus, the model is reliable. The prediction accuracy of the model is 84.7%, and its prediction effect is good. Private car ownership, education level, health status, annual travel expense, familiarity with rural tourism, interest in rural tourism, household income are the significant influential factors in the female sub-samples. The regression coefficients and ORs can be found in Table 3.

By comparing the regression results of the two sub-samples, we can see there are gender differences in the influential factors of the rural tourism behavior. Take the influence of private car ownership on rural tourism behavior, for example, we can see the significant positive influence of private car ownership on rural tourism behavior in the two sub-samples. However, the degrees of influence are different. In the two sub-samples of men and women, the ORs between rural tourism behavior and private car ownership are 2.650 and 3.065, respectively, which indicates that the odds that a male respondent who owns a private car will engage in rural tourism are 2.650 times as large as they are for a male respondent who has no private car. Moreover, the odds that a female respondent who owns a private car will engage in rural tourism are 3.065 times as large as they are for a female respondent who has no private car.

The coefficients of annual travel expense, familiarity with rural tourism and interest in rural tourism are significantly positive at the common statistical level in the two sub-samples. This finding shows that there are no gender differences across the three variables, which can therefore significantly promote rural tourism behavior among both males and females. However, the regression results of the two sub-samples also exhibit obvious differences. In the male sub-sample, the coefficient of place of residence is significantly positive at the 5% statistical level, which indicates that living far away from the country promotes male rural tourism. Moreover, the coefficient of overtime is significantly negative at the 1% statistical level, which indicates that working overtime will block male rural tourism. In the female sub-sample, the coefficients of health status and household income are significantly positive at the common statistical level, which indicates that both health and household income can promote female rural tourism. However, the coefficient of education level is significantly negative at the 5% statistical level, which indicates that education level can block female rural tourism.

The high urbanization level of place of residence helps to promote rural tourism among men, but it has no significant effect on women. This result might be attributed to the possibility that men are more sensitive to the differences between urban and rural life. Furthermore, working overtime diminishes rural tourism among men but has no significant effect on women. We might explain this result by pointing to the fact that men have to complete substantive work tasks when they work overtime. Health is beneficial to promoting rural tourism among women but has no significant effect on men; it is possible, then, that women enjoy rural tourism only when they are healthy. Similarly, household income can promote rural tourism among women but has no significant effect on male; this result may be observed because women are more conscious of budgetary

concerns. Lastly, education limits rural tourism among women but has no significant effect on men. This result may be attributable to the fact that education can enrich women's spiritual life and reduce their demand for rural tourism.

Conclusions

The development of rural tourism not only offers to meet urban residents' increasing demand to return to nature in their leisure time; it also promises to increase farmers' income and develop the rural economy. In our investigation, 353 respondents reported that they are willing to participate in rural tourism in 2013. Therefore, the conditions should be created for the development of rural tourism.

The empirical analysis indicates that, annual travel expense, familiarity with rural tourism and interest in rural tourism can significantly promote rural tourism behavior among both males and females. However, there are also obvious gender differences in the influential factors of rural tourism behavior. Place of residence and overtime are the factors that can significantly influence males' rural tourism behavior. Living far away from the country promotes male rural tourism, and working overtime will block male rural tourism. While health status, household income and education level can significantly influence females' rural tourism behavior. Health and household income can promote female rural tourism, and education level can block female rural tourism. When marketing strategy and promotion policy of rural tourism are made, the analysis results should be considered to make the strategy and policy more effective.

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Design of Personalized Learning System based on Learning Styles

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Pages: 66–75

Abstract: Learning styles refers to the concept that individuals differ in regard to what mode of instruction or study is most effective for them. Because of individual has a different learning style, then the needs of learning materials are also different. With the heterogeneous proliferation of web devices, the delivery of learning materials on such devices becomes subject to more and more requirements. Personalized learning content adaptation becomes increasingly important to meet the diverse needs imposed by users, usage contexts, and infrastructure. Historical server logs offer a wealth of information on hardware capabilities, learners' preferences, and network conditions, which can be utilized to respond to a new user request with the personalized learning materials created from a previous similar request. In this paper, we propose a personalized learning system, which applies clustering and decision tree approaches, to efficiently manage a large number of historical learners' requests. The proposed method will intelligently and directly deliver proper personalized learning materials by means of the proposed adaptation decision and content synthesis processes.

Keywords: Learning Styles, Personalized Learning System, Experiment analysis

1. Introduction

The term “learning styles” refers to the view that different people learn information in different ways. In recent years, the concept of learning styles has steadily gained influence (Gonçalves et al., 2016). The learning styles concept appears to have wide acceptance not only among instructors but also among parents and the general public. The learning styles idea is actively promoted by vendors offering many different tests, assessment devices, and online technologies to help instructors identify their students' learning styles and adapt their instructional approaches accordingly.

In recent decades, personalized learning has attracted many researchers especially from two different fields: computer science and education (Tseng et al, 2008), Personalized learning is the learning process conducted in accordance with the diversity of students' personal characteristics (Leung et al, 2007), For example, from various personal features, there is a group of students who have same personal characteristics which are easy to remember things or information based on what they hear. Therefore, teachers need to provide the student, a set of learning materials that involving audio.

In general, personalized learning is flexible learning that allows students to interact with the learning material that suits with their needs. Personalized learning was introduced because of increased awareness among researchers about the diversity of students from learning styles.

Nowadays education field have moved rapidly towards integrating computer network technology in the process of teaching and learning. So the learning process has been moving towards the application of online learning, which is a system and process that connects learners with the materials and information that distributed online (Liaw et al, 2007). Online learning has great difference from the conventional classroom, instructors need to use some special techniques to make students can learn the best based on their preference. Therefore, instructors require an understanding on the characteristics of the learners that might affect how they interact with the learning environment. It also helps instructors to design an appropriate learning environment based on student's preferences or differences.

To cater all the individual's differences in online setting, Personal Learning Environment (PLE) has emerged in educational field. PLE is a tool that allows for a learner to engage in a distributed environment consisting of a network of people, services and resources. PLE is a new concept in designing and developing an online learning system. It is more focused on individual learning styles rather than the instructor, facilities, and materials.

PLE is an environment that constructed by individual. Individuals are responsible for their own learning process. They also need to manage the process of learning more effectively and takes a larger stake in the ownership of content. In general, personalized learning approach has the potential to meet the educational needs in the future as well as providing a new alternative to encourage students' learning.

Personalized learning environments can be provided by any differences in tendencies towards the students such as cognitive style, thinking style, learning style and many more.

In our study, the differences that are selected are according to students' learning styles. The chosen model of learning style is Kolb's learning style model. Then a personalized learning system based on learning style is proposed, the system applies data mining techniques to efficiently manage a large number of historical learners' requests. Furthermore, the experimental results indicate that it is efficient and is expected to prove beneficial to learners.

This work is organized as follows. Section 2 describes related work. In Section 3 we introduce the content adaptation mechanism and delivering process of personalized learning system. In Section 4 the experiment analysis is presented. In Section 5 we conclude this paper.

2. Related work

The proliferation of e-learning has been sparked by the rapid development of the Internet. E-learning has become more and more popular because it allows learners to conveniently study anytime, anywhere. At the same time, personalized environment

is becoming increasingly important in many areas such as e-commerce, e-tourism and cultural heritage, digital libraries, e-learning and many more. In education, personalized environment more synonymous with e-learning compared to conventional learning. There are a lot of researchers focusing on personalized learning environment with e-learning (Maria 2013). Riecken stated that personalization helps teacher to build a meaningful one to one relationship with students, by understanding their needs (Riecken 2000).

What kind of individual differences that our users have. The question is the main key when developing an educational online system (Chen et al, 2003). To address the question, research into individual differences and needs has becoming an important issue. Magoulas (Magoulas et al, 2003) stress on the importance to accommodating individual differences when designing web-based instructions. When the issue about individual differences arises, which we should support individuals to customize the learning environment according to their difference characteristics.

The emergence of web as a medium for learning has led to student-centered learning and it is hope to improve the learning experience of students (Lin et al, 2001). Traditional learning environment is often design for the “average learner” while in a personalized learning environment, the materials and learning sequence are depending on the learner’s characteristics such as learning styles, skills, interests and so on (Sampson et al, 2002).

There are still many controversial issues related to the effectiveness of online instruction. An investigation of student learning preferences have shown that among the variables influence the success of learning and considered as important are cognitive styles, learning styles and prior knowledge (Foster et al, 2003).

The design and the instruction of the online learning also considered as important part to achieve the learning goals. However, the main problem in exploiting information in a web-based learning environment is to determine which attributes should be used and how to attend the diverse type of students. Hence, identifying different types of learner variables and their impact on student learning has been a major area of study in online instruction (Thomas et al, 2012). Many researchers claimed that the main problem with online learning environment is the lack of personalization aspect. One of the key issues concerning in today’s learning is individualized learning. Groot thinks that individualized learning is a learning model that places student in the center of the learning process. Students are active participants in their learning which mean they learn at their own pace and use their own strategies, they are more motivated and their learning is more standardized (Groot et al, 2011).

The historical records of a given learner, including hardware capabilities, various learning preferences, and the current situation of wireless networks, can help solve the problems arising from variant mobile device capabilities, vacillating network conditions, and learners’ diverse preferences. The proposed resolution is a concept that focuses on historical learners’ requests to provide successful new requests, which share similar preference attributes. This is complicated by the fact that there are vast amounts of educational data and information available for e-learners. In an e-learning system, teaching materials are usually stored in a Learning Object Repository (LOR), which can

be formatted based on one of the most popular standards on the e-learning system. In an LOR, a substantial amount of teaching materials, including related learning objects, will result in management issues over wired or wireless environments (Su et al, 2011).

To consider the user's preference in the context-based adaptation approach, Lum and Lau (Lum et al, 2004) proposed a decision engine, which can determine automatically an appropriate content adaptation version based on the Quality of Service-sensitive (QoS) approach.

In learning environments, the learners' preferences vary greatly because each learner is an individual student, and thus, has his or her individualized learning behaviors and preferences. The variety of behaviors and preferences can include content type preferences such as text, picture, audio, video, or a hybrid of those types (Gilbert et al, 1999). Learners also differ in their inclinations for how learning material is presented and how they intellectually receive and digest that material. That is, learners vary in their preferences of presentation styles, cognitive styles and learning styles (Muntean, 2008).

3. Content adaptation mechanism and delivering process of personalized learning system

The architecture of the personalized learning system is shown in Figure 1. The system can manage efficiently a large number of historical learners' requests and intelligently deliver proper personalized learning content with higher fidelity from a Learning Object Repository (LOR) directly to the learner.

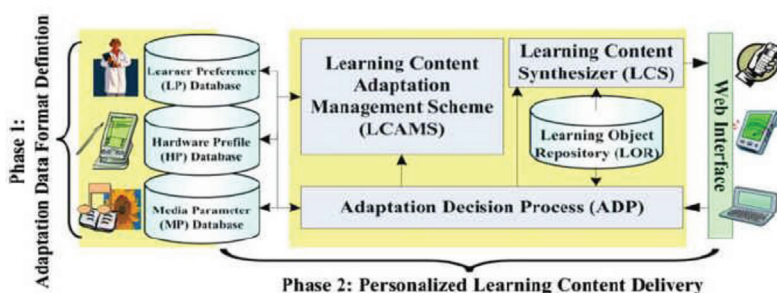


Figure 1 – Architecture of personalized learning system

The personalized learning system includes two phases: adaptation data format definition phase and personalized learning content delivery phase.

We define the adaptation data format including Learner Preference (LP), Hardware Profile (HP), and Media Parameter (MP). Here, the LP describes the diverse needs of a learner. The HP describes the hardware capabilities of a learner's device. The MP describes how to adapt and transcode the multimedia.

To deliver the suitable learning content with associated learning resources efficiently to learners in accordance with their preferences, their device's hardware capabilities, and variable wireless bandwidth, we propose the following three modules.

Learning Content Adaptation Management Scheme (LCAMS): To manage the learners' historical request data efficiently, we first apply the distance-based clustering approach to group the historical learners' requests into several sets, according to Learner Preference (LP). After the initial clustering phase, every cluster created with a similar LP will be tagged with a cluster label. The Hardware Profiles (HP) within the historical requests with corresponding cluster labels are used as training data to create a decision tree, called Content Adaptation Decision Tree (CADT). The CADT can be used to efficiently determine the appropriate adapted content.

Adaptation Decision Process (ADP): To determine a precise and proper adapted content version based on CADT, we propose an ADP algorithm, which can determine a suitable version of the existing adapted content.

Learning Content Synthesizer (LCS): According to the results of ADP algorithm, the LCS will use the identified adaptation parameters to transcode the content if necessary.

To manage existing user requests efficiently, we must model and define a data format including the LP, HP, network condition, and MP, which will be recorded in a database to represent every learner's request. Thus, a Content Adaptation Rule (CAR) is defined to represent a processed learner request transaction in the system.

Each learner's request, with his or her preferences logged as a transaction, can be represented by a CAR, which can be used to construct a Content Adaptation Decision Tree (CADT). The CADT can be used to efficiently and quickly determine the suitable adapted content in an LOR for learners according to the device features, and the preferences of learners. As shown in Figure 2, the system includes three processes to construct the CADT: clustering process, decision tree construction and CADT maintenance process.

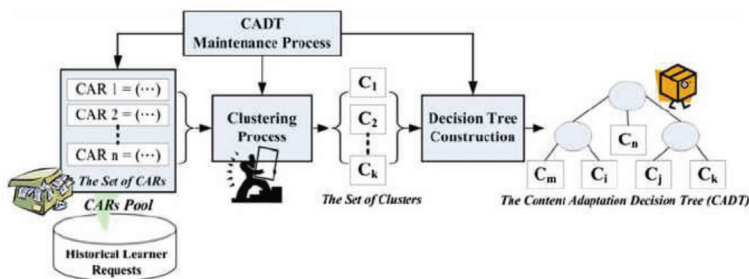


Figure 2 – Process of personalized learning system

We can apply the distance-based clustering algorithm to group these historical CARs into several clusters according to learners' preferences, where every learner in the same cluster shares similar LPs. However, it is difficult to determine the number of clusters while applying the clustering approach. To resolve this problem, the ISODATA clustering

algorithm can be employed. This process can dynamically change the number of clusters by lumping and splitting procedures and by iteratively changing the number of clusters to produce better results.

To apply the ISODATA clustering approach, a similarity measure estimating the similarity value between two CARs based on the LP must be determined.

Given two $LP_i = (a_1, a_2, \dots, a_n)$ and $LP_j = (b_1, b_2, \dots, b_n)$, the similarity measure of numerical attribute can be formulized as follows:

$$SimofNum_k = 1 - \frac{|a_k - b_k|}{Max_k - Min_k} \quad (1)$$

where $1 \leq k \leq n$, the Max_k and the Min_k are the predefined maximum and minimum values of k_{th} attribute in an LP, respectively.

To evaluate when to split and merge the cluster, the $Deviation_{LP}$, which is used to calculate the standard deviation of the samples, must be defined as:

$$Deviation_k^{LP} = \left| \frac{a_k - b_k}{Max_k - Min_k} \right| \quad (2)$$

where $1 \leq k \leq n$, the Max_k and the Min_k are the predefined maximum and minimum values of k_{th} attribute in an LP, respectively.

Then the LP clustering algorithm based on ISODATA is proposed to group these LPs into several clusters according to the aforementioned similarity and deviation measure. The algorithm is shown as follows:

Step 1: Initial Clusters Selection:

Step 1.1: For $i = 1$ to K .

(1) random select $LP_i \in LP_{set}$ to insert LP_i into C_i with $CC_i = LP_i$ and then insert C_i into C_{set}

Step 2: ISODATA Clustering Process:

Step 2.1: Execute the following sub-Steps (2.2–2.6) repeatedly until there is no difference between two iterations or exceed the T_i .

Step 2.2: Insert each $LP_j \in LP_{set}$ into appropriate cluster $C_i \in C_{set}$ according to the $Similarity_{LP}(CC_i, LP_j)$.

Step 2.3: Delete the C_i if the number of LP is less than T_n .

Step 2.4: Split a C_i into two clusters according to the T_s and T_n .

Step 2.5: Merge two clusters into one according to the T_m and T_p .

Step 2.6: Re-compute the Cluster Center (CC_i) for each $C_i \in C_{set}$.

Step 3: Output the C_{set} .

where

C : a cluster with several learner preference vectors (LP).

CC : the Center of Cluster.

C_{set} : the set of clusters with the Center of Cluster (CC)

T_s : the split threshold (Standard Deviation) for splitting a cluster into two ones.

T_m : the merge threshold (Mean Distance) for merging two clusters into one.

T_n : the minimum number of the members in a Cluster for deleting a cluster.

T_i : the maximum iteration number for executing the clustering process

T_p : the minimum number of Cluster pair for merging clusters process.

After the clustering process, each cluster will be tagged with a label. Determining a suitable cluster for a new request is an issue which can be resolved by using the decision tree approach. In this system, a decision tree induction algorithm, ID3 (Quinlan 1986), is used to create a decision tree, called CADT. Figure 3 depicts the result of applying the ID3 algorithm for an example data.

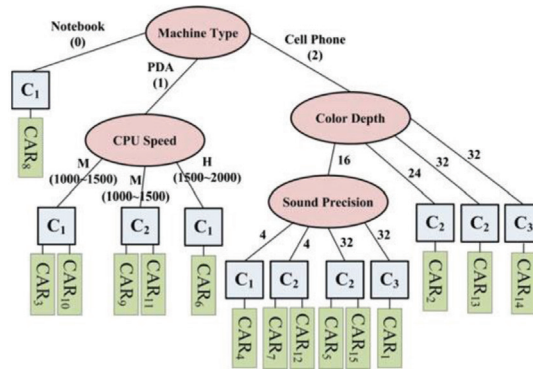


Figure 3 – CADT results

4. Experiment analysis

For evaluating the performance and effectiveness of the system in depth, simulated experiments were carried out, emulating a large number of diverse user requests with Learner Preferences (LPs) and Hardware Profiles (HPs) to access the desired Learning Objects (LOs) from the Learning Object Repository (LOR).

Comparison among the inadaptation, static adaptation, and our approaches is shown in Figure 4.

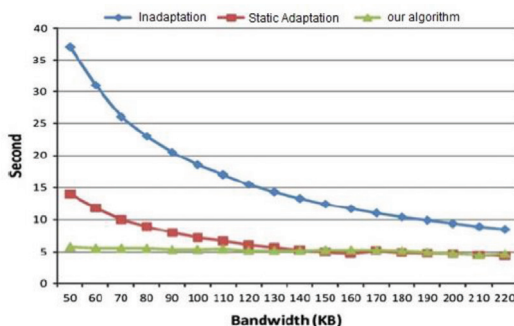


Figure 4 – Comparison among the inadaptation, static adaptation, and our approaches

In this experiment, the static adaptation approach prepared three versions of learning content in advance, i.e., 200, 170, and 140 KB. Therefore, within the bandwidth range from 140 to 220 KB, the DT is almost the same between the static adaptation approach and our approach. However, the static adaptation approach cannot consistently provide users with the appropriate content version according to the various bandwidths; thus, this approach spent a great deal of time gradually decreasing the bandwidth from 140 to 50 KB. On the contrary, our approach is still able to offer a stable delivery time and the proper personalized adapted content to meet the diverse user needs.

5. Conclusions

In order to develop a personalized learning system, individual differences need to be taken into consideration to ensure the impact on students' achievements and satisfactions. Therefore, the learning system must be suitable for their differences, to include their learning styles, learning orientations, preferences and needs in learning. In this paper, we design a content adaptation mechanism which can efficiently manage a large number of historical learners' requests and intelligently deliver proper personalized learning content with higher fidelity directly to learners. The mechanism uses the Content Adaptation Decision Tree (CADT) created by data mining techniques to efficiently determine the appropriate adapted contents from a Learning Object Repository (LOR).

Acknowledgements

This work was supported in part by Science and Technology Planning. Project of Shandong Province, China (Year: 2014; No:2014GGX101018).

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Development Status of China's Outdoor Sports and Countermeasures Based on SWOT Analysis

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Abstract: The outdoor sports industry in China is in the stage of rapid development. The paper, based on the SWOT strategic analysis, analyzes the current situation of outdoor sports in China and the strengths, weaknesses, opportunities and challenges it faced in details; the paper points out that the strategic development decisions should be considered from various aspects including: to optimize and adjust the industrial layout, promote integrated development among industries, enhance outdoor sports culture comprehensively and actively shape local brands.

Keywords: SWOT Analysis –Outdoor Sports and Countermeasures –SWOT strategic choice

1. Introduction

China's outdoor sports industry includes many areas: sporting goods industry, sports tourism, sports sponsorship industry, sports stars economy, sports gaming, fitness and entertainment, competitive performance industry, technology training industry and intangible assets as well as others. At present, the outdoor sports industry in China starts taking shape and forms a sports market encompassing more than 20,000 operating organizations of sports industry and with a total investment volume more than 200 billion Yuan and an annual turnover of over 60 billion Yuan. Developing China's outdoor sports industry can not only resolve the sub-health problem of Chinese people currently, but also stimulate consumption and domestic demand (Darling et al., 2003). With China's economic growth, the consumption structure of urban and rural residents gradually turns to recreation; the number of people participating in physical fitness, recreation and tourism increases at an annual rate of 20%.

SWOT analysis method is also known as trend analysis, and is proposed by a Management professor at the University of San Francisco in the early 1980s. It is used to analyze and study the given internal conditions of business operations to identify business strengths and weaknesses and core competitiveness. SWOT matrix is shown in Table 1, wherein, S represents strength, W for weakness, O for opportunity and T for threat. S and W are internal factors while O and T are external factors (Yao, 2014).

Strength	Weakness
Opportunities	Threats

Table 1 – SWOT matrix

In accordance with the overall concept of competitive strategy, the strategy should be an organic combination of what an enterprise “can do” (ie, strengths and weaknesses of the organization) and what it “may do” (ie opportunities and threats of the environment) (Lee et al., 1999). Accordingly, four different strategies can be formed based on S, W, O and T, and they are as follows:

1. SO strategy: pioneering strategy. It focuses on the advantages and opportunities, aiming to maximize the two factors. SO strategy is a strategy relying on internal strengths to seize external opportunities.
2. WO strategy: supporting and guiding strategy. It focuses on the factors of weaknesses and opportunities, aiming to minimize weaknesses and maximize opportunities. WO strategy is to take advantage of external opportunities to improve internal weaknesses.
3. ST strategy: overcoming and strengthening strategy. It focuses on the strengths and threats, aimed at maximizing strengths and minimizing threats.
4. WT strategy: improving and defensive strategy. It focuses on weaknesses and threats, aiming at minimizing both factors. WT strategy is to directly overcome internal weaknesses and avoid external threats.

What are the strengths and weaknesses of China’s outdoor sports industry? What are the opportunities for and threats to the development? After SWOT strategic analysis, what kind of decisions should be made on development strategies? This paper analyzes the above questions and hopes to offer some references to the decision-making of development strategy in China’s outdoor sports industry.

2. SWOT analysis of China’s outdoor sports industry development

After analysis, the strengths, weaknesses, opportunities and threats of China’s outdoor sports industry are shown in Table 2:

Strength	Weakness	Opportunities	Threats
potential market	Management behind	Policy strongly advocated	Unbalance of the development of the industry structure
Lack of Development and utilization degree	Lack of business model	The steady rapid economic growth	Low of Urban and rural residents’ consumption
improve the economy	Lack of management talent	Constantly improve the level of consumption	Strong international competitive pressure

Table 2 – China’s outdoor sports industry development analysis

2.1. Strengths of China's outdoor sports industry (S)

Outdoor sports is conducive to good physical and mental state and to the recovery of sub-health. Colorful outdoor sports includes hiking, fishing, climbing mountains, fitness and bodybuilding; when all these combine together, it can both restore people's physical strength and energy and make people maintain a pleasant mindset, being helpful to prevent mental illness and relief the sub-health state and posing as a new sports lifestyle. The development of outdoor sports industry can meet people's needs for fitness in their leisure time and aspirations for recreational sports, and meet people's a variety of psychological demands in participating in sports activities' on the other hand, participating in outdoor sports can alleviate physical and mental stress caused by heavy work, create a harmonious atmosphere improving relationships and enhance exchanges. Studies have shown that the accumulation of people's healthy capital are dependent on outdoor sports, nutrition and health care means currently, and outdoor exercise can promote people's physical and mental health and its sound development, being a way to gain a thorough relaxation after getting rid of all labor restrictions (Germann et al., 2012). When compared with other industries, the outdoor sports industry has a series of strengths, including low cost, quick start, strong penetration and wide radiation. Outdoor sports industry can not only produce considerable economic benefits itself, but also stimulate other industries such as garments, tourism, catering, transportation, communications and construction.

2.2. Weaknesses of China's outdoor sports industry (W)

1. Laggard business philosophy

Influenced by the planned economy system, China's sports cause has long been regarded as public welfare, tainting with a strong color of government actions. The existing sports operating mechanism is mainly to set up institutions and allocate resources surrounding competitive sports, and pays insufficient attention to people's growing consumption demand for outdoor sports, which results in the separation between sports cause and sports industry, hindering the cultivation and development of China's outdoor sports industry market to a certain extent.

2. Unsound business model

The market business model of China's outdoor sports industry is not flexible. Because of deviation on the cognition of outdoor sports industry, the capital investment in outdoor sports industry depends largely on government's sports funding and sponsorship and other forms, and investors can not directly participate in the management' club management does not implement in the form enterprises, greatly limiting the investors' passion. The capital investment is relatively limited, so that certain sports or activities can be temporarily operated regarding specific conditions, which cannot develop the outdoor sports industry fundamentally.

3. Lack of operating personnel

The operating talents in China's outdoor sports industry cannot meet the current needs in the industry in terms of both quantity and quality (Sun and Ji, 2014). Due to the closure of the sports talents chain, it is difficult for other sporting to enter the outdoor

sports industry; there are few training institutions for the training of professional sports personnel in China and colleges and universities only started to encompass outdoor sports industry related professions in enrollment plan only a few years ago

2.3. Opportunities of China's outdoor sports industry (O)

1. Vigorous advocate of national policies

In the mid-1990s, China promulgated the Outline for the Development of Sports Industry, Program of Striving for Olympic Glory and the Outline of National Fitness Program subsequently. So far, the three outlines are still the core of China's sports development. Outline for the Development of Sports Industry published in 1995 clearly states that "the revitalization and development of sports industry poses an important significance to the implementation of Program of Striving for Olympic Glory and National Fitness Program". In the On Further Strengthening and Improving the Sports Efforts in the New Era issued by CPC Central Committee and the State Council in 2002, it is stated that "enhancing people's health and improving the overall quality of the whole nation" serve as a fundamental objective of the sports cause in new era.

2. The rapidly growing demand for sports brought by steady and rapid growth of economy and continuous improvement in consumption level

The steady and rapid growth of economy and continuous improvement in consumption level is a major opportunity for the development of China's outdoor sports industry. The development of outdoor sports industry has a direct relationship with the country's macroeconomic environment. The economic development brings about improvement in consumption level. According to the statistics in 2007 *National Statistical Yearbook*, the total household consumption expenditure reaches 6.38335 trillion Yuan in 2004 and 8.01205 trillion Yuan in 2006, in which the spending in cultural, educational and entertainment products and related services is increasing every year (see Table 3 and Table 4). Meanwhile, people's demand for sports also evolves from the original single demand in the past to more diversified needs. People are no longer satisfied with simple sport supply such as broadcast gymnastics and work-break exercises; instead, they turn to pursuing entertainment, fitness, recreation, adventure sports demands in line with their own conditions and consumption level, such as holiday sports, tourism and sports, family sports and so on. The rapidly growing demand for sports becomes the main driving force for the development of outdoor sports industry, and the development of outdoor sports industry will be one of the significant factors that meet people's growing consumer demand for leisure and promote the socio-economic development.

3. Increase in citizens' leisure time and enhancement of leisure concept

Increased leisure time has changed people's concept of leisure. In the past, people's income was low, and has not much leisure time, so their recreation way is quite single-mainly watching television, visiting friends, shopping and so on. With the increase in income, the way of recreation also constantly enriches, thus citizens have experience a tremendous change concerning leisure concept. Recreational ways focus both on leisure and body health, so that more and more people choose sports, with a high degree of freedom and strong arbitration, as their own way of leisure

Years	2004	2005	2006
Consumer spending	63833	71217	80120
The rural economy in consumer spending	17550	19228	21114
The cultural and educational entertainment products and services	1888	2006	2140
Urban residents' consumption expenditure	46254	54856	59654
The cultural and educational entertainment products and services	5650	6012	6845

Table 3 – China's consumer spending levels Hundred million

years	Outdoor sports		Sports competition		Total amount
	times	Total amount	times	Total amount	
2003	3	171	3	43.2	214.0
2004	4	87.8	6	635.4	723.4
2005	2	210.2	7	387.6	596.4
On average,	3	156.2	5.4	354.2	514.0

Table 4 – In 2003-2005 Chinese mountaineering association outdoor activities or competitions (Ten thousand)

2.4. Threats of China's outdoor sports industry (T)

1. Imbalanced development of regional economy and industrial structure

The regional economic development in China poses an imbalanced mode (Panei, 2014), the soft and hard environment for the development of outdoor sports industry in the eastern, southern and northern coastal regions present a certain degree of strengths. The Bohai Bay region centering on Beijing and Tianjin, the Yangtze River Delta centering on Jiangsu and Zhejiang and the Pearl River Delta centering on Guangzhou and Shenzhen are economically developed areas, so that most major matches are held in these areas. Since in these areas, the economy is developed, demands for outdoor sports are large and the development outdoor sports industry starts early with large-scale investment, so that these areas have many established leisure institutions with higher service level. However, the more economically backward southwest, northwest and northeast have a long way to go concerning the true commercialization of outdoor sports even though they have actively developed outdoor sports. China's outdoor sports industry structure currently is that the development of outdoor sports noumenon industry obviously lag behind the development of sporting goods. In current stage, the industries related to

outdoor sports that develop well include sporting goods industry and sports lottery industry, while the main businesses including competitive performance industry, sports tourism, and sports media industry do not develop in an ideal way - the integration among industries are not enough, the scale effect is not obvious and a complete industrial system does not come into being (Lin et al, 2014).

2. Low cultural and enjoying consumption of urban and rural residents

As can be seen from the table below, in the consumption structure of urban and rural residents, routine expenditure still accounts for a large proportion, while the ratio of cultural consumption and enjoying consumption is low, which limits the market size and development pace of outdoor sports industry in general.

3. SWOT strategic choice of outdoor sports industry development

Based on the above analysis, strategic decision-making in the development of outdoor sports industry should be made considering the following aspects.

3.1. Optimizing and adjusting industrial layout, promoting integrated development among industries

There is a huge difference in economic, social, cultural, natural resources and sports capital stock among different regions, thus each region should develop the regional outdoor sports industry projects with regional characteristics based on comparative advantage theory. For example, the Mission Hills area in Shenzhen founded in 1992 has developed into the Mission Hills sports and leisure industry complex centering on golf industry; Qinghai Province focuses on the traditional ethnic sports entertainment events and creates the “national sports circle surrounding Qinghai Lake” led by “Tour de Qinghai Lake”. At current stage, China’s outdoor sports industry should take the development sequence of point - axis - section -- first develop competitive entertainment industry in the eastern, southern, northern coastal cities and and some socially and economically developed cities and then gradually move to other regions.

3.2. Enhancing outdoor sports culture comprehensively and actively creating national brands

Outdoor sports culture is an integral part of social culture. Participating in outdoor sports is both a kind of cultural experience leisure and the dissemination of culture (Hararik and Gabriel, 2014). To this end, the development of outdoor sports industry should focus on three dimensions--the first is to pay attention to the heritage and diversity of sports culture, making the outdoor sports activities fashion connect with traditions; when introducing new sports activities, we must continue to tap the traditional local sports projects to promote local culture, and make use of local sports event to promote the local cultural characteristics. The second is to constantly inject cultural connotation into sports activities, so that people can experience cultural molding and improve the overall quality in the process of participating in sports activities. The third is to create well-known brands through the cultivation of sports projects.

3.3. Establishing the investment and financing system for development of outdoor sports industry

To encourage the investment from all kinds of social capital into outdoor sports industry, it is necessary to deepen reform and change the restrictions posed by sports event management centers and associations to the investment from non-sports system and non-public economic sectors into industrial projects. Concerning the investment and financing body structure of outdoor sports, it should be expanded from the single government administrative subject to the pluralistic investment and financing bodies including government, enterprises, nonprofit organizations, community groups and the general public (such as monetary funds for outdoor sports industry, sports investment companies, etc.). On the investment and financing ways of outdoor sports, it should be transformed from the single type of government funding to the three-dimensional investment and financing operations including sports fund, sports lottery, sports ventures, sports bonds, sports stock, sports investment fund, the low-interest or subsidized loans from policy banks.

3.4. Introduction of advanced management concept, cultivate management talent

Set up is given priority to with indirect management of leisure sports industry and the market macroscopic management system, form conforms to the leisure sports market regulation and law of development of leisure sports industry market mechanism. At various levels and attached to the sports administrative institution of the production and business operation entity to separate government functions from enterprise management, for-profit and nonprofit, promote leisure sports system operational institution to the transformation of the enterprise. Focus on guide the strengthening of the broad masses of the leisure sports at the same time, should be constant use of various marketing means, improve the interest, cultivate the habit of their leisure, increase the satisfaction of the masses, to attract more potential consumer groups. As for the white-collar workers with higher income, can develop golf products; In view of the working class, bowling, billiards sports product development; Aimed at young people, can be swimming, pulley, ball games product development; National dance for the elderly, but development of tai chi chuan, sports, health care medical operating sports products, etc. To strengthen the training of recreational sports talents and introduced. To fundamentally solve the problem of lack of leisure sports industry in China, formulating a series of policy should be. First of all, should be in the current sports colleges and universities the economic departments of courses in related to leisure sports industry and professional, set up a high level of recreational sports economic enrollments. Again, the establishment of new discipline of leisure sports industry and scientific research institutions, to strengthen the study of leisure sports economic theory, guide the practice of leisure sports industry activities in a timely manner. At the same time, encourage leisure sports business units of the relevant personnel to post training, on-the-job training, training meets the needs of leisure sports industry development in our country is mainly engaged in leisure sports industry.

3.5. The rational allocation of leisure sports resources

Leisure sports venues, sports resources development and utilization. On the one hand, compared with the developed countries, such as per capita in China 16 times higher than

that of track and field in the United States, in 73 times higher per capita possession of the basketball court, per capita in 19 times higher than that of the tennis court, China's 28 times higher per capita natatorium. Level of sports facilities in such a huge difference, determines the difference of leisure sports in our country and developed countries. If the track and field, football field, basketball court, volleyball court, tennis court, natatorium 6 class sports facilities construction scale to Japan of a third person, needs to increase investment about 300-40 billion Yuan. The investment from the industry association, pull function on the other relevant departments product demand is considerable. This would require the support of the government and related enterprises and commitment., on the other hand, is rich in outdoor sports resources in our country, this is our country leisure sports fitness activities conducted by the "natural playground", can be use and development. Such as hills, rivers, lakes, forests, grassland, etc., and these resources because of its rich and colorful and naturalness widely favored by urban residents, can develop and utilize the natural resources, can carry out mountain climbing, rafting, swimming, boating, horse riding, outing, leisure sports activities, such not only can enrich the public way of leisure activities, to drive the surrounding area tourism, sports and tourism complementary and mutual harmony, also can reduce the excessive concentration in the center of the city area of traffic congestion phenomenon, is conducive to the long-term development of the leisure sports industry

4. Conclusion

Taking a comprehensive view at the external environment and internal conditions of China's outdoor sports industry, it can be found that in general, the situation faced by China's outdoor sports industry is the one opportunities outweigh threats and weaknesses is greater than strengths. Therefore, the development strategy of China's outdoor sports industry should take a WO strategy, namely, a supporting and guiding strategy. The strategy focuses on the factors of weaknesses and opportunities, aiming to minimize weaknesses and maximize opportunities and takes advantage of external opportunities to improve internal weaknesses. The current outdoor sports industry is transforming from the visible and single competitive goals in the past to the modern invisible and pluralistic humane care goals. Under the social background of sports moving towards the market and achieving sports industrialization, China's outdoor sports industry, as the part and parcel of national economy, possesses promising prospects for development.

Acknowledgements

This paper is supported by National Philosophy and Social Science Fund Project (No. 12BTY022).

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Empirical Research on the Results of Smart Phone English Software in College Students English Teaching

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Pages: 85–95

Abstract: This research explores the teaching mode and practical application effect of mobile learning applied to English subject, discovers the advantages and disadvantages of mobile learning of smart phone in English teaching, summarizes it and proposes countermeasures and suggestions through letting learners use smart phone to study and interview the true feelings of students who use smart phone to learn English.

Keywords: smart platform, English teaching, software development, English learning.

1. Introduction

The rapid development of science and technology in modern society attracts our attention and former study and work with paper can't adapt to current social development any more. At present, each post has realized digital office basically and school education also introduces multimedia intelligent voice system and other teaching information equipment with the advancing of time. But current teaching mode still depends on traditional teacher-focused teaching mode and does not realize real breakthrough, while the appearance of mobile learning concept breaks the inherent thinking of teaching (Park and Abelman, 2004). The characteristics of mobile learning lie in that it cannot only adapt to the teaching mode integrated with tradition well, but also make good supplement for traditional teaching mode with its characteristics of combining with advanced technologies (Miller and Glover, 2002; Abreu et al., 2015); at the same time, the appearance of mobile learning subverts the former learning method and inherent learning thought of learners. At present, education researchers pay increasing attention to this kind of learning method and mobile learning has become the popular content in education field.

The appearance of mobile learning well cater to the problems appeared in current society. People need to continue to study after leaving school, while the teaching quality of some education and training institutions can't be guaranteed at all. Mobile learning can combine the learning resources of these teaching resources into shared resource across time and space, which forms good complement with current teaching system. In addition, this kind of elastic mobile learning mode enables learners to select their

interested learning content, learning time and learning places etc. independently and strengthens personalized learning mode development direction (Suh et al, 2010). One of the advantages of mobile learning is to spread learning knowledge by make use of various kinds of modern portable device as basic tool. While with the extensive popularization of smart phone in China, its portable and diversified advantages make it become the terminal equipment most suitable for mobile learning (Doering and O'Brien, 2007; Vázquez et al., 2016). The related technical support of smart phone has been improved continuously. It is believed that with the realization of wireless network technology as well as the continuous progress of each producer in production technology innovation, the functions of smart phone will be well improved, while the mobile learning based on smart phone will welcome bright future with hope.

2. Feasibility analysis of mobile learning based on smart phone applied to English teaching

1. Take the learning objective, learning activity demand and learning characteristics of English subject as primary considerations. English is a language and the objective of learners is to use English as communication tool. The learning activity of English happens in real and natural scenes, which will be more beneficial for learners to digest and absorb. Because smart phone is with very strong mobile and real time interactive features, it can make English training in environment good for learners to learn English during English learning activities. According to the characteristics of English learning, learners can learn English knowledge at any time and any place based on own situation, such as when see English sentences in advertisement, the learners can take a photo, check English words and grammar with electronic dictionary, internet and other functions on phone, learn the word spelling and pronunciation in the sentence. In this way, the continuous accumulation in practical life enables learners to master English knowledge more quickly and accurately (Nunan, 2005).
2. Based on the characteristics of mobile portable device, in current popular mobile devices such as panel computer, MP3/MP4 and intelligent learning machine etc., the reason for selecting smart phone is that it has incomparable advantages than other intelligent terminals. First, the technical advantages of smart phone, such as mobility, connectivity, real time interaction function, good multimedia support and very strong information processing ability etc. are enough to make smart phone superior than other mobile terminals. Second, wireless network technology, streaming media technology, smart phone operation system and other related infrastructures based on the mobile learning of smart phone have been developed and improved continuously (Kikuchi and Browne, 2009). Third, design and development technology of mobile learning system makes the screen of smart phone more suitable for the presentation of English content, while the design of mobile learning resource is with more and more scientific nature, which is in line with the learning thought and learning habit of learners, makes continuous improvement based on the feedbacks of learners and walks toward maturity.
3. Take the use scale of mobile device as reference. It has been shown in the 33rd "Statistical Report on the Development of Internet in China" published by CNNIC (China Internet Network Information Center) in Beijing that till Dec.

2013, China denizens reach 618 million and internet popularity rate is 45.8%. Mobile phone users in China reach 500 million with annual increase rate of 19.1%, continue to keep the position as the first large terminal for internet. It can be seen from this data that more and more people like using smart phone for surfing the internet and dealing with other affairs, which has built solid foundations for smart phone in supporting English teaching.

3. Design of mobile learning teaching mode based on smart phone

3.1. Demand analysis

Demand analysis of mobile learning equals to consider about problems from the perspective of providers of mobile learning. As the designers, developers and controllers, they should control the overall situation, make preliminary analysis and statistics for market demands, features and demand of learners, current development state, following development direction, technical problems and other aspects, understand basic situation and prepare for the better development of mobile learning (Swenson, 2006). The final goal for all demands is serving learners, so the most important is to deeply understand the feedbacks of learners after used by learners, what are the specific demands of mobile learning and design products suitable for the personal habits of learners based on the features of learners, as shown in Figure 1.

3.2. Design of mobile learning scene

The design of mobile learning scene can be understood as the specific situation of learners when making learning activities. It can be seen from the analysis of the third chapter that learners are more inclined to the study state at any time and in any place. The learners described in this paper have not been set up as one group specifically, because any one using smart phone or going to use smart phone can be

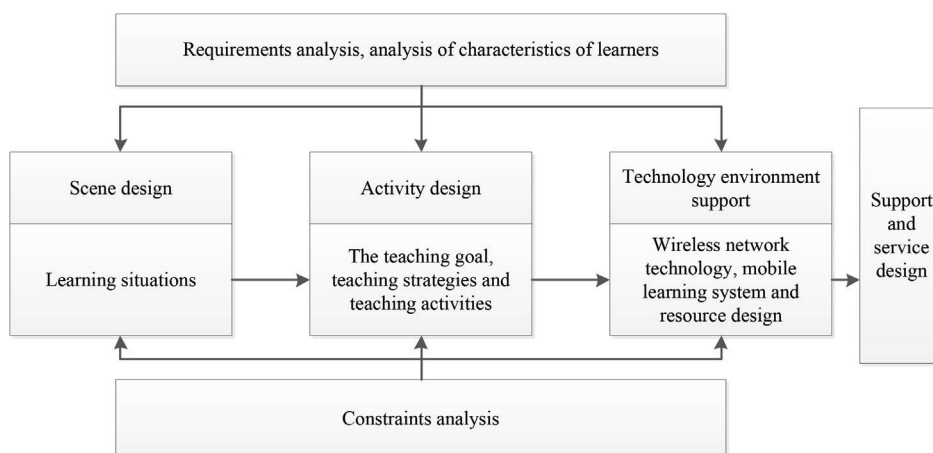


Figure 1 – mobile learning teaching mode

potential learner (Cho, 2004). This paper starts from the perspective and demand of learners generally, because mobile learning has the characteristics of learning at any time and in any place, the learners can use mobile phone to study in any place with mobile wireless network according to their practical needs; they can also download the learning resource to mobile phone for offline study, which enables learners to maximize their spare time for study. Specific scene is as shown in Figure 2.



Figure 2 – Mobile learning scenario design

3.3. Technical environment support

1. Wireless network technology

As introduced in the second chapter, the characteristic of mobile learning is “at any time and in any place”. Wireless network technology needs to present mobile learning resources timely and efficiently at different times and in different places and support learners’ study activities and other interaction contexts. Wireless network technology can well integrate learners, learning resources and learning environment together organically and provide good technical support for mobile learning.

2. Design of mobile learning system

At present, greater progresses have been made in the mobile learning system designed for smart phone in the aspects of categories and functions. All general mobile learning systems have desktop version, mobile version, web version and others (Jones, 2006). The content which can’t be accomplished by learners on smart phone can be realized in other devices, they can login with own account to continue to study generally. Most of

mobile resources in the system provide download functions for learners to use offline. Take the following mobile learning APP as example, as shown in Figure 3.



Figure 3 – Youdao dictionary in Mobile phone

3. Design of mobile learning resources

The mobile device selected in this paper is smart phone, so the design of mobile learning platform needs to consider about various kinds of features of smart phone comprehensively (Sperling and Dipardo, 2008). First, mobile learning resources based on smart phone need to have unified standards and norms. Because the systems and page layout screen sizes of current smart phones are different, difference devices can only realize resource sharing with unified standards and norms. Second, mobile learning resources based on smart phone should fully consider about the characteristics of mobile devices. The designed mobile content should be short and pithy; the connections between knowledge are not strong and try to highlight each crushed learning achievement, which is good for learners to study in spare time. The presentation of mobile learning resources should be simple and comfortable, which enables learners to enter into learning state quickly. At the same time, current learners have very strong demand for personalized demand, so in the design, it is better to highlight the personalized characteristic of mobile learning resource.

3.4. Design of mobile learning support service

The concept of learning support service is from the field of remote education. In remote education, learners and teachers are separated in time and space. Various kinds of difficulties may be encountered in study, including the aspects of study, technology and emotion etc. (Whitty, 2008); all these difficulties need to be solved, or else it will affect the learning quality and effect. As described in the third section of the second chapter, mobile learning has different application modes. Mobile learning support service should provide corresponding service for different modes. This paper has summarized six categories, as shown in table 1.

Type	content
Information service	<i>Learning resources, including the study content, resources, difficult point, feedback, etc</i> <i>Mobile learning services agencies, a teacher or counselor</i> <i>Management information</i> <i>Technical information</i>
Technology support	<i>Wireless communication technology, mobile terminals and other technical support for the motionless</i>
Study strategy support	<i>Autonomous learning method of support, and help learners in learning generalizations of learning skills, help learners master the search method of mobile resources</i> <i>Assist in the support of the learning method, help learners' self assessment and evaluation of others</i>
Emotional support	<i>Clear mobile learning effect evaluation index</i> <i>The relevant person in charge of specific work methods and specific tasks</i>
The support of the management and sustainable development	<i>For mobile learners evaluate the evaluation of the need to take a variety of ways</i>
Feedback evaluation service	<i>Mobile learners are usually in the form of autonomous learning, can pass such as learners' self-evaluation, mutual between learners and learning effect on feedback</i>

Table 1 – Mobile learning support services

4. Application cases of smart phone in English teaching

4.1. Analysis of learner characteristics

The research objects selected in this paper are from all kinds of college students, who are from different regions and learning in different departments; they have very strong learning desire for certain demand of English learning or demand for individual development (Tendero, 2006). As the auxiliary method of traditional classroom and network study, mobile learning will provide certain assistance to improve the study performance and individual growth of learners.

4.2. Design of mobile learning activity

1. Learning objective and content

The learning objective of this case is to recite one article of New Concept English III, ten English words, learn one English proverb, read an English story, listening to English broadcast and propose one problem met in English study in ten days. Explain the mode of mobile English learning through the implementation of specific situation (Butler, 2014). The premise of this case study is that learners already have certain English basic knowledge and need to further expand the English knowledge. Make full use of mobile learning mode, motivate the initiative of learners to study and make the learners experience the pleasure of the other kind of English learning.

2. Implement teaching activity

1. Learners preparation

It is learnt that each learner has own mobile phone, possessing essential condition for mobile learning based on smart phone. On one hand, learners need to get familiar with the software used in this activity and they need to master what are the functions of the software and how to make use of this software to study in advance, and then the study efficiency will not be affected by the software after getting familiar with the software. On the other hand, understand related matter of this study activity and get familiar with activity process.

2. Implementation of mobile learning activity

During the activity, the writer will push mobile learning content to learners every day. Check whether the learners have received the push content and started mobile learning through QQ online situation and download situation, as shown in Figure 4.

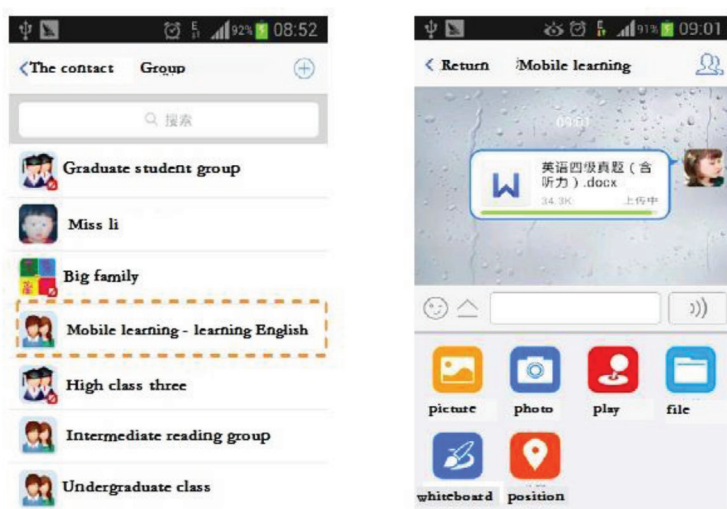


Figure 4 – English learning activities based on the smart phone

4.3. Technical environment support

1. The communication transmission tool selected in this case study is QQ with high use efficiency. The mobile learners can make mutual communication through creating QQ group; at the same time, the writer will upload some English learning material every day for learners to study, such as CET 4 listening, English news broadcast, English examination questions, small English stories and English songs etc (Sonia, 2012). The selection of recite words software is Baicizhan, which strengthens words reciting with sounds and images and improves the efficiency and accuracy for learners to recite words, the software interface is as shown in Figure 5.

2. The network support of this case study is mobile internet GPRS.
3. The mobile learning system of this case study is Android operation system, the version is above 4.0.
4. Part of mobile learning resources of this research is the original resources of learners and the other part is the mobile learning resources provided by the writer, including the following content:

4.4. Case summary

It can be seen that the effect is good through research on mobile learning based on smart phone and the pre-estimated targets have been realized basically: first, the learning method of learners is changing quietly. Learning not only happens in class; the teaching tools are not limited to blackboard, multi-media and electronic white board etc. (Chang, 2009), the teaching mode based on smart phone has provided another program for English reform. In mobile learning, the teachers have become the instructors and designers in teaching, but not leaders or main bodies of teaching, which enables learners to develop and improve their own learning thought, learning consciousness and learning ability gradually in the process of independent learning (Utiyama et al, 2004). Second, the mobile learning based on smart phone expands the learning time and space of learners: not limited to study in classroom or at home and not limited to the time of studying at home (Kiany, 2012). At present, the society presents a trend of information explosion, the knowledge and information acquisition at school can't meet the needs of learners, the learners can visit various kinds of mobile learning resources through mobile learning and study at any time and in any place. They can study the knowledge that they want to learn by making use of their spare time; moreover, mobile learning integrates learners, learning resources and learning environment together, makes learners integrate into learning atmosphere and improve the learning efficiency and effect. Third, mobile learning based on smart phone can make the learners study in game, provide an interesting and vivid learning environment and enable the learners not only learn the English knowledge with form and spirit in study, but also create real scene for English learning by combining the rich animations, music and image information etc. together. In this way, it can inspire the learning interest of learners, strengthen the learning motivation of learners, keep the learning passion of learners and enrich the English knowledge of learners in a better way, as shown in Table 2.

Time	Content	Source
6:00	New concept 3 lessons	YesHJ
8:00	English CET 4 words	The word cut
9:00	English CET 4 exam questions	YesHJ
12:00	English proverbs, little story	YesHJ
15:00	Voice of American	Ace English network
20:00	English songs	Song taste
23:30	Ask a day	30 the learner

Table 2 – Mobile learning resources



Figure 5 – The word user interface

5. Conclusions

This paper has summarized and designed mobile learning teaching mode suitable for smart phone through feasibility analysis of mobile learning based on smart phone in supporting English teaching, which provides realistic evidence for the teaching mode design of mobile learning, increases practical application case for the theory of mobile learning and solves the problems of lacking situational interaction in traditional English teaching and limitations in learning time and place etc. Finally, explain the application of mobile learning in English teaching through the research on specific cases of learning on smart phone. Following conclusions can be drawn through above researches:

1. Research objects of mobile learning have been improved in interest degree, habit of learning thought as well as cognition level for English knowledge, which proves that mobile learning is an effective supplement for traditional teaching.
2. The writer has proposed English teaching mode based on smart phone through theoretical exploration and it has been proven through practice that this mode can increase the English knowledge for learners on original basis and have certain effect on improving the performance of learners.

Acknowledgments

Fund program: Soft Science Program of Science and Technology Agency in Henan province (142400411422); Youth Fund of Luoyang Institute of Science and Technology (2011QR13);

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Decision Making for Reliable Functional Logistics Provider Selection based on DIFHWG Operator

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Pages: 96–105

Abstract: The integrated logistics service network is a network organization composed of logistics service integrator and functional logistics provider, which integrates the resources of functional logistics provider to complete the demand of clients. The important issue for logistics service integrator is to choose the reliable functional logistics provider. In view of this, a reliability measurement and evaluating criteria of functional logistics provider are put forward. Then, a method based on dependent intuitionistic fuzzy hybrid weighted geometric operator (DIFHWG) for selection functional logistics provider is developed. Furthermore, some of main properties and particular cases of the DIFHWG operator are studied. Finally, an experimental analysis is provided to illustrate the validity and applicability of the method developed in this paper.

Keywords: integrated logistics service network, functional logistics provider, DIFHWG Operator.

1. Introduction

The integrated logistics service network is a network organization composed of logistics service integrator and functional logistics provider, who has the ability to make independent decisions, by a certain supply and demand chain to meet client's logistics requirements (Wang, 2015). As a kind of core corporation, the logistics service integrator integrates the resources of functional logistics provider to complete the demand of clients, among which is accompanied by materials flow, capital flow and information flow.

In the integrated logistics service network, logistics service integrator is the core business which plays an important role as a center commander. It receives client's operation information, and conveys the demand information to functional logistics provider, along with issuing operation instructions according to client's operation requirements conveying to functional logistics provider and getting the feedback of its outcome to the client.

Logistics service integrator is the designer and organizer in the whole logistics activities (Wang, 2015). It needs to integrate all member companies' resources and processes, and coordinate logistics service operation in the overall situation. Functional logistics provider is a participant of vital importance for integrated logistics service, including logistics provider of the warehousing-oriented, transportation-oriented, distribution-oriented,

finance-oriented, distribution processing-oriented, information-oriented and the like (Dong, 2005). Due to the storage and transportation accounts for more than two-thirds of total logistics cost, functional logistics providers mainly are warehousing-oriented, transportation-oriented, and with the increase of customer's demand for distribution services, distribution-oriented logistics provider also is becoming an important participant.

In terms of tangible measure for the quality of products, reliability makes a significant index. For intangible service products in logistics, reliability must be given full attention. Logistics service integrator, as a key corporation, must offer reliable products of logistics service to meet clients' demand for production and sales. Only by this way is it possible to establish their own competitive edge. It has to coordinate each member companies' functional logistics service. Reliable and quick response to customers' demand gradually becomes an indispensable partner in overall operating strategy. For logistics service integrator, it must choose reliable functional logistics provider which is directly related to customer satisfaction index as well as their own interests.

2. Literature review

Academia started research regarding the supplier selection of logistics services in the sixties. Murphy et al. (2000) analyzed the key factors in a successful relationship from both supplier and user perspectives, whereas Gotzamani et al. (2010) paid special attention to quality-related factors and deliberated the relationship between quality management and financial performance of 3PL. Vaidyanathan (2005) proposed a 3PL evaluation framework that comprised six major criteria of IT, quality assurance, cost, services, performance, and intangibles. Chidambaranathan and Muralidharan (2009) and others offered the three indexes involving quality, punctuality on goods delivery and technical facilities to study on the issues of selection and assessment of supplier under the circumstance of supply chain. Menon et al. (1998) proposed assessment indicator system applied in third-party logistics service providers on the basis of empirical study, which were price, punctuality on goods delivery, financial condition, corporation reputation, management ability, capacity of fulfillment and reaction to unpredictable things. Hu (2005) introduced the assessment criteria of selection for logistics service suppliers in terms of technology, quality, delivery, cost and environment through the on-site investigation of Agilent Technologies Co., Ltd. Ruriani (2004) believed that customer service, shipping cost, profitability, automatically get-help should be taken into consideration as to the selection of third-party logistics service providers. Saen (2010) identified service-quality experience and service-quality credence as dual-role factors when selecting third-party reverse logistics suppliers. Tian (2010) offered three criteria of the competitiveness analysis index system of logistics service suppliers, which includes price, quality, and customer service.

The research regarding the criteria of the supplier selection consists of the perceived performance and the perceived capabilities of logistics enterprises. The reliability is an important performance factor especially to the selection of functional logistics provider.

3. Reliability evaluation criteria for functional logistics provider

When contracting customer's logistics business, its service integrator would make a promise to reach a certain standard of service. If the whole integrated logistics

service operation cannot reach the corresponding service standard that would prove to be unreliable.

In the table of SERVQUAL proposed in 1998 by PAB, three of them believed that the reliability of service quality is a kind of capability which can reliably and precisely perform the service that has been promised by company (Parasuraman et al, 1988; Sá et al., 2016). It also implies that company must perform their services they once promised continuously, unmistakably and promptly. Continuity means the reliable and stable service, coupled with the accurate and prompt quality of service. With a view to the level of logistics service, its reliability is shown in the process of completing logistics tasks securely, promptly and continuously in each of logistics service units. When selecting the reliability evaluation index for logistics service integrator, customer's requirements for the quality of logistics service must be taken into consideration.

For functional logistics provider, reliability is mainly embodied in the reliability of logistics capability, time for logistics service, and safety of goods, either warehousing functional provider or transportation provider. In order to optimize functional logistics provider, the reliability of functional logistics provider would be discussed as follows in terms of logistic service integrator.

3.1. Reliability of logistics capability

A certain amount of logistics capability must be put into operation for the need of certain tasks completed by integrated logistics service. But in some cases, either subjective causes or objective causes, it is difficult for logistics capability to meet the logistics demand, and meanwhile, there would exist problems of reliability for logistics capability. Customers might question about the ability of logistics service integrator, affecting the operation of integrated logistics network. Therefore, the reliability of logistics capability must be given top priority when measuring the reliability of logistics service unit. Especially when most of logistics service integrator lacked the resources of logistics capability, they needed to integrate the resources given by functional logistics provider. Integration capability, strong or weak, was incorporated at first in the quantities of integration of logistics capability resources.

3.2. Reliability of logistics service time.

Completing the promise of logistics service is an important element in a specific time. Time is an extremely important controlling point in each links of logistics service, directly influencing the value creation of integrated logistics service network.

The basic target for logistics service integrator realizing the resources integration of functional provider is to coordinate every joints of logistics chain, ensuring that every joints of this chain can complete the logistics tasks promptly and so as to enhance the overall effectiveness. Thus, in order to ensure the reliability of time for logistics service, logistics service integrator has to measure the reliability of time.

3.3. Reliability of goods safety

The fundamental service goal is to ensure the value in use of goods during the process of logistics service. Logistics service integrator would focus on the security and reliability

of goods when organizing and coordinating each functional logistics providers. For transportation providers, when goods arrived at designated place, it must check the damage status of goods. For warehousing functional provider, it usually paid attention to the damage status of goods in warehousing storage and transportation. For distribution-oriented function provider, it would monitor the damage status of goods in the process of sorting and distribution. Therefore, logistics service integrator must measure reliability of goods safety for functional logistics provider.

For functional logistics provider without any previous cooperative experience, these three reliability indexes of data are difficult to acquire, it must apply the decision methods to select functional logistics provider.

4. Decision making model for functional logistics provider selection based on DIFHWG operator

Basically, the nature of the supplier selection is as a type of multi-criterion decision-making (MCDM) problem based on the relative priority assigned to each selection criterion. A considerable number of decision models have been developed based on the MCDM theory, such as analytical hierarchy process (AHP), analytic network process (ANP), total cost ownership (TCO), and data envelopment analysis (DEA). Now a new decision making model based on intuitionistic fuzzy set is introduced.

4.1. Basic knowledge for intuitionistic fuzzy set

Intuitionistic fuzzy set is a kind of expansion and development of traditional fuzzy set. Compared with it, intuitionistic fuzzy set is more in line with decision-maker's thinking habit in which to show affirmation, negation, and hesitation. when dealing with the problem with ambiguity and uncertainty, intuitionistic fuzzy set is more flexible and pragmatical.

Assume that $X = \{x_1, x_2, \dots, x_n\}$ is an non-empty set, then,

$$A = \{ \langle x, \mu_A(x), \nu_A(x) \rangle | x \in X \} \quad (1)$$

Which can be referred to as intuitionistic fuzzy set, where number $\mu_A(x)$ or number $\nu_A(x)$ is the element x of X that respectively belongs to membership degree and non-membership degree of A .

That is,

$$\mu_A : X \rightarrow [0,1], x \in X \rightarrow \mu_A(x) \in [0,1] \quad (2)$$

$$\nu_A : X \rightarrow [0,1], x \in X \rightarrow \nu_A(x) \in [0,1] \quad (3)$$

And with the condition,

$$0 \leq \mu_A(x) + v_A(x) \leq 1, \forall x \in X \quad (4)$$

Additionally,

$$\pi_A(x) = 1 - \mu_A(x) - v_A(x), \forall x \in X \quad (5)$$

To express that the element x of X belongs to hesitancy degree or uncertainty of A .

If $\pi_A(x) = 1 - \mu_A(x) - v_A(x), \forall x \in X$, then A is degenerated into fuzzy set of Zadeh.

Concisely, $\alpha = (\mu_\alpha, v_\alpha)$ is referred to as intuitionistic fuzzy number (Xu, 2007), in which,

$$\mu_\alpha \in [0,1], v_\alpha \in [0,1], \mu_\alpha + v_\alpha \leq 1 \quad (6)$$

And assume that number Ω is the set of all intuitionistic fuzzy numbers,

For any intuitionistic fuzzy number $\alpha = (\mu_\alpha, v_\alpha)$ can be evaluated by using score function s :

$$s(\alpha) = \mu_\alpha - v_\alpha \quad (7)$$

$s(\alpha)$ is the score value of α , $s(\alpha) \in [-1,1]$. thus it can be seen, from the above formula 4, the score of intuitionistic fuzzy number α is the difference between membership degree μ_α and non-membership degree v_α , namely, the greater the difference between μ_α and v_α is, the bigger $s(\alpha)$ is, coupled with the increase of intuitionistic fuzzy number α as well.

Hong and Choi (2000) defined an exact function:

$$h(\alpha) = \mu_\alpha + v_\alpha \quad (8)$$

Number h is the exact function of α , $h(\alpha)$ is the degree of accuracy for α , $h(\alpha) \in [0,1]$. and the degree of accuracy for intuitionistic fuzzy number α would be increased as the value of $h(\alpha)$ is increasing.

Based on above analysis on score function s of intuitionistic fuzzy number and exact function h , Xu (2007) introduced an ordering method about intuitionistic fuzzy number:

Assume that $\alpha_1 = (\mu_{\alpha_1}, v_{\alpha_1})$ and $\alpha_2 = (\mu_{\alpha_2}, v_{\alpha_2})$ are two intuitionistic fuzzy numbers, $s(\alpha_1) = \mu_{\alpha_1} - v_{\alpha_1}$ and $s(\alpha_2) = \mu_{\alpha_2} - v_{\alpha_2}$ are respectively the score of α_1 and α_2 , $h(\alpha_1) = \mu_{\alpha_1} + v_{\alpha_1}$ and $h(\alpha_2) = \mu_{\alpha_2} + v_{\alpha_2}$ are respectively the accuracy of α_1 and α_2 , then,

1. If $s(\alpha_1) < s(\alpha_2)$, then α_1 is less than α_2 , namely, $\alpha_1 < \alpha_2$
2. If $s(\alpha_1) = s(\alpha_2)$, then,
 - If $h(\alpha_1) < h(\alpha_2)$, then α_1 is less than α_2 , $\alpha_1 < \alpha_2$;

- If $h(\alpha_1)=h(\alpha_2)$, then α_1 equals α_2 , $\alpha_1 = \alpha_2$;
- If $h(\alpha_1)>h(\alpha_2)$, then α_1 is greater than α_2 , $\alpha_1 > \alpha_2$.

Supposed that $\alpha=(\mu_\alpha, v_\alpha)$, $\alpha_1=(\mu_{\alpha_1}, v_{\alpha_1})$ and $\alpha_2=(\mu_{\alpha_2}, v_{\alpha_2})$ are three arbitrary intuitionistic fuzzy numbers, then, the operational rule are as follows (Xu, 2007):

1. $\alpha_1 \oplus \alpha_2 = (\mu_{\alpha_1} + \mu_{\alpha_2} - \mu_{\alpha_1} \mu_{\alpha_2}, v_{\alpha_1} v_{\alpha_2})$;
2. $\alpha_1 \otimes \alpha_2 = (\mu_{\alpha_1} \mu_{\alpha_2}, v_{\alpha_1} + v_{\alpha_2} - v_{\alpha_1} v_{\alpha_2})$;
3. $\lambda \alpha = (1 - (1 - \mu_\alpha)^\lambda, v_\alpha^\lambda)$, $\lambda > 0$;
4. $\alpha^\lambda = (\mu_\alpha^\lambda, 1 - (1 - v_\alpha)^\lambda)$, $\lambda > 0$

4.2. Decision-making Procedures

As for the issue of decision making for intuitionistic fuzzy multicriteria group, let $A=\{A_1, A_2, \dots, A_m\}$ be an alternative set, $D=\{D_1, D_2, \dots, D_t\}$ be the set for decision-makers, and $G=\{G_1, G_2, \dots, G_n\}$ be an criteria set, then decider, $D_k \in D$ would measure plan $A_i \in A$ about criteria $G_j \in G$, so that the decision-making matrix $R^{(k)} = (r_{ij}^{(k)})$ ($k=1, 2, \dots, t$) is made, $r_{ij}^{(k)} = (\mu_{ij}^{(k)}, v_{ij}^{(k)})$ is intuitionistic fuzzy number. $\lambda = (\lambda_1, \lambda_2, \dots, \lambda_n)^T$ is the expert weight vector, $\lambda_k \in [0, 1]$ and $\sum_{k=1}^t \lambda_k = 1$. $w = (w_1, w_2, \dots, w_n)$ is the criteria weight vector, $w_j \in [0, 1]$ and $\sum_{j=1}^n w_j = 1$.

Methods and procedures of intuitionistic fuzzy decision-making matrix based on IFWG operator and DIFHWG operator are as follows:

Step 1 Utilize IFWG operator to gather criteria value in the i line of intuitionistic fuzzy decision-making matrix $R^{(k)}$, making the decider D_k obtain Individual comprehensive criteria value of decision alternative A_i .

Assume that $\alpha_j = (\mu_j, v_j)$ ($j=1, 2, \dots, n$) is a set of intuitionistic fuzzy number, and suppose that IFWG: $\Omega^n \rightarrow \Omega$, if

$$IFWG_w(\alpha_1, \alpha_2, \dots, \alpha_n) = \alpha_1^{w_1} \otimes \alpha_2^{w_2} \otimes \dots \otimes \alpha_n^{w_n} = \prod_{j=1}^n \alpha_j^{w_j} \quad (9)$$

Then, call IFWG as intuitionistic fuzzy weighted geometric operator, in which, $w = (w_1, w_2, \dots, w_n)^T$ is the criteria weight vector of α_j ($j=1, 2, \dots, n$), $w_j \in [0, 1]$, and $\sum_{j=1}^n w_j = 1$.

According to algorithm,

$$IFWG_w(\alpha_1, \alpha_2, \dots, \alpha_n) = \left(\prod_{j=1}^n \mu_j^{w_j}, 1 - \prod_{j=1}^n (1 - v_j)^{w_j} \right) \quad (10)$$

$$r_i^{(k)} = IFWG_w(r_{i1}^{(k)}, r_{i2}^{(k)}, \dots, r_{in}^{(k)}), i=1, 2, \dots, m, k=1, 2, \dots, t \quad (11)$$

are obtained.

Step 2 Calculate intuitionistic fuzzy similarity

Assume that $\alpha_1 = (\mu_{\alpha_1}, \nu_{\alpha_1})$ and $\alpha_2 = (\mu_{\alpha_2}, \nu_{\alpha_2})$ are two arbitrary intuitionistic fuzzy numbers, $\alpha_2^c = (\nu_{\alpha_2}, \mu_{\alpha_2})$ is the supplementary set of α_2 , then

$$s(\alpha_1, \alpha_2) = \begin{cases} 0.5, & \alpha_1 = \alpha_2 = \alpha_2^c \\ \frac{d(\alpha_1, \alpha_2^c)}{d(\alpha_1, \alpha_2) + d(\alpha_1, \alpha_2^c)}, & \text{other} \end{cases} \quad (12)$$

is the similarity of α_1 and α_2 , in which,

$$d(\alpha_1, \alpha_2) = \frac{1}{2} (|\mu_{\alpha_1} - \mu_{\alpha_2}| + |\nu_{\alpha_1} - \nu_{\alpha_2}| + |\pi_{\alpha_1} - \pi_{\alpha_2}|) \quad (13)$$

is the Standard Hamming distance between α_1 and α_2 .

Thus, the value of intuitionistic fuzzy similarity is

$$s(r_i^{(k)}, x_i) = \begin{cases} 0.5, & r_i^{(k)} = x_i = x_i^c \\ \frac{d(r_i^{(k)}, x_i^c)}{d(r_i^{(k)}, x_i) + d(r_i^{(k)}, x_i^c)}, & \text{other} \end{cases} \quad (14)$$

In which, x_i is intuitionistic fuzzy $(r_i^{(1)}, r_i^{(2)}, \dots, r_i^{(t)})$ average value.

Step 3 Use DIFHWG operator to gather individual comprehensive criteria value of decision alternative A_i made by decider t , obtaining group comprehensive criteria value.

Assume that $\alpha_j = (\mu_j, \nu_j)$ ($j=1, 2, \dots, n$) is a set of intuitionistic fuzzy number, and suppose DIFHWG: $\Omega^n \rightarrow \Omega$, if

$$DIFHWG_{\omega(j)}(\hat{a}_1, \hat{a}_2, \dots, \hat{a}_n) = \prod_{j=1}^n \hat{a}_j^{\frac{\hat{a}(\sigma(j))}{\sum_{j=1}^n \hat{a}(\sigma(j))}} \quad (15)$$

In which, $\hat{a}_j = n\omega_j\alpha_j$, $(\sigma(1), \sigma(2), \dots, \sigma(n))$ is the substitution of $(1, 2, \dots, n)$, making arbitrary j , with the condition $\hat{a}_{\sigma(j-1)} \geq \hat{a}_{\sigma(j)}$, $\omega = (\omega_1, \omega_2, \dots, \omega_n)^T$ is the weight vector of $\alpha_j = (\mu_j, \nu_j)$ ($j=1, 2, \dots, n$), and with the condition $\omega_j \in [0, 1]$ and $\sum \omega_j = 1$, number n is a balance coefficient, then term DIFHWG as dependent intuitionistic fuzzy operator of mixed weighted geometric aggregation.

$$r_i = DIFHWG\left(r_i^{(1)}, r_i^{(2)}, \dots, r_i^{(t)}\right) = \prod_{j=1}^n \left(t \lambda_k r_i^{(k)}\right)^{\frac{s\left(r_i^{(k)}, x_i\right)}{\sum_{k=1}^t s\left(r_i^{(k)}, x_i\right)}} \quad (16)$$

Step 4 Through the rule of comparing intuitionistic fuzzy number, we may obtain the order of $r_i (i=1,2,\dots,m)$, giving the alternatives rank.

5. Case analysis in decision making of functional logistics provider selection

A logistics service integrator who lacks any operation experience looks for a special line transportation function provider for his key customer, now there exists 5 available provides of transportation function $A_i (i=1,2,\dots,5)$. A group of expert team consists of four experts (decision makers) $D_k (k=1,2,3,4)$ are familiar with the market utilizing the following evaluation attributes to assess transportation function provider, and weight vector is $\tilde{e}=(0.3,0.2,0.3,0.2)$.

1. G_1 —reliability of logistics capability
2. G_2 —reliability of time for logistics service
3. G_3 — reliability of safety of goods.

Defining the weight vector of index $w=(0.3,0.35,0.35)$ according to customer's requirements. Expert $D_k (k=1,2,3,4)$ describe each functional logistics provider's $A_i (i=1,2,\dots,5)$ features on the basis of intuitionistic fuzzy numbers $r_{ij}^{(k)} (i,j=1,2,\dots,5)$ with the index of $G_j (j=1,2,3)$ as shown in table 1-table 4.(that is intuitionistic fuzzy decision matrix $R^{(k)} = \left(r_{ij}^{(k)}\right)_{5 \times 3} (k=1,2,3,4)$).

Reliability Provider	G_1	G_2	G_3
A_1	(0.4,0.5)	(0.5,0.2)	(0.6,0.2)
A_2	(0.6,0.2)	(0.7,0.2)	(0.3,0.4)
A_3	(0.7,0.3)	(0.8,0.1)	(0.5,0.5)
A_4	(0.3,0.4)	(0.7,0.1)	(0.6,0.1)
A_5	(0.8,0.1)	(0.3,0.4)	(0.4,0.5)

Table 1 – Intuitionistic fuzzy decision matrix $R^{(1)}$

Reliability Provider	G_1	G_2	G_3
A_1	(0.5,0.3)	(0.6,0.1)	(0.7,0.3)
A_2	(0.7,0.2)	(0.6,0.2)	(0.4,0.4)
A_3	(0.5,0.3)	(0.7,0.2)	(0.6,0.3)
A_4	(0.5,0.4)	(0.8,0.1)	(0.4,0.2)
A_5	(0.7,0.3)	(0.5,0.4)	(0.6,0.3)

Table 2 – Intuitionistic fuzzy decision matrix $R^{(2)}$

Reliability Provider	G_1	G_2	G_3
A_1	(0.6,0.3)	(0.5,0.2)	(0.6,0.4)
A_2	(0.8,0.2)	(0.5,0.3)	(0.6,0.4)
A_3	(0.6,0.1)	(0.8,0.2)	(0.7,0.3)
A_4	(0.6,0.3)	(0.6,0.1)	(0.5,0.4)
A_5	(0.8,0.1)	(0.6,0.2)	(0.7,0.3)

Table 3 – Intuitionistic fuzzy decision matrix $R^{(3)}$

Reliability Provider	G_1	G_2	G_3
A_1	(0.3,0.4)	(0.9,0.1)	(0.8,0.1)
A_2	(0.7,0.1)	(0.7,0.3)	(0.4,0.2)
A_3	(0.4,0.1)	(0.5,0.2)	(0.8,0.1)
A_4	(0.8,0.2)	(0.5,0.1)	(0.6,0.4)
A_5	(0.6,0.1)	(0.8,0.2)	(0.7,0.2)

Table 4 – Intuitionistic fuzzy decision matrix $R^{(4)}$

Step 3 Gather the individual comprehensive criteria value of decision alternative A_i made by decider t by using DIFHWG operator to obtain the group comprehensive criteria value of decision alternative A_i .

$$r_1 = (0.561, 0.271), r_2 = (0.541, 0.281), r_3 = (0.615, 0.275), r_4 = (0.548, 0.255), \\ r_5 = (0.597, 0.282).$$

Step 4 Through the comparison of intuitionistic fuzzy number rules, the order of $r_i (i=1,2,\dots,5)$ has been made to rank the plan.

6. Conclusion

This method is quick, simple and convenient for calculating as to fully making use of existing information, along with eliminating the influence on some unfair subjective factors made by deciders, and meanwhile avoiding the irrationality of decision results. By using DIFHWG operator, it can laid a solid foundation for enhancing reliability for integrated logistics service to optimize functional logistics provider on the premise that we are not familiar with the reliability performance of functional logistics provider.

Acknowledgements

This paper is funded by Project supported by the Open Foundation from Marine Sciences in the Most Important Subjects of Zhejiang (No.20140207).

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Research on Optimization of Automobile After-sale Service Supply Chain Network Based on Big Data Processing

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Pages: 106–116

Abstract: This paper speculates the use behavior characteristics of clients, constructs user portrait and uses collaborative filtering recommendation algorithm to measure the similarity between users based on current situation of after-sale service and existing problems in 4S shop and through measuring, reading and integrating static user basic data, dynamic driving data as well as the loss of auto parts etc. with adoption of intelligent network platform; at the same time, predicts the service program requested by client and service opportunity and constructs active, intelligent and networked automobile after-sale service innovation model with combination of related data of real time traffic and weather etc. and based on preferences of nearest neighbor set accepting service.

Keywords: Automobile after-sale service, supply chain network, big data process.

1. Introduction

Based on the data results of “Statistical Bulletin of National Economy and Social Development” published by National Bureau of Statistics, till the end of 2013, our car ownership has exceeded 137 million and the sales of new car increases rapidly every year at the speed of tens of millions of vehicles. It is also estimated that till 2018, the automobile related telecommunications, hardware and software service market size will reach 51 billion dollars. In automobile industry, the general automobile after-sale service market is about four times of before market and this digit is over five times in America (Sellitto et al, 2010). In addition, the profit attained from aftermarket accounts for 60% to 70% of the total profit of the whole automobile industry chain. It can be said that automobile aftermarket is the most stable profit “motor” in automobile industry chain. The ratio of new car and old car in domestic 4S shop is 4:6, in which the average profit rate of old car is above 11.5%, which is much higher than that of new car at 4.5%. Based on the prediction of experts, till 2015, the aftermarket size of China automobile will exceed America, attain the top place in global automobile market and the mixed operation mode of 4S shop will be copied in Chinese market in the near future.

The rapid development of internet big data not only provides convenience to the vast majority of users, but also produces great user stickiness and dependence. Automobile aftermarket is a cake with huge profit and traditional operation mode does not make good use of the product of era development (Rubin, 1997). For the special traditional industry of automobile, the essence of internet is tool, which can't be completely replaced by entity, while it can realize optimization upgrading for the service of automobile aftermarket and even the service of the whole industry chain by depending on intelligent network platform, which can combine manufacturer, service provider and user closely in a better way, waken the large amount of data, realize the real time of demand response and promote service to client in a more accurate way (Huang, 1998; Faria et al., 2015).

2. Current situation of automobile after-sale service

1. System is not sound and market order is chaotic

Automobile after-sale service industry lacks industry standards and perfect laws and regulation system and one set of scientific, systematic and standard service process has not been established; therefore, automobile after-sale service does not follow up the times development as well as the improvement of user demand layer closely (Goloboff, 1999). On one hand, it is because the government does not publish related policies, laws and regulations to standardize the automobile after-sale service and does not set up special responsible department to plan, monitor and manage related enterprises and practitioners; on the other hand, as there are numerous automobile brands, there are a lot of providers for corresponding automobile after-sale service and the phenomenon mixed with good and bad is inevitable.

2. Weak service consciousness, shortage of information feedback

At present, domestic auto stores put more attention to the sales number, but lack the attention to user service and do not have the thought of serving clients wholeheartedly. Some suppliers of automobile after-sale service pay more attention to the profit brought about by changing automobile parts while providing service to car owners, but not start from the perspective users, examine faults and reasons carefully and propose of changing auto parts randomly, while the users take the advice without understand the practical health situation of the car and their own legitimate rights and interests have been damaged (Ramaswamy, 2000).

3. Single service category and low parts quality

There is certain gap between the after-sale service level for automobile in our country and automobile after-sale maintenance technology abroad. Some suppliers of automobile after-sale service have reached the international level in image presentation and service equipment, but the service level and technical level can meet the increasingly personalized demand of users, some even can't meet the basic demand of users. Certain shortages and defects even exist in the quality of practitioners.

3. Realization of automobile after-sale service network based on big data platform

3.1. Analysis of user clustering and user behavior

1. Purpose of user clustering

The so-called user clustering, as the term suggests, it is to cluster users with the same property, the same characteristic and the same preferences into one class subset, and then make it convenient to manage specific user group service recommendation in customer relationship management work. Good clustering method can make us understand the data group characteristics clearly and decrease the complexity of analysis effectively (Torralba et al, 1958). On intelligent network platform, based on the brands, models, ages of users and other properties of the driven cars, divide users with greater similarity into subset of the same category, predict the service programs requested by target users through summarizing the service programs that users accept most and then reach the purpose of changing passive service to active service.

2. Validity measured based on clustering distribution

1. Cluster density

Cluster density is a measurement for intra cluster variance, the smaller variance, the higher identity of data set. Given one data set X and its intra cluster variance is defined as formula (1):

$$\text{var}(x) = \frac{1}{N} \sum_{i=1}^N \text{distance}(x_i, \bar{x}) \quad (1)$$

In which, $\text{distance}(x_i, \bar{x})$ is the distance between samples x and $\bar{x}$, N is the number of total samples and $\bar{x}$ is the mean value of X . For cluster results $C_1, C_2, \dots, C_i$, cluster density is defined as formula (2):

$$\text{cmp} = \frac{1}{C} \sum_{i=1}^C \text{var}(C_i) / \text{var}(x) \quad (2)$$

In which C is the number of cluster and $\text{var}(C_i)$ is the variance of cluster C_i .

The smaller cluster density, the smaller, but in extreme conditions, when each sample is alone into one class, the cluster density is 0.

2. Cluster proximity

Cluster proximity is defined as formula (3):

$$\text{prox} = \frac{1}{C(C-1)} \sum_{i=1}^N \sum_{f=1, f \neq i}^C \text{distance}(\bar{x}_i, \bar{x}_f) \quad (3)$$

Each cluster should be separated effectively, and then the bigger cluster proximity, the better.

3.2. Correlation matching between customer characteristic and service program

Take the driving habits, behavioral features and other properties of clients as vectors, construct N-dimension space, compare the difference between customer value and standard value on each property and then select other clients with high similarity with one client in habit and preference and then do base for the recommended unused service project for it (Tsang et al, 2005). This kind of customer characteristics and service program correlation matching are widely applied in e-commerce and commonly used calculation methods for similarity include the following:

First, Euclidean Distance: it is firstly used to calculate the distance between two points in Euclidean space. Assume x, y are two points in n -dimension space and the Euclidean distance between them is as shown in formula (4):

$$d(t, f) = \sqrt{|x_{t1} - x_{f1}|^2 + |x_{t2} - x_{f2}|^2 + \dots + |x_{ti} - x_{fi}|^2} \quad (4)$$

It can be seen that when $n=2$, Euclidean Distance is the distance between two points on plane. When use Euclidean Distance to express similarity, it generally adopts following formula to convert, the smaller distance, the bigger similarity (at the same time, avoid divisor at 0). Second, Manhattan Distance, as shown in formula (5):

$$d(t, f) = |x_{t1} - x_{f1}| + |x_{t2} - x_{f2}| + \dots + |x_{ti} - x_{fi}| \quad (5)$$

Third, Minkowski Distance, as shown in formula (6):

$$d(t, f) = \sqrt[p]{|x_{t1} - x_{f1}|^p + |x_{t2} - x_{f2}|^p + \dots + |x_{ti} - x_{fi}|^p} \quad (6)$$

The above three are relatively traditional calculation methods, take the service evaluation index of two clients as two points in N -dimension space and express their similarity degree through calculating the distance between them. But the results calculated through this method are with great deviation, especially when there are few intersections of two clients in their experienced service programs (Tegmark, 1996).

Fourth: Cosine-based Similarity: regard the evaluation scores of clients u_1 and u_2 for service program are two vectors in space, similarity calculation is made based on calculating the Cosine angles of two vectors, and then, for $m \times n$ scoring matrix, the calculation formula for the similarity $\text{sim}(u_1, u_2)$ of u_1 and u_2 is as shown in formula (7).

$$\text{slm}(u_1, u_2) = \cos(u_1, u_2) = \frac{u_1 u_2}{|u_1| |u_2|} \quad (7)$$

Cosine-based similarity method is the user similarity comparison method commonly used in user personalized service in current e-commerce field. It can be seen that cosine-based similarity method judges similarity degree through calculating the angles of two client evaluation vectors; compared with the distance between two points in the space, it can compare the relationship of user in service preference tendency effectively (Kovar and Gleicher, 2004). But this method still has shortages in program recommendation of automobile after-sale service. The using frequency of e-commerce is higher and there are more user evaluations, which has formed social atmosphere. User can form mutually similar evaluation scale through traffic commodity evaluation information, for example, rate five stars for satisfied goods and service has become a popular trend (Loosli, 2007). However, compared with e-commerce service, the using frequency of automobile after-sale service is less and clients do not know the evaluation scale of other people, therefore, there will be great deviation in scoring among users, which will affect the evaluation results.

Fifth, Pearson correlation coefficient: to make the calculation results more accurate, it needs to find the service program which has been evaluated by clients together (Chen, 2014). Record the automobile after-sale service program set experienced by users together as $l_{u1,u2}$, and then the calculation formula of cosine correlation coefficient of corresponding two clients is as shown in formula (8):

$$\text{sim}(u1, u2) = \frac{\sum (R_{u1t} - \overline{R_{u1}})(R_{u2t} - \overline{R_{u2}})}{\sqrt{|u_{t1} - u_{f1}|^2 + |u_{t2} - u_{f2}|^2}} \quad (8)$$

Based on above problems, this research makes modification for traditional cosine-based similarity and Pearson correlation coefficient and forms improved cosine-based similarity- Pearson correlation coefficient. The basic thought and using method is as shown in formula (9).

$$\text{sim}(u1, u2) = \frac{\sum (R_{u1t} - \overline{R_{u1}})(R_{u2t} - \overline{R_{u2}})}{\sqrt{|u_{t1} - u_{f1}|^2 + |u_{t2} - u_{f2}|^2}} \cdot \frac{|R_{u1} \cap R_{u2}|}{|R_{u1} \cup R_{u2}|} \cdot \left(1 - \frac{R_{u1,t} - R_{u2,t}}{R}\right) \quad (9)$$

3.3. Prediction of service program and service opportunity

To make full use the advantages of internet company in data, recommendation of most current scenes adopts hybrid recommendation model, for example, the method recommended in the advertisement promotion of one internet company is hybrid method of “high latitude parallel algorithm” and “superimposed enhanced CF algorithm”, its recommendation effect has been improved greatly, as shown in Figure 1.

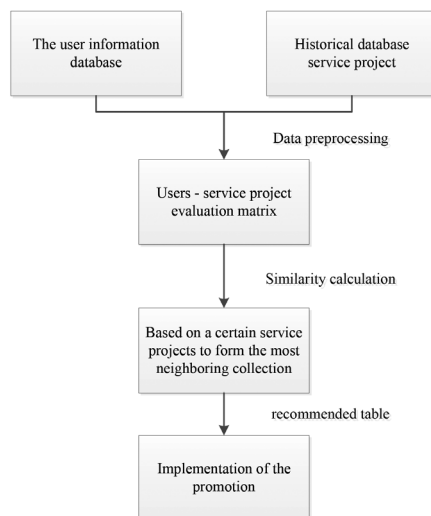


Figure 1 – Collaborative filtering flow chart

4. Empirical research

4.1. User clustering

Some differences in system, parts and performance etc. exist in different automobile brands and different models of the same brand. At the same time, the category client accepted for automobile after-sale service is greatly determined by the automobile brand and model purchased and driven by client. For the division of user group, it mainly refers to the driven automobile brand and model. This research takes client of “Magotan 87L” as research object and gets 167 service records after senior selection, as shown in Figure 2.

#	A	B	C	D	E
1	Type	Factory	mileage	Fault description	
2	0	Magotan E7L	5312	The first confirmed	
3	3	Magotan E7L	5362	G17	
4	5	Magotan E7L	2065	Car accident	
5	0	Magotan E7L	5365	The first confirmed	
6	2	Magotan E7L	5254	The difference	
7	2	Magotan E7L	45655	refueling	
8	2	Magotan E7L	4410	maintenance	
9	0	Magotan E7L	4425	maintenance	
10	3	Magotan E7L	6035	buy materials	
11	0	Magotan E7L	6562	The first confirmed	
12	0	Magotan E7L	5545	The first confirmed	
13	0	Magotan E7L	5465	The first confirmed	
14	2	Magotan E7L	3365	refueling	
15	0	Magotan E7L	2556	buy materials	
16	3	Magotan E7L	5695	The first confirmed	
17	2	Magotan E7L	8451	The first confirmed	
18	2	Magotan E7L	2301	The first confirmed	
19	1	Magotan E7L	2568	The first confirmed	
20	3	Magotan E7L	8859	buy materials	
21	2	Magotan E7L	4100	maintenance	
22	0	Magotan E7L	3658	Check the water leakage	
23	3	Magotan E7L	9896	The first confirmed	
24	2	Magotan E7L	5846	The first confirmed	

Figure 2 – Magotan user information

4.2. Construction of user-project scoring matrix

There are many data items in user subsets (2), (3) and (5); therefore, this research selects ten clients with “Magotan 87L” brand and travel mileage between 5000-7000 as research objects and scores for following ten service programs in explicit and implicit two ways, including routine maintenance (P1), changing oil and machine filter (P2), repairing painting(P3), 30,000 miles maintenance (P4), 20,000 miles maintenance (P5), 10,000 miles maintenance (P6), material purchasing (P7), filling fuel additive (P8), G17 (P9) and spray (P10). The final attained user-service program scoring matrix is as shown in table 1.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
U1	4	2	2	3	0	1	2	0	4	0
U2	2	2	3	2	2	2	3	0	1	1
U3	3	1	2	5	1	1	1	2	2	0
U4	2	4	3	1	0	1	0	3	1	0
U5	2	2	3	0	3	1	2	5	2	2
U6	1	5	4	0	3	1	1	2	2	0
U7	4	0	1	2	3	0	4	1	2	2
U8	2	2	2	3	2	2	4	2	2	0
U9	5	3	1	4	4	3	1	0	3	3
U10	1	1	1	0	0	4	0	3	2	3

Table 1 – Users - service project score matrix 4.3. User similarity calculation

Take the index value in user evaluation matrix into improved cosine-based similarity-Pearson correlation coefficient algorithm, as shown in formula (9).

First, calculate Pearson correlation coefficient through comparing the scoring situations of ten users for ten programs of automobile after-sale service and with adoption of Excel built-in Pearson function, as shown in Figure3.

D18		=PEARSON(C4:L4,C8:L3)											
	A	B	C	D	E	F	G	H	I	J	K	L	
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													

Figure 3 – Pearson correlation coefficient

Calculation results are as shown in table 2.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
U1	1.02	0.48	0.69	0.25	-0.36	0.12	0.36	0.14	0.41	0.31
U2	0.12	1.00	0.58	0.56	0.25	0.42	0.25	0.47	0.69	0.32
U3	0.42	0.51	0.24	0.85	0.52	0.52	0.58	0.41	0.82	0.21
U4	0.62	0.36	0.15	0.25	0.45	0.47	0.65	0.25	0.12	0.36
U5	0.52	0.14	0.54	0.14	0.48	0.74	0.36	0.36	-0.03	0.85
U6	-0.31	-0.26	0.52	0.48	0.85	0.85	0.31	0.36	0.21	0.25
U7	0.56	0.56	0.36	0.75	0.81	0.65	0.32	0.54	0.36	0.14
U8	0.85	0.69	0.36	0.69	0.47	0.36	0.21	0.21	0.32	0.48
U9	0.24	0.74	0.25	0.59	0.45	0.54	0.36	0.36	0.12	0.75
U10	-0.08	0.03	0.74	0.01	0.36	0.45	0.36	0.58	0.32	0.65

Table 2 – User similarity matrix - Pearson correlation coefficient

Second, attain common scoring coefficient of two users through calculating union and intersection of user scoring programs number in pairs, as shown in Figure 4 and 5.

P23		=SUM(IF(INDIRECT("\$C\$1:IP(\$B:\$B,0)\$A'\$:\$L\$1:AMATCH(\$B2,\$B:\$B,0)<0,1,0)))																	
		F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
22	交集	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10								
23		U1	7	5	6	6	6	7	7	5	5								
24		U2	5	8	8	7	8	8	6	7	7								
25		U3	6	6	8	7	5	6	8	7	6								
26		U4	6	7	7	8	5	5	6	8	6								
27		U5	6	6	5	5	7	6	7	6	6								
28		U6	5	6	8	8	6	7	6	6	6								
29		U7	7	6	6	6	7	6	8	7	6								
30		U8	7	7	8	8	6	6	7	9	7								
31		U9	5	7	7	6	6	6	7	8	7								
32		U10	6	7	6	6	7	6	7	7	8								
33																			
34																			
35	并集	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10								
36		U1	7	10	9	9	8	9	9	9	10								
37		U2	10	8	10	9	9	9	10	10	9								
38		U3	9	10	8	9	10	10	9	9	10								
39		U4	9	9	9	8	10	10	9	10	10								
40		U5	8	9	10	10	7	8	8	10	9								
41		U6	9	9	10	10	8	7	9	10	9								
42		U7	8	10	10	10	9	9	8	10	10								
43		U8	9	10	9	9	10	10	9	10	10								
44		U9	10	9	9	10	9	9	10	10	8								
45		U10	10	9	10	10	9	8	10	10	9								

Figure 4 – The user grade intersection together

D16		=COUNT(IF(\$C\$4:\$L\$4+C3:L3>0,\$C\$4:\$L\$4+C3:L3,""))/COUNT(IF(\$C\$4:\$L\$4+C3:L3>0,\$C\$4:\$L\$4+C3:L3,""))									
		C	D	E	F	G	H	I	J	K	L
13											
14											
15											
16		U1	U2	U3	U4	U5	U6	U7	U8	U9	U10
17		U1	1	0.5	0.66666667	0.66666667	0.75	0.55555556	0.875	0.77777778	0.5
18		U2	0.5	1	0.6	0.77777778	0.666667	0.66666667	0.6	0.7	0.777778
19		U3	0.666667	0.6	1	0.77777778	0.5	0.5	0.6	0.88888889	0.777778
20		U4	0.666667	0.777778	0.77777778	1	0.5	0.5	0.6	0.88888889	0.6
21		U5	0.75	0.666667	0.5	0.5	1	0.75	0.875	0.6	0.666667
22		U6	0.555556	0.666667	0.5	0.5	0.75	1	0.666667	0.6	0.666667
23		U7	0.875	0.6	0.6	0.6	0.875	0.66666667	1	0.7	0.6
24		U8	0.777778	0.7	0.88888889	0.88888889	0.6	0.6	0.7	1	0.7
25		U9	0.5	0.777778	0.77777778	0.6	0.666667	0.66666667	0.6	0.7	1
26		U10	0.5	0.777778	0.6	0.6	0.666667	0.875	0.6	0.7	0.777778

Figure 5 – Common grade proportion coefficient calculation

Calculation results are as shown in table 3.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
U1	0.52	0.58	0.48	0.74	0.58	0.41	0.36	0.15	0.41	0.82
U2	0.47	0.65	0.85	0.85	0.65	0.25	0.14	0.54	0.25	0.12
U3	0.74	0.36	0.81	0.65	0.36	0.36	0.26	0.52	0.36	0.03
U4	0.85	0.31	0.47	0.36	0.21	0.25	0.56	0.36	0.36	0.21
U5	0.65	0.32	0.25	0.36	0.36	0.14	0.21	0.21	0.54	0.36
U6	0.36	0.21	0.56	0.25	0.32	0.48	0.36	0.36	0.54	0.14
U7	0.56	0.36	0.85	0.52	0.12	0.75	0.36	0.58	0.52	0.48
U8	0.69	0.36	0.25	0.45	0.32	0.65	0.48	0.69	0.36	0.75
U9	0.74	0.25	0.14	0.48	0.36	0.69	1.00	0.58	0.36	0.69
U10	0.03	0.74	0.81	0.65	0.25	0.59	0.51	0.24	0.81	0.65

Table 3 – User similarity matrix - common score coefficient

Third, attain scoring difference coefficient through calculating the proportion of average value of score differences of users in pairs for the same automobile after-sale service program accounting for the pre-set highest score of program, as shown in Figure6.

C16		=1-AVERAGE(\$C\$3:\$L\$3-C3:L3)/5											
	A	B	C	D	E	F	G	H	I	J	K	L	
13													
14													
15			U ₁	U ₂	U ₃	U ₄	U ₅	U ₆	U ₇	U ₈	U ₉	U ₁₀	
16		U ₁	1	1	1.02	1.1	1.1	1.14	1.02	1.04	1.06	1.08	
17		U ₂	1	1	1.02	1.1	1.1	1.14	1.02	1.04	1.06	1.08	
18		U ₃	0.98	0.98	1	1.08	1.08	1.12	1	1.02	1.04	1.06	
19		U ₄	0.9	0.9	0.92	1	1	1.04	0.92	0.94	0.96	0.98	
20		U ₅	0.9	0.9	0.92	1	1	1.04	0.92	0.94	0.96	0.98	
21		U ₆	0.86	0.86	0.88	0.96	0.96	1	0.88	0.9	0.92	0.94	
22		U ₇	0.98	0.98	1	1.08	1.08	1.12	1	1.02	1.04	1.06	
23		U ₈	0.96	0.96	0.98	1.06	1.06	1.1	0.98	1	1.02	1.04	
24		U ₉	0.94	0.94	0.96	1.04	1.04	1.08	0.96	0.98	1	1.02	
25		U ₁₀	0.92	0.92	0.94	1.02	1.02	1.06	0.94	0.96	0.98	1	

Figure 6 – Poor score proportion coefficient calculation

Summarize and multiply above three calculation results and attain the final user similarity matrix, as shown in Figure7.

C19		=pearson(C19*共同评分项占比/C17*评分差系数/C17											
	A	B	C	D	E	F	G	H	I	J	K	L	
16			U ₁	U ₂	U ₃	U ₄	U ₅	U ₆	U ₇	U ₈	U ₉	U ₁₀	
17		U ₁	1	0.236779	0.293743	0.428199	0.542131	-0.190957	0.608536	0.595715	0.144001	-0.046529	
18		U ₂	0.236779	1	0.444762	0.437347	0.394872	-0.187768	0.094154	0.261894	0.595082	0.02663	
19		U ₃	0.282224	0.42732	1	0.350295	0.064852	-0.185149	0.157841	0.46228	0.57943	0.16915	
20		U ₄	0.350344	0.357829	0.2984	1	0.12722	-0.257115	0.13455	0.686897	0.090301	-0.131554	
21		U ₅	0.443562	0.323077	0.055244	0.12722	1	-0.059648	0.182083	0.05612	0.209489	-0.090427	
22		U ₆	-0.144055	-0.14165	-0.145474	-0.237337	-0.05506	1	0.067295	-0.271193	-0.092115	0.078351	
23		U ₇	0.584672	0.090462	0.157841	0.15795	0.21375	0.085649	1	0.426274	-0.038905	0.226358	
24		U ₈	0.549891	0.241748	0.444151	0.774586	0.063284	-0.331458	0.409557	1	0.062014	-0.090236	
25		U ₉	0.127699	0.527714	0.534858	0.097826	0.226947	-0.108135	-0.035912	0.059582	1	0.143768	
26		U ₁₀	-0.039636	0.022855	0.150001	-0.136923	-0.094118	0.088353	0.200733	-0.083294	0.13813	1	

Figure 7 – The user similarity computing

Calculation results are as shown in table 4.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
U1	1.00	1.00	1.02	0.85	1.03	1.00	0.91	0.32	0.65	0.25
U2	0.47	0.36	1.03	0.96	1.05	1.00	0.84	0.36	0.69	0.14
U3	0.25	0.36	1.00	0.96	1.16	1.14	1.00	0.25	0.59	0.48
U4	0.56	-0.25	-0.95	0.75	0.81	1.12	1.00	-0.21	0.54	0.75
U5	0.85	0.52	0.91	0.69	-0.47	1.12	0.48	0.74	0.98	0.65
U6	0.47	0.36	0.84	0.59	0.45	0.98	-0.54	0.14	1.02	0.69
U7	0.36	0.36	1.00	0.01	-0.36	0.85	0.52	-0.48	1.03	1.10
U8	0.21	-0.25	1.00	0.96	0.85	1.03	0.36	0.75	0.98	-0.98
U9	0.36	0.14	0.88	1.03	0.96	1.05	0.36	0.69	0.85	0.96
U10	0.32	0.48	0.98	1.04	0.96	1.16	0.81	0.65	1.03	0.93

Table 4 – User similarity matrix

It can be seen from the data in table 4 that the bigger of the value, the higher similarity among two users. For example, user U7 has the highest similarity with user U1 and the similarity is as high as 60%, U6 is with lower similarity, and so on.

5. Conclusions

This paper proposes optimization suggestions and sets up prediction and recommendation model for automobile after-sale service program based on cosine-based similarity algorithm and Pearson correlation coefficient calculation and with adoption of intelligent and quick big data processing; introduces common score program ratio and program score difference into formula calculation, which avoids error of similarity measurement brought about by data sparseness as well as the influence of pre-set highest program score on the final estimation value; calculates the similarity of this group of users and selects one user to make prediction and recommendation for three unaccepted automobile after-sale service programs through making empirical analysis of the customer entry data in one company and based on the scoring situation of ten users for ten kinds of service programs.

Acknowledgment

This paper is the research results of college teaching reform program in Zhejiang, 2016: “Personnel Training Exploration of Higher Vocational Automobile Marketing and Service under Modern Apprenticeship system (jg20160415)”. 2014 Top-quality course of Shaoxing “technology of Automobile Sales”.

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Analysis on Correlation between Banking Saving-Loan Scale in Hunan Province and Regional Economic Development from 2006-2014

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Abstract: With the continuous development and expansion of China's financial industry, the importance of financial development on economic development is highlighted increasingly. It has become the main driving force of economic development. Viewed from the development economics, local economic growth and local financial development are mutually influenced and interacted. Based on the banking saving and loan scale in Hunan Province, this paper disclosed influences of intra-regional financial size difference on local economic development through theoretical and empirical analyses. Moreover, some constructive countermeasures were proposed.

Keywords: Regional Economic Development, Banking Saving, Loan Scale, Empirical analysis

1. Introduction

China's economic growth entered into a "new normal state" in 2015. The growth rate dropped from high speed to medium-high speed. Change of macroeconomic growth will surely influence economic developments in different regions. Multi-aspects (including historical development and natural talent) differences lead to significant differences in economic development among different provinces and cities in China. Therefore, regional economic development difference is essential to study effects of financial development on economic growth. As everyone knows that financial capital is one of important influencing factors of regional economic development. However, regional capital distribution in China is extremely uneven. The regional difference between savings and loans in the same province expands significantly. This is manifested by that provincial capitals and sub-provincial central cities have far higher financing capacity than other cities and "reflow of capital" occurs among different regions in the province. Therefore, based on saving-loan data of financing institutions in Hunan Province from 2006 to 2014, this paper studied influences of saving-loan scale of commercial banks on regional differences of economic development through an empirical analysis. It tried to find an innovative way to optimize financial development in Hunan Province. Some constructive suggestions on how financial industry in Hunan Province to support the provincial "13th Five-year Plan" of economic development were proposed.

2. Literature review

Chinese academic circles began to study the opinion that “financial development is one of core influencing factors of economic development” in middle of 1990s. The relation between economic growth and financial development was discussed from different perspectives. (Chen, 2013) made a statistical comparative analysis on saving-loan balance of three regions and concluded that regional bank liquidity is closed related with local economic development. Regions with big capital flows have high economic growth rate and big potentials of economic development, while regions with small capital flows surely have slow economic development.

Mckinnon (1973) published the *Currency and Capital in Economic Development* and proposed the “Financial Repression Theory”. He mainly analyzed developing countries and pointed out that “separated” regional economic structures and imperfect financial market are the main causes of less developed economy in developing countries. Shaw published *Financial Deepening in Economic Development* in 1973 and proposed the theory of “financial deepening”. He got a conclusion similar with Mckinnon: financial development plays an important role in economic development. Besides, he proposed a new financial deepening strategy –financial liberalization is vital to economic development. These two theories are widely used in some developing countries or regions and promote economic development of these countries and regions.

3. Current saving-loan scale of banks in Hunan Province

Hunan is a traditional big agricultural province and an emerging powerful industrial province in middle China. Ranking of its economic indicators increases continuously. It ranked the 12th in China’s provincial and city development quality in 2014. With the emerging o traditional industries, the financial development in Hunan Province takes the leading role in China. In the following text, saving-loan indicators are further analyzed by dividing Hunan Province into five regions: Chang-Zhu-Tan area, south, north, west and middle regions.

We can see in Table 1 that although saving in the whole Hunan Province and main regions grew at a high rate, the growth rate of different regions differed to a certain extent. The saving growth rate of the Chang-Zhu-Tan area was 2%-4% higher than that

	2007	2008	2009	2010	2011	2012	2013	2014
Chang-Zhu-Tan area	18.00%	19.08%	34.07%	19.87%	15.63%	19.36%	16.26%	18.87%
Middle region	16.29%	20.85%	19.57%	16.82%	17.53%	17.57%	15.28%	14.20%
North region	14.51%	21.12%	24.74%	18.34%	20.25%	20.16%	16.62%	16.64%
South region	18.40%	21.26%	18.55%	17.13%	17.61%	17.68%	16.21%	14.01%
West region	20.58%	13.97%	24.54%	20.72%	21.84%	20.62%	15.47%	14.76%

Notes: Chang-Zhu-Tan area covers Changsha, Zhuzhou and Xiangtan. Middle region covers Hengyang, Loudi and Shaoyang. North region covers Yiyang, Changde and Yueyang. South region covers Chenzhou and Yongzhou. West region covers Zhangjiajie, Huaihua and Xiangxi autonomous prefecture.

Table 1 – Saving growth rate in different regions in Hunan Province

of rest regions. Based on data comparison over the years, the saving growth rate of different regions kept stable except for the significant high growth rate in 2009 caused by the national macro-economic stimulus. However, saving growth rate of different regions decreased slowly in recent years as the national macro-economic growth slowed down.

Table 2 displays the effect of 4,000 billion RMB stimulus in 2008 ----- sharp loan growth. However, the effect of such stimulus policy weakened gradually since 2009. This is mainly because the base loan values in the earlier stage in Chang-Zhu-Tan area accounted for as high as about 60% of the provincial loans (Table 4) and the economic growth pattern based on investment demand is changing gradually in the past years, which led to gradual slowing-down loan growth in this area. On the contrary, loan growth of other regions was stable because the base loan values in the earlier stage were relatively lower.

	2007	2008	2009	2010	2011	2012	2013	2014
Chang-Zhu-Tan area	20.46%	17.58%	46.32%	21.88%	18.19%	15.16%	13.88%	14.09%
Middle region	14.28%	12.08%	27.59%	19.63%	17.66%	17.77%	23.52%	23.26%
North region	8.43%	5.30%	26.30%	19.01%	14.79%	16.95%	20.39%	15.30%
South region	18.75%	12.97%	35.65%	15.98%	17.17%	19.37%	19.37%	17.28%
West region	15.90%	4.34%	28.61%	24.95%	17.45%	19.57%	17.72%	18.47%

Table 2 – Loan growth in different regions of Hunan Province

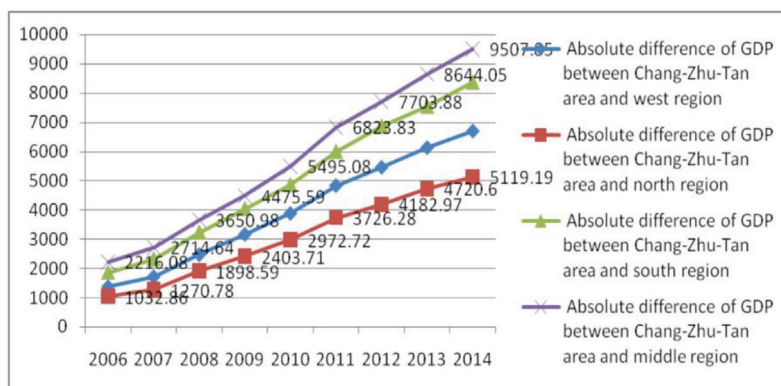


Figure 1 – Absolute difference of GDP between Chang-Zhu-Tan area and other regions in Hunan Province

The absolute differences of GDP among different regions were analyzed. It can be seen from Fig.1 that the absolute GDP differences between the Chang-Zhu-Tan area and other regions increased gradually from 2006-2014. Such absolute GDP difference in 2006 was

maintained at basically the same level, but it increased year by year since then. By 2014, the absolute GDP difference between the Chang-Zhu-Tan area and the economically underdeveloped regions (south and west regions) was far higher than that between the Chang-Zhu-Tan area and regions with moderate economic development (middle and north regions). This further illustrated the unbalanced economic development in the Hunan Province. Besides, the “reflow of capital” in economically underdeveloped regions is more serious than that in moderately developed regions.

4. Empirical analysis of influences of banking saving-loan scale in Hunan Province on regional economy

In Chapter III, saving-loan scale of financial institutes in different regions of Hunan Province and national economic development indicators were analyzed by the descriptive statistical method. With vigorous supports from governments at all levels in the Hunan Province for years, the social and economic development gap between the south and west regions and the Chang-Zhu-Tan area was narrowing, but the financial development gap was still distinct. Therefore, this part collects related data of different regions in the Hunan Province and establishes a measurement model with financial and economic measurement indicators. It hopes to further analyze influences of banking saving-loan scale on regional economic development through the empirical analysis based on panel data.

1. Explanation to data and variables selection

Some scholars generally use GDP to measure economic development level of one country or a region. Some scholars use per capita gross national product (GNP). Although these two indicators have good representativeness, they neglect influences of employee population in the study area. To address this problem, this paper chose GDP per capita of employees in the study area as the measurement indicator of economic development.

Financial related ratio (FIR) which is the ratio between the total financial assets and national wealth of one country or region is commonly used to measure financial development in the world. Generally speaking, higher FIR indicates bigger degree of separation between savings and investment and larger financial size. On the contrary, smaller FIR reflects poorer capital liquidity, smaller financial size and weaker financing capacity.

From the perspective of savings and loans of financial institutes, this paper defined FIR as the ratio between sum of savings and loans of financial institutes and regional GDP: $FIR = (S+L)/GDP$. Loan-deposit ratio was chosen as another measurement indicator of financial development. Moreover, since there are a lot of influencing factors of regional economic development, the author also applied two assisted variables – consumption and investment, which were measured by household consumption expenditures (CONU) and fixed asset investment (INVE).

2. Data selection and processing

This paper chose data of 14 regions of the Hunan Province from 2006 to 2014 as observation samples. The research area was divided into economically developed region,

moderate economic development region and economically underdeveloped region. The economically developed region covers Changsha, Zhuzhou and Xiangtan. The moderate economic development region covers Hengyang, Loudi, Shaoyang, Yiyang, Changde and Yueyang. The economically underdeveloped region includes Chenzhou, Yongzhou, Zhangjiajie, Huaihua and Xiangxi autonomous prefecture.

Banking savings-loans balance of different regions was used as the basic asset variable and GDP per capita of employees in different regions was used as the economic development measurement indicator. It set 2006 as the base period. The GDP per capita of employees was 100. To eliminate heteroscedasticity, all explanatory variables were chosen natural logarithms when converting GDP per capita of employees into actual GDP per capita. (All data in this paper were collected from the Hunan Statistical Yearbook.) In this paper, the panel data regression analysis model used intercept-variable fixed effect model. Model estimation results are listed in Table 8.

3. Establishment and analysis of measurement model

There are many empirical researches on the relationship between financial development and economic growth. This paper mainly applied two different econometrics test methods – regression based on cross-country sectional data and regression based on time series data.

$$\ln eGDP_{it} = \alpha_1 + \alpha_2 \ln FIR_{it} + \alpha_3 \ln \left(\frac{L}{S}\right)_{it} + \alpha_4 \ln CONU + \alpha_5 \ln INVE$$

where eGDP is per capita GNP of employees in the region with 2006=100; FIR is financial related ratio ($FIR=(S+L)/GDP$) which is to measure the financial development scale; L/S is the ratio of loan balance and saving balance, which is used to measure financial development efficiency, that is, transformation efficiency from savings to investment. Besides, household consumption and fixed asset investment were used as assisted variables and were measured by CONU and INVE. i represents regions, $i=1, 2, 3, \dots$ and $t=2006, 2007, \dots, 2014$.

According to regression results, it comes to conclusions that:

Firstly, explanatory variables in the economically developed region all pass the test and show goodness of fit. But the D.W value fails the test. To eliminate autocorrelation, an empirical regression to eliminate first-order autocorrelation was carried out (Abreu et al., 2015). Results showed that S/L in the economically developed region has positive effect on economic development. In the Chang-Zhu-Tan area where concentrates capitals of the province and takes the leading role in infrastructure projects and external investments, achieves significantly higher financing capability and transformation efficiency from savings to investment than other regions in the province.

Secondly, in economically moderate developed region, FIR, CONU and INVE affect GDP per capita significantly and show good degree of fitting after the first-order autocorrelation was eliminated. S/L didn't pass the test and couldn't explain the local economic development well. It disagrees with actual economic development in central Hunan in the past years. This may be because the Chang-Zhu-Tan area which lies in the

Variables	Economically developed region	Economically moderate developed region	Economically underdeveloped region
C	-2.8451*	-3.3976*	-1.6258*
	(-11.1879)	(-8.3446)	(-2.9778)
	[0.0000]	[0.0000]	[0.0045]
L/S	0.2423*	0.0574	0.1458
	-2.6963	-0.6476	-0.9386
	[0.0077]	[0.5183]	[0.3492]
FIR	-0.1272**	-0.1775**	-0.6663*
	(-2.0314)	(-2.6640)	(-4.0265)
	[0.0487]	[0.08883]	[0.0001]
CONU	1.4004*	1.0168*	0.7015*
	-15.3282	-8.0394	-3.9834
	[0.0000]	[0.0000]	[0.0000]
INVE	0.4789*	0.7675*	1.0214*
	-5.5609	-8.2626	-8.429
	[0.0000]	[0.0000]	[0.0000]
R ²	0.9939	0.9959	0.9919
F value	2326.812	2934.231	1698.372
D.W value	2.05	2.63	2.31

Note: Value in [] is p-test value; value in () is t-test value. *, ** and *** are significance levels of 1%, 5% and 10%.

Table 3 – Regression analysis results of three regions in Hunan Province

central region with moderate economic development attracts capitals from economically moderate developed region for its better investment environment, while the central region owns inadequate investment.

Thirdly, GDP per capita in the west region was slightly influenced by S/L. Other variables all passed the test. Due to the disadvantageous overall economic environment and geographic position, economically underdeveloped region has backward infrastructure construction and local investment and financing are mainly dominated by nationalized banks, assisted by few foreign capitals. The financing capability and transformation efficiency from savings to investment are very low, which restricted economic development directly.

5. Conclusions and prospects

Based on the analysis current savings and loans in commercial banks in the Hunan Province as well as the empirical analysis on regional economic developments, it concludes that:

1. Regions with different economic development levels form a gradient of financial development level. The Chang-Zhu-Tan area, a leading economic development region, possesses a good geographic position, rich financial resources and preferential policies. But financial development in economically underdeveloped regions is restricted by various factors. Financial resources are allocated unevenly between the economically developed and underdeveloped regions.
2. In recent years, total financial assets in Hunan Province increased year by year, but contributions of the savings-loan scale of financial institutes to GDP decreased gradually. The sum of banking saving-loan makes fewer contributions to GDP in economically developed regions like Chang-Zhu-Tan area compared to economically underdeveloped regions. This demonstrates that regional economic development didn't depend on expansion and development of banking assets simply. In other words, the overall financial development in the region increased significantly.

Limited by research ability and data availability, this paper only made a preliminary study on influences of financial development on economic development. It still needs a lot of improvements, which will be discussed in future researches.

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A Complex Recursive Algorithm for the Lexicographic Sequence of Binary Trees with n Nodes

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Abstract: This paper used the recursive relation among the generating binary trees with n nodes, considered the trees as a type according to the number of nodes of its left and right subtree firstly, then found out the sequences in each type of them, thus achieved the binary trees in lexicographic order. Not only can generate the next tree according to any trees, but find the corresponding binary tree according to the random number. This provided the basis for security mechanism with the encryption/decryption of multi binary trees

Keywords: binary tree, lexicographic order, recursion, encryption, decryption.

1. Introduction

AES was an encryption standard designed by NIST (National Institute of Standards and Technology) to replace DES in twenty-first Century (Matsui, 1993; Biham and Shamir, 1993; Daemen and Rijmen, 1998; Ferguson et al., 2002; Biryukov and Khovratovich, 2009). The length of the group was 128bit, the key length was 128/192/256bit, and the corresponding number of rounds was 10/12/14. By comparison, 128bit's AES key was 10^{21} times more than that of 56bit's DES key.

If consider a binary tree as a key, we could use the traversal sequence of the tree to encrypt (Wei, 2015). Because the number of the binary trees which was composed of n nodes was large enough, the binary tree was used as the key to encrypt/decrypt operations, which had more keys than the AES encryption algorithm. When the length of the key was 128, the trees with n nodes were 35 orders of magnitude higher than the AES key.

Since some of the binary tree traversal sequences can uniquely determine a binary tree (Knuth, 1973; Tang, 2001, 2010, 2011; Mäkinen, 2000), if there was only one binary tree to encrypt/decrypt, it was easy to be attacked. Using more binary trees was required to achieve safe and efficient encryption algorithm (Lino et al, 2016).

The security mechanism based on encryption/decryption algorithm needed to generate a key according to the random number (Prasad et al, 2014; Bharatesh and Rohith, 2014; Cui, 2013), and all the keys were arranged in lexicographic order.

How many binary trees with n nodes were needed to sort? The formula was (Knuth, 2006):

$$C_n = \frac{1}{n+1} \binom{2n}{n} = \binom{2n}{n} - \binom{2n}{n-1} \quad (1)$$

This formula didn't show the existence of the order between the binary trees. In order to study forest, used earthworm observing way to create forest model of the left bracket "(" and the right bracket ")". P, B, N, and L algorithm could find the lexicographic order for the forest on the model. Because there was a one-to-one correspondence between the forest and the binary tree, the traditional algorithm for binary trees' sort was basically converted through the forest.

This paper studied how to use the recursive relation of the generating trees to get its lexicographic order.

2. Binary trees' lexicographic order with n nodes

$B(n)$ indicated the number of generating binary trees with n nodes (Yong Wei et al, 2014). If all binary trees were divided into n cases of n-1, n-2, ..., 2, 1 and 0 in accordance with the number of left subtree's nodes, the number of trees of each case is $B(n-1)B(0)$, ..., $B(2)B(n-3)$, $B(1)B(n-2)$, $B(0)B(n-1)$, $B(n)$ could also be written:

$$B(n) = \sum_{k=1}^n B(n-k)B(k-1) \quad (2)$$

Formula(2) showed that there was a recursive relationship between the binary trees.

2.1. According to the trees' shapes to generate binary trees with n nodes

[Definition 1] Y_{ij} represents the set of all trees whose left subtree has $i(i \geq 0)$ nodes and right subtree has $j(j \geq 0)$ nodes.

According to multiplication principle, the number of trees of Y_{ij} shape was $B(i)B(j)$. Formula(2) could also be written:

$$B(n) = \sum_{k=1}^n B(n-k)B(k-1) \quad (3)$$

Firstly, sorted all binary trees with n nodes by their shapes:

- Form the trees where the left subtree has n-1 nodes and the right subtree has no nodes;
- Then form all the binary trees where the left subtree has n-2 nodes, and right subtree has 1 node;
- ...
- Then form all the binary trees where the left subtree has n-k nodes, and right subtree has k-1 nodes;

- ...
- Finally form all the binary trees where the left subtree has no nodes and the right subtree has $n-1$ nodes.

Or by forming such as $Y_{(n-1)|0}$ binary trees, then generating $Y_{(n-2)|1}$ binary trees ... lastly generating $Y_{0|(n-1)}$ binary trees, they constituted all binary trees with n nodes.

For example, when $n=3$, firstly forming two binary tree such as $Y_{2|0}$, generating 1 tree such as $Y_{1|1}$, lastly generating two trees such as $Y_{0|2}$. 5 binary trees generated by 3 nodes, ordered as shown in Figure 1.



Figure 1 – 5 Binary Trees Ordered by 3 Nodes

The remaining question was how to further sort all binary trees shaping like Y_{ij} .

2.2. The generation order of binary trees in the same shape

2.2.1. Find out the next tree

To an arbitrary tree in the shape of $Y_{(n-k)|(k-1)}$, it contained $n-k$ left nodes and $k-1$ right nodes, the problem was how to generate its next binary tree. Firstly, defined the first and the last tree among the same shape trees.

[Definition 2] The first tree of the trees shaped as $Y_{(n-k)|(k-1)}$ is that the $n-k$ nodes in left subtree only have left child except the leaf, and the $k-1$ nodes in right subtree only have left child except the leaf.

As shown in Figure 2 was the first tree with n nodes.

[Definition 3] The last tree of the trees shape as $Y_{(n-k)|(k-1)}$ is that the $n-k$ nodes in left subtree only have right child except the leaf, and the $k-1$ nodes in right subtree only have right child except the leaf.



Figure 2 – the first Tree

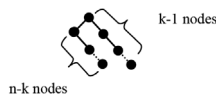


Figure 3 – the last Tree

As shown in Figure 3 was the last tree with n nodes.

As the definitions of the first and the last tree with the same shape, the following steps could generate the next tree from the current tree:

1. Find the next subtree of the left subtree;
2. If find, get the next tree, end the program.
3. If can't find the next tree in the left subtree, to find the next tree of right subtree;
4. If find, get the next tree, end the program.
5. If can't find the next tree in right subtree and $n-k>0$, then take the first tree in the next shape trees of $Y_{(n-k-1)|(k)}$, return the tree, end the program.
6. If can't find the next tree in right subtree and $n-k=0$, the current tree is the last tree with n nodes, no next trees, end the program.

The above general idea was to get a tree in the left subtree firstly; if didn't get, then got from the right subtree; if didn't get, got the first tree from next shape trees.

2.2.2. Boundary condition

When n was equal to 0, it represented an empty tree, so $B(0)=1$; $B(1)$ was equal to 1, said only binary tree that had one node; $B(2)$ was equal to 2, said there were 2 binary trees that consisting of two nodes, see Figure 4.



Figure 4 – Binary trees consisting of two nodes

When $n=3$, $B(3) = B(2)B(0) + B(1)B(1) + B(0)B(2) = 2 \times 1 + 1 \times 1 + 1 \times 2 = 5$

In the same way, it could be calculated that there were 14 trees when $n=4$; when $n=5$ there were 42 trees....

2.2.3. Algorithm for the next tree

Used the following steps to get trees in the shape of $Y_{(n-k)|(k-1)}$.

Supposed r was a node of the binary tree, $Tree(r)$ was the binary tree of considering r as root; If the integer $n \geq 0$, used get $NextTree(r, n)$ method to return the next tree for the tree that root was r, the number of nodes was n. Then used the recursive method to achieve get $NextTree(r, n)$ method as following.

```

/* Return the next tree for the tree, that root is r, with n nodes*/
Tree getNextTree(r, n){
    for (k=1; k<=n ; k++ ){
/*the tree, with empty or 1 node, does not exist the next tree*/
        if (n<2) return NULL
        else {

```

```

    r.lchild<- node; // Formation of the root of the left subtree
/*Initialize the left subtree, their nodes
*have only left son except for the leaf.*/
    initTree(r.lchild, n-k);
    r.rchild<- node; // Formation of the root of the right subtree
/*Initialize the right subtree, their nodes
* have only right son except for the leaf.*/
initTree(r.rchild, k-1);
/*does not exist next tree in the left subtree*/
    if getNextTree(r.lchild, n-k) = NULL
        /* does not exist next tree in the left and right subtree,
* take a tree from the next shape
*/
        if getNextTree(r.rchild, k-1) = NULL continue;
/*exists next tree in the right subtree*/
        else return(getNextTree(r.rchild, k-1));
/*exists next tree in the left subtree*/
        else return(getNextTree(r.lchild, n-k));
    }
} //end of loop
}

```

Every node, except the leaf, had only left son in the first tree of the same shape. The algorithm according to the preorder traversal sequence(DLR), starting from the near leaf node, transfered the left subtree gradually into the right subtree, until the last tree.

3. Generating a binary tree with n nodes accordance with a random

With the binary tree's lexicographic order, we could put a binary tree and a random number to the corresponding. The following steps generated the binary tree with n nodes according to a random number r.

1. $k=1$; if $r > B(n)$, n nodes can not generate the corresponding binary tree;
2. $r = r - B(n-k)B(k-1)$, $k = k+1$
3. if $r - B(n-k)B(k-1) > 0$, continue step 2;
4. if $r - B(n-k)B(k-1) < 0$, that is the rth tree, it has shape such as $Y_{(n-k)|(k-1)}$;
5. if $r - B(n-k)B(k-1) = 0$, that is the 1th tree, it has shape such as $Y_{(n-k+1)|(k-2)}$;

4 nodes could generate 14 trees, in accordance with the above steps, which tree did the random number 6 refer to?

- $6 - B(3)B(0) = 6 - 5 = 1 > 0$;
- $1 - B(2)B(1) = 1 - 2 < 0$

So 6 was 1th tree its shape such as $Y_{2|1}$, shown in figure 5.



Figure 5 – Random Number 6 Corresponding to the 4NodesBinary Tree

The binary tree had 2 nodes in the left subtree, and 1 node in the right subtree.

4. Conclusions

For the encryption/decryption efficiency, using multi-binary tree algorithm existed more keys than AES, so more safety.

The actual encryption/decryption process needed to sort key, and according to the random number to generate key etc. So it was necessary to study the lexicographic order of the binary trees.

In the past, the model of forest was established by the way of the worm's observation, and the traditional lexicographic algorithm was used to implement the forest's order. To get the binary tree order, needed to be converted through the forest.

In this paper, based on the recursive rule generated by the binary tree, we first classified the n node binary tree. In order to solve the n node binary tree lexicographic algorithm, focused on how to get the next tree from the current tree, they had same shape. The paper used the recursive method to find the 1th tree of one shape firstly, then changed the node's left subtree into right subtree gradually from the near leaf node until the last one with the shape.

In this paper, we could get one binary tree from any one, the implement of the binary tree's order no need to change through the forest. Encryption was directly based on the binary traversal, the lexicographic algorithm was more suitable for encryption/decryption system based on binary tree traversal. And the efficiency of getting the binary tree according to the random number would be higher.

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Design and Application of Support System for University Teachers' Professional Development Based on Cloud Computing

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Pages: 133–147

Abstract: The rapid development of cloud computing and its wide application provide a new design and development of technical concepts and forms of construction for the design and development of support system for university teachers' professional development. How to use the cloud computing environment to provide high-quality resources and services for the professional development of university teachers has become the trend of the professional development of teachers in the information environment. Based on the analysis of the connotation and demand of the professional development of teachers in universities, the author designs and constructs the support system of teachers' professional development under the cloud computing environment by creating an open, flexible and cooperative community of professional development of teachers. By Analyzing and describing the structure design, function module design and practical application, to provide advanced learning mode and high quality resources and services for the professional development of university teachers, to arouse the autonomy, cooperation and constancy development of professional development of university teachers and to promote the dissemination and sharing of knowledge and experience of teachers' professional development.

Keywords: cloud computing, university teachers, Professional development, support system

1. Introduction

With the continuous development of higher education, teachers are regarded as the core factors influencing the quality of higher education. The continuous promoting the professional level of teachers in universities becomes the important measure to improve the quality of education and teaching. At present, the professional development of university teachers is mainly based on short-term training and professional learning activities, and specifically use these two forms: centralized face-to-face teaching and distance education. Whether the centralized face-to-face teaching or the distance education, due to the lacking of time and effective development and tracking mechanism, teachers do not have many opportunities to think deeply about the professional

knowledge and skills and apply them into practice, so training effectiveness is difficult to highlight immediately. At the same time, because of the contradiction between work and study (Dong, 2012), it is difficult to spread the professional knowledge, skills, experience and resources to other teachers in the school area after the training (Wang and An, 2010). The knowledge information flow and resource flow which serve the professional development of university teachers have not been effectively circulated and widely shared in the whole higher education system. Therefore, the current service system which supports the effective professional development of university teachers is insufficient (Li and Fu, 2009).

The emergence of cloud computing provides a new concept, environment and platform support for the professional development of university teachers. Its own advantages can strongly support the advanced theory of professional development of teachers, and it focuses deeply on university teachers who are the special learning group, bases on the actual situation of work and learning and finally provides high quality of services and resources. Based on cloud computing, this paper will build an open, flexible and collaborative support system for university teachers' professional development. It can effectively overcome the contradiction between work and study, reduce the technical threshold for teachers to use professional development support system, further inspire the enthusiasm of university teachers to access the system, improve the utilization rate of university teachers on system resources, promote the independent, cooperative and continuous professional development of university teachers and ultimately achieve the purpose of enhancing the professional level of university teachers.

2. Overview of cloud computing

Cloud computing still has no unified definition now (Jiang, et al., 2013), it can be understood as a new commercial computing model based on the Internet, which is the result of the common development of parallel computing, distributed computing and grid computing. Cloud computing "will be distributed computing tasks in a large number of computer resources pool, so that the corresponding system can be required to obtain computing power, storage space and information services. (Liu, 2015)" In this statement, the "resource pool" is called a "cloud" and it is a virtual computer resource that includes computer servers, storage servers, and network bandwidth resources. Joins different locations of the pool of resources together to provide to users in the form of commercial services through the use of server virtualization technology, distributed file storage technology. In addition, it can execute the dynamic expansion and configuration for the resource pool according to the need of the users to achieve efficient sharing of hardware and software resources and on-demand distribution. It is conducive to "improve efficiency, reduce costs and technological innovation." (Liu, 2015)

From the above description we can see that cloud computing has the characteristics of powerful computing ability, diverse access terminals, demand for scalability, fault-tolerant ability, low-cost facilities and so on. Basing on the type of service, cloud computing can be categorized into three types: "infrastructure as a service" (IaaS), platform as a service "(SaaS), "software as a service" (SaaS). This provides a variety of service types based on hardware, platform, software resources, and then forms the basic framework of cloud computing applications. The development of cloud computing gradually

condenses the core idea of “cloud”: integration of resources, centralized services, and these rise to an advanced service concept. The core idea of “Cloud” emphasizes the sharing of resources. The core idea of “Cloud” emphasizes the centralized sharing of the resources and achieves flexible use and utilization rate of resources by pooling resources on the same advanced platform and implementing unified deployment management. (Wang, 2009)

3. The system object design of support system for university teachers’ professional development based on cloud computing

Taking Qinzhou University for example, this paper introduces cloud computing into the project construction of teachers’ development.

The system regards cloud computing as the basic development idea and concept. It is designed basing on the connotation of professional development of teachers and aiming at the deficiencies and shortcomings of current university teachers’ professional development support system. Its own objective is to provide teachers the open, unified, flexible, convenient, safe, efficient and full-featured system platform for teachers’ professional development. At the same time, solve the problems of the system facilities, construction and maintenance and upgrade issues and reduce system construction costs.

The system focuses deeply on the teachers who are the main development personnel, strives to break through the traditional passive, isolated, closed, mechanical form of professional development of teachers and create active, open, flexible, shared college teachers learning community. On the basis of accurately grasping the culture characteristics and strategies of teachers’ professional development, the system uses self-learning, collaborative learning, knowledge management, action research and other modern educational teaching theory as a guide, gathers and integrates the resources of professional development of university teachers and implements personalized push, designs various training session and activities of the professional development, emphasizes equally important on theoretical knowledge and practical skills, establishes a diversified, multi-dimensional and efficient exchange interaction mechanism, fully stimulates the autonomy, collaboration and continuity of professional development of teachers, and finally realized the goal of the promotion of professional development level.

4. The frame structure design of support system for university teachers’ professional development based on cloud computing

The support system for university teachers’ professional development based on cloud computing uses the B / S architecture model (Zreikat, 2014), including the teacher client and cloud computing server. The teacher client are the desktop computers, laptops, tablet PCs, mobile phones and so on which are installed the web browsers. Teachers use the personal terminals to access to the system function modules and get services and resources through the professional development support system interface landing.

Cloud computing server includes the cloud computing infrastructures and the cloud computing services applications which are erected on them. Based on the consideration of the characteristics of cloud computing and system development, it makes a reasonable

and orderly design and division for the server-side system functions under the idea of hierarchical design, as shown in Figure 1. The application services layer is at the top of the cloud architecture system, the interface layer is in the middle, and the infrastructure layer is at the bottom. The use of hierarchical design approach to achieve the system independent of each logical layer. When any layer changes, will not affect the next level, so that the system functions in a loosely coupled manner. It is beneficial to promotion, development and maintenance in later stage. (Wu, 2013)

4.1. Infrastructure layer

The infrastructure layer contains three sub-layers, they are physical hardware layer, virtual sub-layer and core management layer (Jin and Mao, 2014). Among them, the

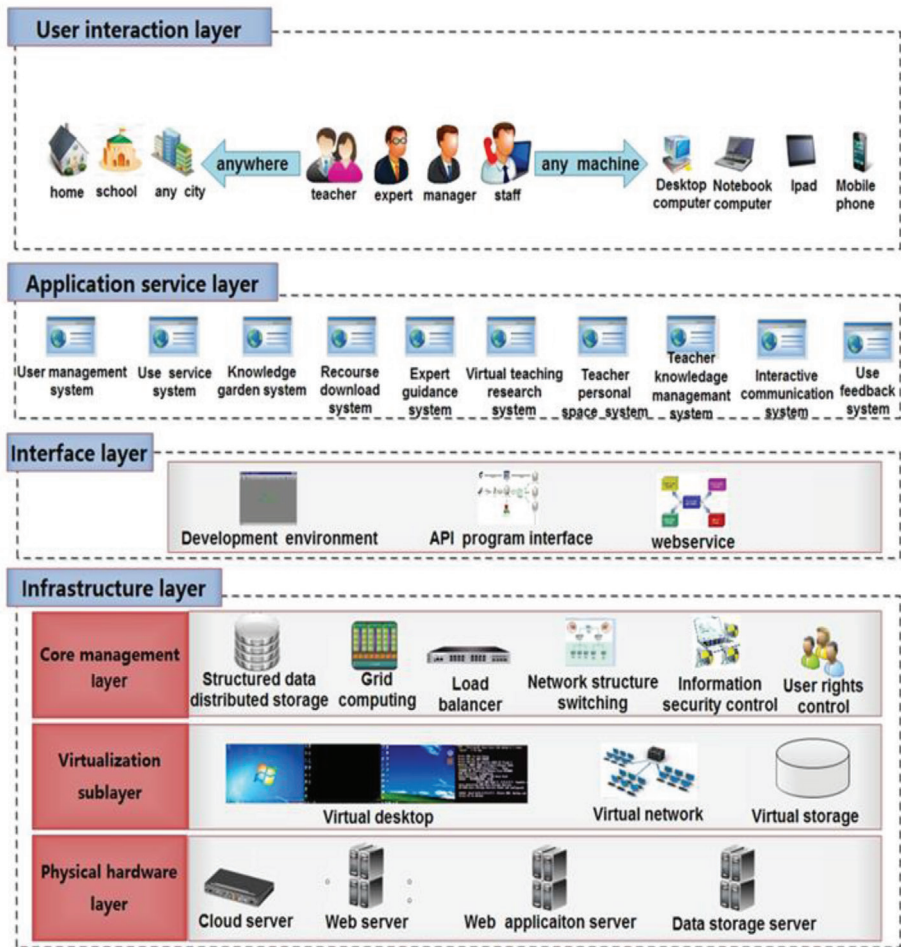


Figure 1 – The frame structure design of support system for university teachers' professional development based on cloud computing

physical hardware sub-layer is the hardware foundation of the entire cloud computing system, including cloud servers, web servers, web application servers, database storage servers. Cloud computing platform will be built and improved by the technologies of Virtualization, load balancing, structured data distribution in the virtual sub-layer and core management sub-layer. (Lu and Liu, 2012)

The cloud computing IaaS service model is integrated into the infrastructure layer of the system. First, the application of the model helps to store the knowledge and resources which are beneficial to the teachers' professional development on the cloud computing server. It can fully use of the cloud computing server high-performance, scalability characteristics and improve the convenience, stability and security of teachers' access to the system while reducing the cost of system facilities construction. Second, use the cloud computing server to allocate personal storage space and knowledge management space for teachers in order to store all kinds all resources and data in the process of the learning. Third, the communication functions of the system components, such as communication communities, e-mail, web instant messaging tools, network whiteboard and video conferencing systems will be stored in the cloud server for easy system calls. Web server is mainly used to complete the teacher system registration, system login, identity authentication and authority audit. Web application server will be assigned to different teachers on the server for professional development training through the load balancing technology. The data storage server is used to record the personal information of the users and the personal data involved in the teachers' training process.

In addition, the infrastructure layer provides a number of common public services for all users aiming at offering the internal support, including user rights control, information security control.

4.2. Interface layer

The interface layer mainly includes the development environment, public API and Web Service three modules. Here mainly provides the infrastructure layer and the application service layer for data exchange and program running between the intermediate environment and interface.

4.3. Application service layer

Application service layer is the logic structure module which is based on the unified management and provides the application service to the teachers. It contains the following sub-systems: user management system, use service system, knowledge garden system, resource download system, expert guidance system, teacher personal space system, teacher knowledge management system, interactive communication system, use feedback system, and support teachers' professional development needs comprehensively. Among them, the communication functions of the interaction communication system and other sub-system will be achieved by the cloud computing SaaS service. That is, packaging the communication functions that are needed into services by using SaaS service of cloud computing. It can be called by system and helps to save the cost of developing the function module, and reducing the system development cost (Zhang and Wang, 2011).

4.4. User interaction layer

User interaction layer is mainly to provide the access to interactive interface and environment of the support system of professional development to teachers, users, experts, managers and staff. Users can visit the support system of professional development at any time and any place through a variety of personal terminal equipment and access to the corresponding functional modules.

5. The function module design of support system for university teachers' professional development based on cloud computing

The development of University Teachers' professional development emphasizes "independent development and self-improvement, which includes the improvement of academic level, the development of teachers' professional knowledge and skills, and the improvement of teachers' professional ethics" (Pan and Luo, 2007). On the basis of the professional development of university teachers and training strategy, we make full use of the high performance computing resources provided by the cloud computing, massive storage space, high-quality technical services and other advantages, then design the user management system, service system, knowledge base system, download system, expert guidance system the virtual teaching system, teachers' personal space system, teachers' knowledge management system, communication system, using the feedback system of ten functional modules under the guidance of the concept of resource integration and sharing in the era of cloud learning, as shown in Figure 2(Ibatouline,2013).

5.1. User management system

The user management system with the functions of user registration, user information, account login, identity authentication, access control, integral management, training, diagnosis, contain teachers, experts, managers and staff four kinds of users which owns the different system permissions. Teachers are the main service object, they must register, login, identity authentication to access system modules, participate in activities and enjoy a variety of resources and services. The experts are responsible for the design, organization, participation and management of the activities of the "Expert Leadership System" module. Management staff participate in the professional development of training activities in the planning, organization, management, evaluation and so on, the system of teacher users to manage, and organize, approve, participate in teacher training activities. Staff are mainly responsible for system management, and provide technical support for teachers, experts, and administrators to use the system. Teachers who do not abide by the rules of the system users, managers and staff have the right to delete, to ensure that the system of professional, healthy development. In addition, the system also introduces the incentive mechanism of system integration and learning feature diagnosis mechanism. System integration will drive teachers to actively participate in professional development, and participate in system activities and training evaluation as a reference. Training diagnosis is to provide teachers with learning styles and training needs of the test, to provide personalized training for teachers to provide the basis for the service.

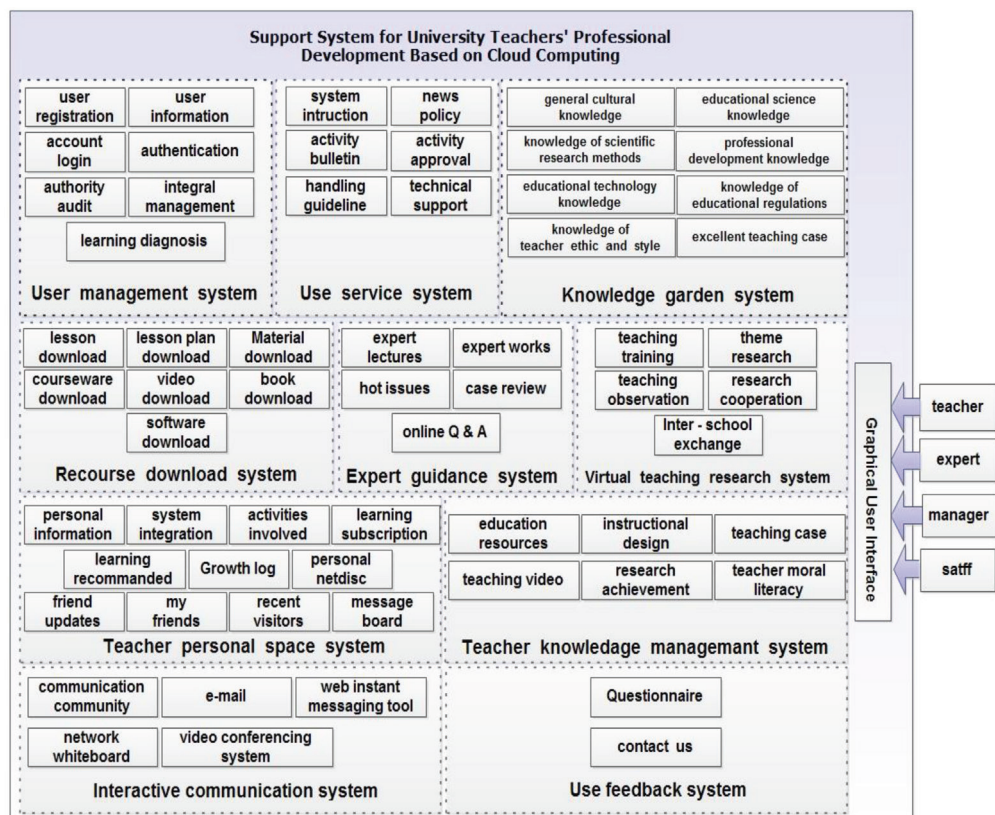


Figure 2 – The function module design of support system for university teachers' professional development based on cloud computing

5.2. Use service system

"Use service system" provides system introduction, news policy, activity bulletin, activity approval, handling guideline, technical support. Teachers access to "system profile" to grasp the system design, basic functions, instructions, etc., do prepare for using the system. Through the "news policy" to understand the domestic and foreign university teacher's professional development information, teachers can grasp the professional development of the foreword and dynamic. "Activity Bulletin" announces the recent training activities make sure that teachers can participate on time as needed. When the system points reach a certain standard, teachers can apply for training activities; accordingly, they get the chance to collaborative training in "active approval". If the teachers have trouble using the system, they can find the description of the issues by referring to the "handling guideline" and relevant technology solutions from "technical support" system.

5.3. Knowledge garden system

“Knowledge garden system” on the connotation requirements of University Teachers' Professional Development, collects targeted, diversified, modern knowledge to meet the professional development of knowledge reserves and literacy upgrade. It Include general cultural knowledge, educational science knowledge, Knowledge of scientific research methods, professional development knowledge, educational technology knowledge, Knowledge of educational regulations, knowledge of teacher ethic and style, excellent teaching case. Knowledge learning uses a short and pithy “micro-class”, the form of flexible and diverse e-books and other information learning. The presentation of multimedia, three-dimensional, changing the previous knowledge of the status quo single boring, greatly improving the enthusiasm of teachers to learn, so that knowledge and effective internalization. Knowledge content is multimedia transmuted, data capacity, frequent operated. Through the use of cloud computing IaaS service model, the knowledge content resources will be stored in cloud server. Its efficient server performance and network transmission performance meet the learning needs of different system access capacity quickly and dynamically.

5.4. Resource download system

The “Resource download system” brings together various resources for teacher professional development; they are divided by function, type in order to facilitate teachers to access download resources. It includes lesson download, lesson plan download, material download, courseware download, video download (Anasuya, et al., 2008), book download, software download. Resources cover a large number of teaching and scientific research practice excellent case text, material, software, image, can effectively support the teacher's independent and cooperative professional development research and study. The module is based on download, resource capacity, many access users, and frequent operations, so this part occupy a larger server and network bandwidth resources. For saving, we used cloud computing IaaS service model, made full use of this model provides high-performance servers; high-speed network bandwidth, load balancers and other infrastructure and services to improve download efficiency. All the download resources are aggregated, classified storage to the cloud server and access to high-quality access to hardware equipment, network bandwidth, secure storage, upgrade maintenance and other issues be effectively addressed.

5.5. Expert guidance system

Expert guidance system consists of expert lectures, expert works, hot issues, case review, online Q & A, it Play the guidance of experts, teachers, demonstration, radiation function to answer questions, broad view sight, provide professional shortcuts for teachers. Teachers can watch the “expert lectures” to study other teacher professional development of lectures and reports; they can browse “expert works” to strengthen and enhance the theoretical quality of teachers' professional development.

Paying attention to the “hot issues” to focus on the key issues of current university teachers' professional development theory and practice research. Studying of case review, expert comments understanding case teaching research, reflection and evaluation to enhance the ability of teaching practice; through the “online Q & A” access to the opportunity

to communicate with experts to address the professional development of the training process of the difficulties and problems. “Online Q & A” can be called interactive communication system in the community, e-mail, instant messaging tools, network whiteboard, video conferencing systems and other tools to achieve synchronization between experts or asynchronous communication, file sharing transmission and other communication functions.

5.6. Virtual teaching and research system

“Virtual teaching and research system” mainly provides teaching reflection, school-based training, research cooperation and other activities for teachers, including teaching training, theme research, teaching observation, research cooperation, inter-school exchange and other functions. The goal of “teaching training” is to train the teachers’ teaching theory and practice skills. The forms which it is carried out are not only the traditional audio and video lectures, but also the popular MOOC courses. “Theme study” can be used to carry out the collaborative training activities for teachers. It can have an in-depth exchange and discussion on the education and teaching subject. Organizer of the subject can be the experts, managers and teachers. Teachers who initiate a theme study need to reach a certain level of system integration, and be approved by applying to the system and submitting a plan. The research plan should include the topic of the seminar, the purpose of the seminar, the significance of the seminar, the discussion time, the moderator, the participants and the expected results. After the approval of the examination, it will be notified by e-mail, research activities will be announced in the activities bulletin of the system. “Theme study” emphasizes the collaborative training between teachers, teachers can use web instant messaging tools for voice communications, exchange of ideas, transfer files. To further improve the efficiency of collaboration, it can also use the network whiteboard, video conferencing and other tools to assist. Network whiteboard can be shared by multi-teacher users. Basing the subject, teachers can use the network whiteboard to write and paint. And the study process and results recorded and presented. If want to strengthen the authenticity and situational of the study, it can use the video conferencing system when displays skills, models, apparatus to transmit presentation in an intuitive, dynamic image form. Teachers in the “teaching observation” module can watch classroom teaching video inside and outside school. They succeed in improving their own classroom teaching skills by observation, evaluation, reference, imitation, migration. To improve the teachers’ academic level, “research cooperation” can provide academic front, scientific research discussion and activities channels. Teachers can initiate research cooperation activities and have a collaborative discussion of series of links, such as project applications, project planning, project development and writing papers with the full use of web instant messaging tools, network whiteboard, video conferencing system and other communication tools. “Inter-school exchange” provide external training channel for teachers. By connecting with the support system for the teachers’ professional development outside school, we will increase the opportunities of observing, learning, and drawing lessons from the excellent teachers, excellent classrooms, excellent teaching and researching and excellent scientific research, and realize self-improvement in resource sharing and complementary advantages. Because of the large amount and frequent operation of teaching and training resources, the IaaS service model of the cloud computing is adopted to store the resources in the cloud

server and improve the efficiency and quality of teachers' access. The communication function is realized by the SaaS service of cloud computing. It can not only make full use of all kinds of powerful communication services, but also keep the development cost low to meet the demand of virtual teaching and research.

5.7. Teacher personal space system

The "Teacher personal space system" mainly collects the basic personal information of the teachers and the use of the system, including personal information, system integration, activities involved, learning subscriptions, friend updates, my friends, recent visitors, message board. Saving system account, educational background, professional background, work experience, contact information in the "personal data", so that teachers can hold on during the interaction. Teachers establish a higher professional development training objectives by checking the "system integration" to know the reward records of participating in the training activities. When the credits reach a certain number of points, teachers can apply to initiate the theme of research, research cooperation and other activities, which is regarded as an important indicator of evaluation of professional development of teachers to encourage teachers to participate in training initiative and initiative. Showing the "participation activities" of can make the teachers to understand the training progress of each other's and mutually improved. Respective "learning subscription" promote the dissemination of resources between teachers. Teachers get the individual learning resources from the "training referral" to make their professional development training more targeted and effective. They use teaching summary, teaching reflection, scientific research experience, training experience and other records in the "growth log" to promote their own professional development of knowledge and skills, to share, disseminate individual education and teaching tacit knowledge. Various valuable formal or informal information stored in the IaaS service can be used as the basis for the teacher knowledge management. "Friends", "My friends", "Recent visitors", "Message Board" to save the teacher's individual practice of professional development of the exchange of records and data to promote the continuing professional development of teachers.

5.8. Teacher knowledge management system

The teacher knowledge management system includes education resources, instruction design, teaching case, teaching video, teaching evaluation, research achievement, teachers' moral literacy and so on, from the perspective of knowledge management, which can be divided into different types and system management. The use of cloud computing IaaS to provide storage space to upload and display. The knowledge and skills of teachers' professional development will be analyzed and categorized in the process of obtaining, creating, sharing, integrating, recording, accessing, updating, etc. of the resources in the teaching and learning practice.

5.9. Interaction communication system

The "Interactive Communication System" brings together the communication components of the Teacher Professional Development Support System, including communication community, e-mail, web instant messaging tools, network whiteboards

and video conferencing System. Through the cloud service SaaS to specific application software function encapsulation realization, Various communication components for the exchange of teachers training to provide a variety of forms, real-time vivid synchronous or asynchronous communication for teachers to develop their own professionalism, collaboration and continuity to provide support and protection.

5.10. Use feedback system

The “Use feedback system” “provides feedback on the use of professional development support systems, including questionnaires and contacts us. The “questionnaire” collects teachers’ satisfaction and feedback, and then the system can be improved to provide effective support for professional development of teachers.

6. The application practice of support system for university teachers’ professional development based on cloud computing

This system based on the connotation and characteristics of university teachers’ professional development, which is on the basis of clear the present situation of the information-based foundation environment, completes the top-level design and module function analysis. The system combines the school existing informatization infrastructure environment with cloud model, innovates development mode of teacher professional development support system, solved the hardware equipment, network bandwidth, safe

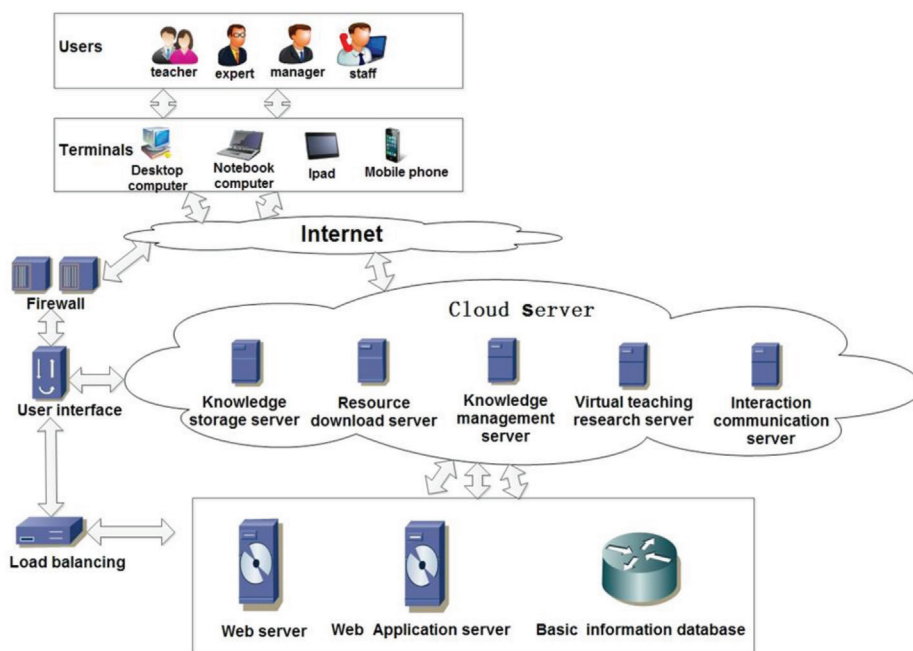


Figure 3 – The indication for application of support system for university teachers’ professional development based on cloud computing

storage, maintenance and a series of problems, which effectively reduces the cost of system development, and ensure the stability, security, and scalability of the system operation. The indication for application of support system for university teachers' professional development based on cloud computing is as shown in Figure 3(Wu, et al., 2015).

Since January 2015 the system has been running, 1020 teachers in the school have opened a personal account registration. Teachers can login the system by desktop computers, laptops, tablets, mobile terminals, according to their own needs, and the personalized push system for professional development training. In order to further improve the system function and operation, and provide continuous and efficient support for professional development for teachers, the school set up a satisfaction survey of the system to the teachers. The survey questionnaires of 600, recovery of 590, the recovery rate is 98.3%. By SPSS statistical software for data analysis shows that the system's overall satisfaction of the teachers, which is to use the operating system and effective support for their professional development, as high as 97.7%, as shown in table 1. In view of the using the indexes of satisfaction, including system interface ease of use and content applicability, operational effectiveness, timeliness of information and system security, are shown in table 2.

Satisfaction (point)	Frequency	Percentage (%)
Very satisfied (100-90)	90	15. 2%
Basic satisfied (89-70)	409	69. 3%
General (69-50)	78	13. 2%
Not satisfied (49-30)	11	1. 86%
Very dissatisfied (29-0)	2	0. 33%
Total	590	100%

Table 1 – The teachers' satisfaction of support system for university teachers' professional development based on cloud computing

Index	Frequency	Percentage (%)
Interface ease of use	518	87. 8%
Content applicability	535	90. 6%
Operational effectiveness	508	86. 1%
Timeliness of information	545	92. 3%
System security	580	98. 3%

Table 2 – Indexes of the teachers' satisfaction of support system for university teachers' professional development based on cloud computing (n=590)

The table 2 shows that teachers achieve high satisfaction to the system performance indexes. Among them, the “content applicability” emphasize the integrating degree between the system content design and meet the requirements of teachers’ professional development. “Operational effectiveness”, “timeliness of information”, “system security” describe the system operation and operation situation, including the system support for training activities efficiency, response and feedback of system operation performance, the operation of the system and data security, etc. Their respective get satisfaction was 86.1%, 92.3%, 98.3%. To a certain extent, shows that the system has good stability, safety and efficiency. At present, the system has played a good role to support for teachers’ professional development, and meet the demand of the connotation of university teachers’ professional development, promote the level of real ascension of the college teachers’ professional development.

6.1. Teachers’ academic level have improved (Qin, 2015)

System gives teachers support in scientific research knowledge, methods, practical training. According the basis of system data, technique knowledge, scientific research and practical training and scientific research cooperation and exchange, research results show has high hit rate by the user. Among them, the virtual teaching system of the module of “scientific research cooperation” launched 800 multiples about the scientific research project. Knowledge management system of teachers “research” shows all kinds of scientific research for more than 1500 multiples. Teachers show has high scientific research innovation and good academic communication consciousness and ability. Since the system is running, in 2015, 2016, the number of successfully declaration of research project and the number of published get a large amount increase, over the previous year. Teachers also showed high enthusiasm on scientific research project declaration, and made remarkable progress.

6.2. Teachers’ professional knowledge and skills have developed

By adopting the combination of individual and collaborative research way, teachers learn the knowledge and resources of the system fully. They learn professional nutrients in the academic community of experts, and get their teaching knowledge and skills of their own education development in the aspect of theory and practice. According to the system data, number of times of the “Resource download” operation is more than 30,000. The teaching problems, which are launched in “The topic for discussion” module in Virtual teaching system, have been more than 900. The discussion on the reform about the education teaching in Online FAQ” Of the Experts in system has been more than 2300 records. All kinds of resources in Knowledge management system of teachers has reached 20000 records. Since the system is running, in 2015, 2016, the number of attending Teachers’ professional skills at all levels, courseware competition is gradually increasing, which has achieved the unprecedented good grades. The quantity and quality of declaring all levels of education teaching reform project and elaborate video open class projects has a bigger breakthrough than ever before.

6.3. Teachers’ moral literacy have advanced

The system transfers and feeds the teachers the knowledge of teacher’s moral cultivation through the garden system and experts leading system Knowledge system. According

to the system data, the messages relating to the teacher's moral literacy, in Online FAQ" Of the Experts in system have been reached 2000 items, which in the knowledge management system has been reached 2200 items. This implies, Ethics training for teachers' also can award the positive recognition, equal attention and internalization. Since the system is running, the teachers showed a high quality political thinking quality and good professional spirit. They observe law and discipline, devote to work and love their students, and devoted to study preciseness. They actively participate in ethics construction activities, decrease the number of accidents in teaching. They obtain the title of outstanding teachers at all levels. The number of those are increases continuously.

7. Conclusions

It is imminent for higher education reform to promote teachers' professional development. The research of the cloud computing environment to provide high-quality resources and services for the professional development of university teachers has become the trend of the professional development of teachers in the information environment. Adopts B/S structure of teachers' professional development support system with an organic combination of cloud computing platform and service model, it breaks through the traditional teachers' professional development of all sorts of shortcomings and the insufficiency. It also effectively reduces the cost of development and the technical threshold and improves the system running stability and safety, riches resources and form of teachers' professional development, and improves teachers' professional development training quality and efficiency. It is an issue worthy of further study, which is about how to improve the cloud computing environment to provide high-quality resources and services for the professional development of university teachers, how to implement it links up to the regional teacher development, the construction and application, and how to improve the university teachers' professional development training effectiveness.

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Research on High-tech Enterprises Secondary Innovation by Technology Import in China — Based on Technology Diffusion and Space Dependence

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Pages: 148–157

Abstract: This paper based on provincial panel data of high-tech enterprises in China and spatial model, selects new product sales revenue and licensing authorized patents as dependent variables, selects R&D internal expenditure, introduction of technology, domestic technology purchasing, input of renovation and full time equivalent of R&D personnel as independent variables. It analyzes the contribution to the technology output. The results show that R&D internal expenditure is the main method of innovation, introduction of technology can't bring about secondary innovation. Technological innovation has obvious spatial effect and the efficiency of R&D personnel needs improving.

Keywords: R&D internal expenditure, introduction of technology, secondary innovation, spatial panel data model

1. Introduction

In China, high-tech companies generally refer to those supported by the state, such as the range of electronics, pharmaceuticals, aerospace, new energy, new materials. They transform the ongoing R&D and technological achievements, formation of core intellectual property rights. They are knowledge-intensive, technology-intensive economic entity. The report of 18th CPC National Congress suggests that we should focus on building business-oriented, market-oriented, a combination of technological innovation system.

In Schumpeter's view, the scope of enterprise innovation is a very wide range, including product innovation, market innovation, technological innovation, raw materials and other aspects. As a result of technological innovation can bring high profits to the enterprise, it has a strong appeal to the enterprise (Freeman, 1982; Freixo and Rocha, 2014). From the path of innovation, technological innovation includes independent innovation, the introduction of foreign technology, the purchase of domestic technology and equipment, etc. Among them, technology introduction is an important way to improve the technical level of developing countries. It can play the advantage of backwardness and promote the rapid development of the economy (Lin and Zhang, 2006).

To catch up with developed countries, the basic path for the enterprises in developing countries as follows. Firstly, introduce technology from other countries, then add their

internal digestion, at last, improve their own level of science and technology. (Ernst et al., 2002) Japan and Korea, for example, because the local market is small, firstly they began to use the export-oriented strategy, introduced a large number of technology from European and American. On this basis, through digestion and absorption, the two countries not only meet the domestic needs of the product, but also according to the demand of Europe and United States market, they eventually infiltrate into the European market (Kim, 2004).

The importance of innovation is beyond doubt, but essentially, the general level of independent research and development, such as simple introduction of foreign technology, simple to buy domestic technology, renewal and transformation equipment, belong to the primary level of innovation. But original innovation, integrated innovation and secondary innovation based on digestion and absorption through purchasing of technology belongs to the high level of innovation.

Take the high technology industry in China as an example, examining the effects on contribution of introduction foreign technology and the purchase domestic technology to high tech-enterprise innovation, analysis the effect of introduction technology to enterprise innovation is very important. It is advantageous to find out the problems existing in the innovation of high technology industry in China, to avoid entering the vicious cycle such as “technology introduction, backward; technology introduction again, backward again...” Therefore, it is of great significance and value to optimize the technology strategy of China’s high-tech industry.

Furthermore, according to the first law of geography, almost all spatial data have the characteristics of spatial dependence or spatial autocorrelation. China is vast in territory, technology accumulation and diffusion between different regions is a very common phenomenon, the development of modern information technology and Internet is exacerbated the spread of knowledge and technology. So, in the performance analysis of high tech industry innovation path, it must consider the space influence of the technology innovation, in order to avoid the bias of measurement results.

Under this background, based on spatial econometric model, according to Chinese provincial high-tech industry technological innovation input and output panel data from 1997 to 2011, this paper first analyzed the spatial correlation index of output value and patents of new products. Then comprehensively analyzed and compared the high-tech industry innovation contribution of enterprises independent R&D, the introduction of foreign technology, purchasing domestic technology and renovation. Through the comparison of regression coefficient and statistical tests of technology introduction and purchase domestic technology, it can objective evaluate technology introduction of Chinese high-technology industry secondary innovation level, and on this basis, we can do more to the in-depth discussion.

2. Research methods

2.1. The basic idea

At present, China’s investment in science and technology can be classified according to many different criteria. Such as in accordance with the funding sources, it can be divided into enterprise funds, government funds, bank loan of science and technology; according to the

R & D funds expenditure object, it can be divided into R & D funds internal expenditure, R & D funds external expenditure; according to the path of innovation, it can be divided into enterprises independent R&D, technology introduction, purchasing domestic technology, renovation, and so on. In this paper, we use the last classification criteria.

If introduction of technology or purchasing domestic technology innovation contribute significantly, it indicating that enterprises can be a good digestion and absorption of foreign technology, and on the basis of this, they make a secondary innovation. If the introduction of technology or purchase of domestic contribution to enterprise innovation is not significant, indicating that poor digestion and absorption, and there is no effective secondary innovation. Of course, this is not to say that technology import or purchase of domestic technology has no effect, only means it did not promote secondary innovation of technology introduction. The contribution to the production and operation of enterprises is undoubtedly, enterprises are rational, it is impossible to waste the limited resources.

2.2. Spatial correlation index Moran'I

Moran (1950) put forward the global spatial correlation index Moran's I, the calculation formula is:

$$Moran's I = \frac{n}{\sum_{i=1}^n (Y_i - \bar{Y})^2} \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{\sum_{i=1}^n \sum_{j=1}^n W_{ij}} \quad (1)$$

In formula (1), Y_i , Y_j respectively indicates i , j area investigation observation index, n is the number of spatial unit, W_{ij} is spatial weight matrix, also known as binary spatial weights matrix, representing the spatial relationship between regions, generally adjacent area index is 1, areas not adjacent is 0.

2.3. Spatial econometric model

Spatial econometric model mainly includes two kinds. On one hand, it is spatial lag model (SLM) or spatial autoregressive model (SAR), it introduced space lag correlation variables into regression model, we can use it to measure the existence and strength of spatial interaction relationship. On the other hand, it is the spatial error model (SEM), and it is the special form of structure which put residual into regression model. It can be used to deal with the effect of spatial self-regression variable difference.

2.3.1. Spatial lag model

According to Griliches-Jaffe's knowledge production function (Griliches, 1979; Jaffe, 1989), input elements include investment funds (k) and R&D personnel (L). On the basis of this, according to the different purposes of investment funds, they can decompose into R&D internal expenditures (K_1), the introduction of Technology (K_2), purchasing domestic technology (K_3), digestion and absorption (K_4). In order to

eliminate heteroskedasticity and increase the interpretation of results, all variables are in logarithmic and we can obtain the spatial lag model.

$$\begin{cases} \log(Y_{it}) = \rho W_n \log(Y_{it}) + \beta_1 \log(K_{1,it}) + \beta_2 \log(K_{2,it}) + \beta_3 \log(K_{3,it}) + \beta_4 \log(K_{4,it}) + \beta_5 \log(L_{it}) + \mu_{it} \\ \mu_{it} = \mu_i + \varepsilon_{it} \\ \varepsilon_{it} \sim N(0, \sigma^2 I_N) \end{cases} \quad (2)$$

In formula (2), Y_{it} is the output of science and technology, W_n is the spatial weight matrix, $W_n \log(Y_{it})$ is the space autoregressive of technology output, represents output of science and technology is not only related to the input of science and technology into one space unit, but also related to scientific output of the adjacent areas. ρ is spatial lag coefficient vector, if it passes through statistical tests, then shows that the existence of spatial dependencies between the output and input of science and technology, that is, there exists knowledge diffusion, spillovers and interaction between adjacent area space units. β_i is the input vector technology of regression coefficients, μ_{it} is the spatial effect related to space unit, including fixed effect and random effect, ε_{it} is normally distributed random error term.

2.3.2. Spatial error model

The expression for the spatial error model is following. In formula (3), λ is the spatial error coefficient of section technological output, reflecting the degree of influence on the observed value of the adjacent areas, and shows the impact of regional scientific and technological output error. That is, the presence of SEM spatial dependence is among the random error μ_{it} term. It shows that the impact of a region on the surrounding area is more involved in the structural characteristics of overall impact, not simply the interaction between the impact of input and output of science and technology.

$$\begin{cases} Y_{it} = \beta_1 \log(K_{1,it}) + \beta_2 \log(K_{2,it}) + \beta_3 \log(K_{3,it}) + \beta_4 \log(K_{4,it}) + \beta_5 \log(L_{it}) + \mu_{it} \\ \mu_{it} = \lambda W_n \mu_{it} + \varepsilon_{it} \\ \varepsilon_{it} \sim N(0, \sigma^2 I_N) \end{cases} \quad (3)$$

The regional spatial correlation test mainly including Moran, LMerr, LMsar, Lratios, Walds etc., they original hypothesis for $H_0: \rho=0$ or $\lambda=0$. For the spatial panel model estimation, generally using the maximum likelihood estimation (Anselin, 1988).

3. Data

About selection of enterprise technology innovation output variables, traditional methods mainly two kinds: one is new product sales revenue (Liu et al., 2007). Another is licensing authorized patents (Groot et al., 2001). In order to improve the robustness of the study, this paper selected the two variables to study.

According to the different path of enterprise innovation, the input variables selection of research funding includes R&D internal expenditure (means enterprise independent

R&D investment), introduction of technology, technological digestion and absorption, domestic technology purchasing and input of renovation. Taking into account the digestion, absorption and the introduction of technology are directly related together, so we can merger them to comprehensively reflect the technology introduction impact on innovation. At last, we select full time equivalent of R&D personnel as R&D personnel input variables, this index is more reasonable relative to the number of R&D personnel.

Taking into account only in 1997 Chongqing city became the provincial-level administrative region independent, so this article selected data from 1998 to 2012 from Chinese high-tech Yearbook, the actual data is from 1997 to 2011. Due to lack of data in Tibet area, so it has been deleted. To the other part of missing regional data, it has been assigned to a unified 1, thus ensuring the integrity of the sample.

4. Empirical results

4.1. Moran'I index over years

During the period from 1997 to 2011, the Moran'I index of new product sales revenue and authorized patents is shown in Table 1. During the 15 years, the technological innovation of high technology industry has obvious spatial correlation, and the Moran'I index number is from 0.4 to 0.7, which indicates that the spatial dependence of technological innovation in the area is obvious. According to the average, Moran'i index of new product sales revenue is 0.488, Moran'I index of authorized invention patent is 0.492. The two indicators approach nearly, from another perspective, it is testified that they can both be described as high-tech industries technical innovation output index.

Overall, Moran'I index fluctuations is gradually narrowing, especially since 2007, Moran'I index tends to fluctuate slightly, indicating regional effect of technological innovation of China's high-tech industry tends to be more stable. The reason mainly due to the increasing convenient means of information and communication between the growing regional economic and technical cooperation. The reason of the existence of the fluctuation of Moran'I index curve is as follows. It decided by the technology accumulation and technology diffusion. Technology always gathers to the core area,

Year	New product sales revenue	Authorized patents	Year	New product sales revenue	Authorized patents
1997	0.537	0.624	2005	0.480	0.509
1998	0.451	0.470	2006	0.490	0.552
1999	0.430	0.537	2007	0.476	0.480
2000	0.457	0.451	2008	0.493	0.490
2001	0.560	0.430	2009	0.456	0.473
2002	0.411	0.457	2010	0.550	0.476
2003	0.509	0.560	2011	0.520	0.493
2004	0.552	0.411	average	0.488	0.492

Table 1 – Moran'I index over years

because the core area has better research conditions, better team and better treatment. But if this accumulation is too excessive, it will inevitably lead to input-output ratio decreased and promote technology diffusion. The interaction between these two kinds of effects can effectively promote knowledge transfer, which is of great significance to narrow the gap of regional technology progress.

4.2.Spatial panel model estimation

4.2.1. Stability test of data

In order to prevent the emergence of spurious regression, the panel data need to be stationary tested. The test methods are more, such as Levin Lin &Chu test, Breitung test, Fisher ADF test, Fisher PP test, Hadri test, and so on. All method principle of test is different, test results are not consistent. In order to ensure the robustness of the study, this article select Breitung, Fisher ADF, Hadri methods tested, with the results of three methods agree to consistent.

From the unit root test results, Breitung test and Hadri test is relatively strict, After the first order difference all the variables is steady, while Fisher ADF test is relatively loose, all variables are steady after the 0-order difference.

4.2.2. Spatial panel econometric model estimation

For spatial panel model estimation, the general use of the method is maximum likelihood estimation, but the precondition must through the spatial correlation test. The test methods are mainly such as: LMsar, robust LMsar, LMerr, robust Robust_LMerr etc. Their original hypothesis is $H_0: \rho=0$ or $\lambda=0$, that means not exist space related. This test method is put forward by Elhorst (2003) who promote it to panel data based on the traditional data, now it has become an important method of spatial correlation panel data test.

In order to improve the robustness of model, this paper selects the new product sales revenue and licensing patent as the dependent variable and the independent variable is the same. Then there are two spatial correlation test results. Firstly, look at the sales revenue of new products as variable spatial correlation test, it goes through LMsar, robust Robust_LMsar and robust_LMerr at 1% level of the statistical test, but can't pass through LMerr statistic test. General speaking, it should choose spatial lag model (SLM), by using the maximum likelihood method of estimation. Secondly, look at licensing patents as dependent variable spatial correlation test, all statistical tests variables pass through the statistical test at the 1% level. In addition, considering we selected data from a sample of 30 Chinese provinces and cities, it is more close to the overall level. Baltagi (2001) believes that when the sample is from the general, it is more appropriate to select the fixed effect model. That's why, the paper chooses fixed effects of SLM model to estimate.

SLM Model estimation results are shown in Table 2. Firstly, look at the new product sales revenue as the output of innovation results, from the spatial lag model (SLM) estimation, only enterprises independent R&D input and spatial lag coefficient vector ρ pass through the statistical test, other variables are not pass through statistical tests. The

R^2 of this model is 0.873, it has higher goodness of fit. On the other hand, look the results of licensing authorized invention patent as innovation output, enterprises independent R&D and R&D personnel full time equivalent pass through the statistical test at 1% level, other variables were not through statistical tests, the R^2 of the model is 0.875, it still has higher goodness of fit.

In consideration of the background of spatial correlation of the technological innovation, no matter how dependent variable is sales revenue of new products or licensing authorized invention patent, the introduction of technology and the purchase of domestic technology are not through statistical tests. Of course, renovation is not through statistical tests too. It indicates that the model estimation results are steady, that is, introduction of foreign technology and the purchase of domestic is helpless to enterprise innovation, or there is no effective secondary innovation in the introduction of technology.

Variable	Meaning	New product sales revenue (Y1)	Licensing authorized patents (Y2)
Log (K1)	R&D internal expenditure	0.655*** (8.101)	0.387*** (6.746)
Log (K2)	introduction of technology	0.057 (1.517)	0.014 (0.519)
Log (K3)	Domestic technology purchasing	-0.029 (-0.777)	0.009 (0.357)
Log (K4)	input of renovation	0.079 (1.544)	0.005 (0.138)
Log (L)	full time equivalent of R&D personnel	-0.157 (-1.312)	-0.322*** (-3.795)
ρ	Coefficient of Spatial autocorrelation	0.161*** (3.065)	0.663*** (19.634)
LR-test		177.579	744.372
Log-likelihood		-678.426	-549.263
Hauseman		-24.929*** (0.000)	2.434 (0.876)
R^2		0.873	0.875

Note: "****" denotes visibility at the level of 1% by test

Table 2 – Panal data LMsar model test result

5. Conclusion

5.1. Independent R&D is the most important innovative way for high-tech enterprises

Independent R&D has become the most important way to high-tech enterprise innovation. Whether we choose sales revenue of new products or licensing authorized invention patents as substitute variable, the elasticity coefficient of independent R&D

is significant. High tech enterprise is facing the fierce competition between regions, international trade, if enterprises don't pay attention to independent innovation, then they will be difficult to survive and develop. Therefore, independent innovation has become the main form of the high tech enterprise innovation, now it has achieved fruitful results. The high-tech enterprises of our country independent R&D investment accounted for the proportion of sales value is about 6.1% and accounted for the profits is 23.6%. Although there is still a gap compared with the developed countries, but the proportion improves quickly in China. According to the empirical results, the R&D of high-tech enterprise investment increases every 1%, it will bring innovative output increased from 0.35% to 0.70%, the result is significant.

5.2. Introduction of technology can't bring secondary innovation

Whether it is introduction of technology or the purchase of domestic technology, there is no contribution to innovation output, and can't pass through statistical test. Taking into account the ratio of digestion and absorption to imported technology expenditure has been below 0.25, while ratio of Japan, South Korea and other countries in a period of rapid economic development even reached 3 to 10, which shows that the serious shortage of investment in the digestion and absorption of foreign technology in China. In this case, the introduction of technology is only to use or simple imitation, it is difficult to a get higher level of innovation. Enterprises did not play the role of technology introduction, resulting in a large number of technology import of waste (Lingyan and Haohan, 2016). For domestic technology, the purchase of domestic technology is often incomplete and advanced than foreign technology, here is no effective secondary innovation.

Of course, this is not to say that technology import and purchase of domestic technology has no effect, the introduction of technology will undoubtedly have a very important role for high technology enterprises to expand production capacity, improve product quality, reduce production costs. It means that if without effective digestion and absorption and secondary development, it is difficult to play the important role of innovation for the enterprise.

5.3. Introduction of technology innovation can only bring short-run innovation

According to Schumpeter's innovation theory, the connotation of high-tech enterprise innovation is very extensive. From the perspective of technological innovation, whether it is introduction of foreign technology or purchase domestic technology, it can promote the technological innovation of the enterprise in the short run. But if the enterprise does not carry out secondary innovation and development on the basis of digestion and absorption, the innovation destined to be short, as short as a few months, or one till two years, it can't promote continuous improvement of the level of enterprise technology innovation.

5.4. Spatial effect of technology innovation is more distinct

From the spatial correlation index of technological innovation, the spatial effect of technology innovation is more distinct in China. The spatial correlation index Moran's I is close to 0.5, and the fluctuations have a narrowing trend., It means that technology

accumulation and diffusion becomes more stable due to the development of information technology, which helps to promote the balanced development of China's regional high-tech industry technological innovation. From the SLM model regression results, the spatial lag coefficient vector ϕ has passed through the statistical test, it illustrated the technology innovation influence of adjacent area is more obvious to regional innovation.

Technology is not public goods, more technology diffusion has the impact through the "demonstration effect", that is, if high technology industry of adjacent areas is more developed, there is a promotion effect on the local area. The spatial effect of technological innovation is of great significance to advanced innovation of high-tech enterprises, which is helpful for high-tech enterprises to original innovation, integrated innovation and secondary innovation.

Acknowledgments

The author is very grateful to the editor and the anonymous referees for their insightful and constructive comments and suggestions, which have been very helpful in improving the paper. This work was supported by Zhejiang Philosophical and Social Science Project (number: 16NDJC102YB); Ningbo University Humanities Post-funded Project (number: XHQ1402); and Sponsored by K.C.Wong Magna Fund in Ningbo University.

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Risk Evaluation Indexation System Construction and Assessment of Stampedes in Large-scale Activities Based on FTA and Catastrophe Progression

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Pages: 158–169

Abstract: Along with the rapid growth of large-scale activities, the security risk gets higher and higher, so how to confine the risk is very essential for the current society. By the case analysis and the achievements on existing stampedes indexation system, the paper introduced the fault tree analysis to track the causes of stampedes of large-scale activities and built a fault tree of stampedes of large-scale activities. Aiming at the problem which is difficult to quantify by traditional mathematical models on the risks of stampedes, this paper constructed the risk evaluation indexation system of stampedes of large-scale activities and made the evaluation by the catastrophe progression method. The quantitative evaluation value coincided with the actual situation. The case study showed that the indexation system and the evaluation method can be used to solve the kind of problems and provided reliable theoretical and methodological support on the prevention of the risk of stampedes.

Keywords: Large-scale activities, Stampedes, Catastrophe progression method, Fault tree analysis

1. Background

Due to the social development and the improvement of living standards in recent years, domestic large-scale activities, both in quantity and in scale and range, get a substantial leap, involving many fields including economics, living, culture, sports and so on. Many of them were held in large and medium-sized cities with extremely concentrated population and relatively developed economics. Along with the rapid growth of large-scale activities, the security risk gets higher and higher, and there are some stampedes happen occasionally.

The stampedes in large-scale activities are very complex, involving many interactive factors like human beings, objects, surroundings and organizational management, which is a kind of distinctive accident, resulted from human beings, and is in the top list of in emergency management.

1.1. The research status of stampedes

Currently most of the studies on stampedes by scholars are from fire evacuation models to analyze safe evacuation problems in crowded stampede conditions, but the research on specific crowded stampede model is still in the exploratory stage at present.

First foreign research in this field started by the survey about the investigation on the behaviors of fire accident survivors by Bryan from University of Maryland. Based on the analysis of domestic and foreign research achievements, the present study mainly focuses on three aspects, including the behavior of the crowds and congestion characteristics, theory and method of people safety evacuation and its application, and the mathematical model of crowd evacuation simulation.

In the study of the behavior characteristics of congested crowds, the French scholar L.Heigeas (2003) analyzed the self-organization behavior rules of congested crowds in depth, and pointed out that some no negotiated emergencies may occur for the crowd in aggregation state, which should be paid more attentions for prevention. For security model construction of the crowd, Pauls (1987) from Canada explored the crowd evacuation time in emergency situation at different positions of buildings, and calculated the time for evacuation by simulation method. John J Fruin (1993) is the first person who built the crowd stampede model and constructed the FIST (Force-Information-Space-Time) model. Hughes (2004) argued that the behaviors of the congested crowd was well regulated, which can be realized by some specific behavior rules by coupling, nonlinear or differential equations. Professor Lu (2002) from Wuhan University explored the influence of the crowded on individuals in the process of emergency evacuation, and proposed the logarithmic relationship between the influence and evacuation speed. He established the escaping evacuation dynamics equation, which laid the foundation for the quantitative study on the evacuation problems. For the mathematical model of crowd evacuation simulation, German scholar Helbing (2000) analyzed the factors resulting in the crowd stampedes, made simulation analysis on the self-organization feature of the crowd in anxiety and panic situation, and deduced the “Social-Force” model. Xie (2012) fully recognized the importance of population density and direction of mutation, and constructed the emergency evacuation complex network model, taking the mutation factor of crowd flow direction into consideration. Based on multi-objective decision-making applied theory, the researcher Chen (2010) from the Chinese Academy of Sciences set up an emergency collaborative decision-making model with multi-stage, multiple perspectives and multi-agents with the consideration of the synergies of the internals of organizations and dynamic decision-making, which opened up a new perspective for emergency management.

Compared with the literature of the current domestic and foreign large-scale activities stampedes, there is some deficiencies of domestic research, which emphasizes more on the particularity and the principle, but lacks the study on generality and rationality.

1.2. Research on achievements of risk evaluation model of large-scale activities

The paper presented the overview on risk management of the large-scale activities from domestic and foreign scholars and research institutions, in order to better understand

the risk evaluation indexation system to provide suggestions and references on risk evaluation indexation system of stampedes of large-scale activities.

Starting from the perspective of risk management, Tong (2006) explored the network structure model of assembled crowd accident risk, and constructed the quantitative evaluation indexation system. From the perspective of safety system engineering, Li & Wang (2008), constructed a quantitative evaluation indexation system model including 4 primary systems, nine secondary systems and 24 tertiary systems based on the theory of risk management, focusing on the nature of activities and disaster prevention and control. Professor Wang (2008) divided the risk of stampedes of large-scale activities into four categories: human beings, objects, objective environment and organizational management, and set up a quantitative evaluation indexation model on large-scale activities. Qiao (2011) built a quantitative stampede evaluation model, including 4 primary systems, 29 secondary systems after analyzing the source causes on the stampede of sports event. Combined with the viewpoint of system theory, Tian (2008) built an evaluation indexation system model on the emergent accidents including 3 primary indexes and 13 secondary indexes by fuzzy mathematics method.

By analyzing the existing risk evaluation systems of large-scale activities, we can concluded that most of the systems selected Man-Machine-Environment-Management as evaluation indexes from the perspective of safety system engineering, which suggested the important influence of these interactive factors in risk management, and which also suggested that the risk evaluation systems are complex systems made up of these interactive and interdependent factors. We should fully take these influences of interactive factors into consideration when we made choices, and moreover, we also paid attention to some other important indexes. Such as Ren (2005) used the clustering index to represent the crowding level and pointed out that the crowd density is a necessary condition for stampedes. If people were under an extremely crowded state for a long time, they would be anxious, impatient and even panic, and as the longer the situation lasted, the higher the risk coefficient of the stampede was. So the population size must be controlled in large-scale activities.

This paper mainly did some research on how to build and evaluate stampedes risk evaluation indexation system of large-scale activities. Firstly, the fault tree analysis was used to analyze the causes of stampedes in large-scale activities by case analysis and literature review, and a fault tree of stampede was constructed, laying a solid foundation on the construction of risk evaluation indexation system of stampede in large-scale activities. Secondly, the catastrophe progression method was used to evaluate the system so as to get quantifiable valuations, combined with fault tree.

2. Methodology

2.1. Fault tree analysis

The FTA (Fault Tree Analysis), taking the so-called top event, which is worst case that the system has to confront, as the object of analysis, traces and lists all the possible root cause. The rationale is: (1) Deducing “reasons” from “results”. (2) Assume an event happened to mark “1” standing for an occurred event, “0” for no occurred events.

The method only assumes two possibilities of random events with the “0” and “1”. In other words, it adopts a zero-sum thought (Bu, 2007).

FTA was summed up by Professor H.A.Watson from the Bell Laboratories in the analysis of reliability of the missile control system in 1960s. Whether or not a danger exactly arises, this method analyzes only from the specific accident cause by a set of feasible methods to find the causes of accident-induced basic events. At present, the theory has been widely applied and is one of the main methods for qualitative and quantitative analysis on security and stability of a given system. Its basic principle is to calculate the probability of the top event, the main path and key source by Boolean algebra method according to the probability of basic events involved in the accident process and the type of the logic gate along the fault path.

By applying FTA, the following four effects can be achieved: (1) Investigating all the causes of one incident. (2) More intuitive and clear to use diagrams to illustrate the process and results of given objects. (3) Finding out all kinds of the “possible paths” resulting in accidents, and the “possible paths” not resulting in accidents. (4) Analyzing quantitatively to get the accidental probability of one system (Yu, 2007).

2.2. The basic idea in catastrophe progression method

Catastrophe theory was first put forward by the French scholar Rene Thom in 1972, and the application foundation of catastrophe theory, singularity theory and topology, was given in his book “Structural Stability and Morphogenesis”-- Based on the mutation type of the critical points of potential functions, it explores the inherent mechanism of the discontinuous sudden change of potential function at different critical points by topological method. For the catastrophe progression method, it is a reliable quantitative evaluation method established under the framework of catastrophe theory. Currently the main research by scholars is to study mutation phenomena by mutational mathematical quantitative model and to evaluate the multi-objective problems using the catastrophe progression method.

The evaluation process of catastrophe progression can be expressed as the following four aspects: (1) Establishing the hierarchical evaluation system. According to the aim of evaluation, the final index was decomposed until the subordinate index of one level index can be easily quantified. (2) Determining the type of the mutation system. According to catastrophe theory, there are seven types of mutation systems, but cusps, dovetail and butterfly mutations are more common. (3) Normalizing control variables. It needs to do the normalized treatment for the catastrophe models' divergence collection. (Xu & Leng, 2011). The normalized formula can control the variables of all levels of non-dimensional treatment into state variables of the same state as to use the normalized formula for comprehensive evaluation. (4) Calculating the catastrophe progression value. After the dimensionless state variables of each hierarchical level are processed, the total catastrophe progression value of the evaluation object is calculated and determined, according to the mathematical model of the corresponding catastrophe theory types and the principle of “complementarities” and “non-complementarities” (Wen & Chen, 2016).

In this paper, the FTA and catastrophe progression method were used to evaluate the risk of stampedes of large-scale activities, which can overcome the drawbacks that the

research data is hard to obtain and the research lacks objectivity resulted from the large number of samples and the long periodicity, and the research is of high practical significance.

3. Risk evaluation and the construction of indexation system of stampedes

3.1. Fault tree analysis on the causes of stampedes of large-scale activities

The stampedes were divided into two categories according to the process of accidents in this paper. The first category is the stampede taking place in the evacuation process due to overcrowding, lacking of emergency evacuation ability, and ineffective emergency management; the other category resulted from such unexpected events as crowd-induced emergencies, building collapse, or structural damage.

Emergencies in large-scale activities is an upheaval of physical environment or crowd gathering environment occurred in a very short time, which results in a major threat and injury on physiology, psychology and even life of the crowds. Factors leading to such drastic changes may be caused by natural environments, such as sudden heavy rains; the result of a combination of both human beings and the environment, such as the collapse of temporary structures; or human induced factors such as terrorist's attacks and rumors. The factors like human induced factors, organizational management, activity environment, site, and equipment, are the main causes influencing the risk of stampedes of large-scale activities.

The main influencing factors of man-made disaster are closely related to crowd density, crowd panic psychology and crowd risk behavior. Under the dual effects of specific environment and objects, the crowd might show some unconventional reactions such as panic, despair and etc, and some dangerous behaviors ensue, leading to sudden release of the energy of the crowds, and the mutation of crowd density and population flow, so the stampede happens. In the organizational management, the occurrence and spread of stampedes are closely related to the level of management, according to the relevant surveys. Many accidents were caused because of the lack of control from the management on crowd density and population flow, and the lack of the emergency preparedness before events, resulting in out of control on crowds after the accident, which aggravated the accidents. The three major accident risks of infrastructure per se include the facility design risk, layout risk and building materials risk. Li (2013) gave four optimization directions on evacuation: building structure, evacuation path orientation, width of path and the design of the evacuation path. As to environmental risk, due to the social nature of large-scale activities, natural environment risk, social environment risk, and surrounding risk are three typical factors of large-scale activities.

3.2. Construction of fault tree of stampedes of large-scale activities

Combined with the book China Music Festival Development Research Report produced by Dao & Strategy Cultural Industry Research Center, literature review, field investigation, brainstorming and the achievement on stampedes research by Wang (2008) and Bai (2009), this paper constructed the causes of fault tree of stampedes of

large-scale activities. On this basis, the fault tree of stampedes was made by collecting stampede cases in the past 100 years. The steps are as follows:

1. Selecting research object. This paper chose the serious consequences caused by stampedes as research object and the casualties and property losses were taken as the top event.
2. Depicting fault tree. According to the basic procedures of constructing the fault tree, the fault tree of stampedes was drawn, combining with the characteristics and its inherent rules of the serious disaster consequence caused by stampedes in the large-scale activities. The collected stampede cases are the overall basis for the FTA. The priority was given for those which can be counted in cases, such as the causes of the accident, and lessons and experiences. Otherwise, the deduction was made according to the basic situations, the process of accidents and the condition of the rescue due to inadequate records.
3. Identifying codes. In order to get concise identification, “codes” were used to be correspondent with the basic events one by one. The fault tree of stampedes of large-scale activities is shown in Figure 1.

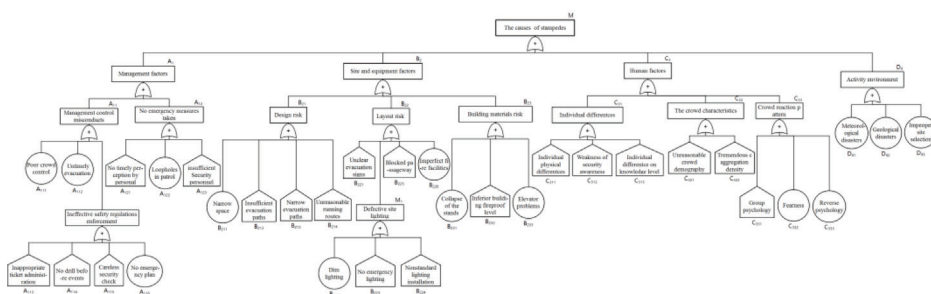


Figure 1 – The fault tree of stampedes of large-scale activities

3.3. Construction of evaluation indexation system of catastrophe progression

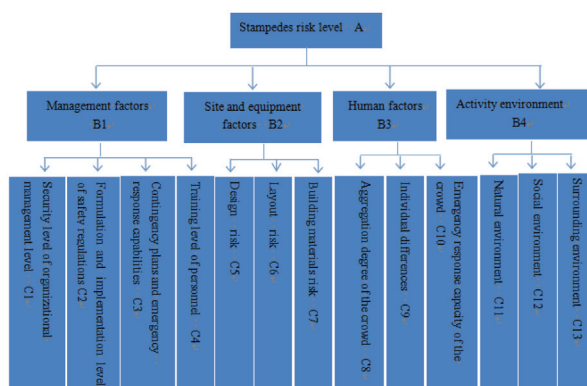


Figure 2 – Risk evaluation indexation system of the stampedes accidents of large-scale activities

According to the results of FTA, the risk evaluation indexation system of the stampedes in large-scale activities can be constructed based on 4 primary indexes and 13 secondary indexes, the risk evaluation indexation system of stampedes in large-scale activities is shown in Figure 2.

4. Case evaluation process and results analysis

To evaluate the risk of large-scale activities, generally it is possible to judge the risk level of the stampedes in large-scale activities. Taking the largest Strawberry Festival in China as the research objects, 10 cities for hosting strawberry music festival–Beijing, Shanghai, Wuhan, Xi'an, Shenzhen, Chengdu, Changsha, Changchun, Xiamen and Guangzhou were selected and evaluated.

4.1. Establishing the evaluation criteria

According to the risk of large-scale stampedes, the risk is divided into five grades, as is shown in Table 1.

Rank	LowRisk (Level 1)	Lower Safety (Level 2)	General Risk(Level3)	HigherRisk (Level 4)	High Risk (Level 5)
Index	<0.20	0.20-0.40	0.40-0.60	0.60-0.80	>0.80

Table 1 – Risk evaluation criteria for stampedes of large-scale activities

4.2.Data acquisition and standardization

In this evaluation indexation system, all the indexes were evaluated by the experts and then the average of the scores was taken as the index value. According to the requirement of catastrophe theory, before the analysis and evaluation, the normalized function

Index City	B1		B2		B3			B4					
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
A	0.86	0.90	0.94	0.65	0.76	0.92	0.73	0.68	0.71	0.56	0.78	0.80	0.94
B	0.94	0.88	0.80	0.53	0.62	1.00	0.70	0.36	0.68	0.53	0.80	0.56	0.76
C	0.67	0.72	0.60	0.42	0.87	0.89	0.82	0.54	0.39	0.44	0.90	0.41	0.67
D	0.82	0.68	0.77	0.38	0.57	0.94	0.87	0.33	0.63	0.63	0.52	0.66	1.00
E	0.90	0.88	0.92	0.35	0.44	0.78	0.69	0.42	0.26	0.57	0.84	0.37	0.96
F	0.75	0.69	0.42	0.24	0.86	0.89	0.94	0.55	0.38	0.52	0.88	0.68	0.83
I	0.87	0.77	0.57	0.39	0.67	0.91	0.59	0.38	0.44	0.37	0.93	0.55	1.00
J	0.92	0.89	0.80	0.62	0.63	0.88	0.77	0.48	0.55	0.60	0.76	0.47	0.90
H	0.85	0.87	0.92	0.62	0.73	0.87	0.73	0.62	0.71	0.52	0.76	0.78	0.90
J	0.89	0.87	0.71	0.35	0.79	1.00	0.85	0.18	0.37	0.49	0.95	0.52	1.00

Table 2 – Normalized data

formula should be used to change the heterogeneous variables into homogeneous variables and the data should be normalized to a dimensionless value between 0 and 1. (see Table 2).

4.3. Normalizing control variables

Potential function is used to explore the characteristics of mutation in catastrophe theory, and dovetail and butterfly mutations were selected in this paper. The relevant formulas are shown in Table 3.

Name	Dovetail model	Butterfly mutation
Potential function	$f(x) = \frac{1}{5}x^5 + \frac{1}{3}x^3 + \frac{1}{2}bx^2 + cx$	$f(x) = \frac{1}{6}x^6 + \frac{1}{4}ax^4 + \frac{1}{3}bx^3 + \frac{1}{2}cx^2 + dx$
Controlling variables	a, b, c	a, b, c, d
Normalized formula	$x_a = a^{\frac{1}{2}}, x_b = b^{\frac{1}{3}}, x_c = c^{\frac{1}{4}}$	$x_a = a^{\frac{1}{2}}, x_b = b^{\frac{1}{3}}, x_c = c^{\frac{1}{4}}, x_d = d^{\frac{1}{5}}$

Table 3 – Mutation models and their normalization formulas

In the table, $f(x)$ is the potential functions of x , the state variable in the mutation system, and a, b, c and d are the coefficients of x , representing its controlling variable. x_a, x_b, x_c, x_d are the normalized x values of a, b, c , and d .

According to the classification method of catastrophe progression and the risk evaluation indexation system of stampedes in large-scale activities (Figure 2), the indexes constituted three dovetail mutations and two butterfly mutations. The specific mutant forms are as follows.

Butterfly mutation: $A \quad (B_1, B_2, B_3, B_4)$

$B_1 \quad (C_1, C_2, C_3, C_4)$

Dovetail mutation: $B_2 \quad (C_5, C_6, C_7)$

$B_3 \quad (C_8, C_9, C_{10})$

$B_4 \quad (C_{11}, C_{12}, C_{13})$

4.4. Calculations and results of the example

By the normalized formula from the bottom-up synthesized step by step, the evaluation results of the highest level can be obtained. Taking the data of city A as an example, the normalized calculation process of control variables is demonstrated:

The subordinate indexes of B_1 are management factors C_1, C_2, C_3, C_4 , constituting the butterfly mutation model and the indexes are complementary indexes.

$$Xc_1 = \sqrt{0.86} = 0.9274, Xc_2 = \sqrt[3]{0.90} = 0.729, Xc_3 = \sqrt{0.94} = 0.7807,$$

$$Xc_4 = \sqrt[5]{0.65} = 0.1160$$

According to the calculated value and the principle of complementarities, the average of the indexes can be obtained:

$$X_{B_1} = Xc_1 + Xc_2 + Xc_3 + Xc_4 / 4 = 0.6383$$

The subordinate indexes of B2 are object factors C_5, C_6, C_7 , constituting the dovetail mutation model and the indexes are complementary indexes.

$$Xc_5 = \sqrt{0.76} = 0.8718, Xc_6 = \sqrt[3]{0.92} = 0.7787, Xc_7 = \sqrt[4]{0.73} = 0.2840,$$

According to the principle of complementarities, the average of the indexes can be obtained:

$$X_{B_2} = Xc_5 + Xc_6 + Xc_7 / 3 = 0.6448$$

Similarly, the value of X_{B_3} and X_{B_4} can be calculated:

$$X_{B_3} = \sqrt{0.68} + \sqrt[3]{0.71} + \sqrt[4]{0.56} / 3 = 0.4270, X_{B_4} = \sqrt{0.78} + \sqrt[3]{0.80} + \sqrt[4]{0.94} / 3 = 0.7253$$

The subordinate indexes of A are human factors B_1, B_2, B_3, B_4 , constituting the butterfly mutation model and the indexes are complementary indexes. According to the principle of complementarities, the average of the indexes can be obtained:

$$X_A = \sqrt{X_{B_1}} + \sqrt[3]{X_{B_2}} + \sqrt[4]{X_{B_3}} + \sqrt[5]{X_{B_4}} / 4 = 0.3252$$

In the same way, the evaluation results of the influencing factors of each index in other cities were calculated in turns, and the calculation results are shown in Table 4.

As shown from the results in Table 4, the overall average risk index is 0.2765 in the selected 10 samples, falling into the Risk level two. So we know that the Strawberry Music Festival stampedes risk level in these 10 cities is generally low and there is little risk into a stampede. At the same time, it can be found that the risk control level of large-scale stampedes is pretty low and there are lots of rooms for improvement. In practice, the cities with lower risk control level should learn from others with good experience to reduce the risk of stampedes level.

Index city	B1	B2	B3	B4	A	Ranking
A	0.6383	0.6448	0.4270	0.7253	0.3252	2
B	0.5256	0.6758	0.3311	0.4679	0.2670	6
C	0.3336	0.6966	0.2772	0.4064	0.2332	10
D	0.3949	0.7195	0.3273	0.6695	0.2867	4
E	0.5880	0.4548	0.2571	0.6055	0.2367	9
F	0.3066	0.8044	0.2899	0.5757	0.2861	5
G	0.3760	0.5644	0.2401	0.7102	0.2443	8
H	0.5413	0.6089	0.3296	0.5439	0.2552	7
I	0.5971	0.5990	0.4061	0.6675	0.2868	3
J	0.6821	0.8036	0.1775	0.7051	0.3441	1
Average	0.4779	0.6572	0.3063	0.6077	0.2765	

Table 4 – Results of the evaluation of the stampedes based on catastrophe progression

Quantitative analysis on emergency indexes of stampedes is an important measure to ensure large-scale activities organized safely, and it has extensive application value. The evaluation indexes were selected by FTA, and the catastrophe progression method was adopted for scientific evaluation. The results of the evaluation are in alignment with the actual situation. And the relevant research results can guide the safe operation of large-scale activities.

5. Conclusion

The fault tree analysis and catastrophe progression method are used in this paper to deeply study the causes of the risk of stampedes in large-scale activities, and the risk evaluation indexation system is constructed objectively and reasonably. In this paper, the feasibility and representativeness of indexes are fully taken into account, and the proportion of human factors compared with the traditional large-scale activities risk indexation system was added. Finally, the system including 4 primary indexes and 13 secondary indexes based on catastrophe progression method was constructed, enriching the risk evaluation model of the stampedes. In addition, it is feasible to study stampedes of the large-scale activities by the catastrophe progression method. In this paper, the advantages of catastrophe progression methods that no weight assignment was needed for indexes were fully considered, when constructing the risk evaluation model. 10 cities holding Strawberry Music Festivals in China were selected as the examples for case study and the results showed that the constructed risk evaluation indexation system and evaluation model had good operability; moreover, the calculation was relatively simple, so there was of certain practical significance.

Acknowledgements

The publishing of the paper is supported by the Fundamental Research Funds for the Central Universities.

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3-D Image Analysis and Discussion on Characteristics of Taekwondo Flank Kick Movement

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Pages: 170–178

Abstract: This article uses 3-D image analysis system to collect relevant kinematics parameters related to top athletes' flank kick movement, and combines fight item group training tester to collect relevant parameters of flank kick, so as to research characteristics of taekwondo flank kick movement based on parameters such as duration, kinematics speed, tache angle, tache speed, strike force of technical motion, quantify, assess and analyse motions, find out characteristics and laws of optimum sports mode of flank kick for top taekwondo athletes of our country, providing an effective template for deep research on taekwondo flank kick movement.

Keywords: 3-D Imag, Taekwondo Flank Kick Movement, kinetic parameters.

1. Introduction

In the word taekwondo, “tae” refers to kicking, treading, trampling; “kwon” means to hit with upper limb; “do” has two meaning: one refers to routines and technique, the other one refers to the philosophical thought of being man and doing something (Zou et al, 2014). Taekwondo consists of basic technique, poomsae and actual combat. The “poomsae” is equivalent to the routine in our martial arts, combining various attack and defense techniques and movements according to certain rules and attack and defense intentions to form specified movements and quantitative form of relation (Medina et al, 2013; Qu, 2014). There are about 25 in taekwondo, of which the most basic and common are Tai Chi Eight Chapter. Basic techniques include upper limb technique and lower limb technique, arms upper limb technique only includes straight punch. Although being more flexible, compared with lower limb upper limb is weak (Lee, 2010), during competition, upper limb is only used to parry attacking limb of the opponents, support movements of lower limb and make some fake motions, so attack of upper limb plays helping role only (Xia, 2014)

So far, the current status of research on taekwondo in our country remains limited to traditional method of exercise physiology (Choi, 2015). This research method is mostly end analysis and assessment of kinetics and dynamics of technical movements and seldom conducts research on elements such as process of taekwondo technical movement and intermediate taches producing effect of actions by using image analysis system, with the depth and extends needing to further expand. Based on this current status, it

is undoubtedly an urgent and hard task facing us to strengthen analysis and research on sports biomechanics characteristics of taekwondo technical movements (Su, 2015), deeply discuss factors influencing movement effects, establish scientific assessment system, and perfect training methods. So, we carry out scientific research by starting from analysing biomechanics characteristics of taekwondo flank kick movement, using 3-D image analysis method.

2. Data acquisition

This article adopts 3-D technology, filming flank kick movement through 2 Panasonic DVs with 50 fps shooting frequency in the experiment. During filming, the DVs are 12 m from the frame, 1.2 m from above the floor, the included angle of principle optic axis of two DVs is about 90 degrees, frame origin is 26 cm above the floor. Then use the “3-D image analysis system”, an American company to process experimental data, obtaining kinematic parameters in action process (Matsubayashi, 2009).

2.1. Acquisition of 3-D image data

1. With two DVs still, film the frame first and save it, starting the synchronizer when filming. Then take away the frame, with the striking target suspended above the mark point, the height of striking centre adjusted appropriately according to the height of athletes.
2. Plot the record form in advance, ranking subjects in order and record their relevant information (name, age, sex, grade, weight, length of every lower limb tache, height, etc.).
3. Have athletes do appropriate warm-up prior to test, then film live. To capture optimum effect of image data, have every athlete repeat action 3 times at least and choose the best one to save (Dou, 2012).
4. Simultaneously start the synchronizer when filming live.

2.2. Acquisition of kinetic parameters

This article also uses the “fight item group exercise training tester” made by Wuhan Institute of Physical Education on its own to acquire kinetic parameters at final time of

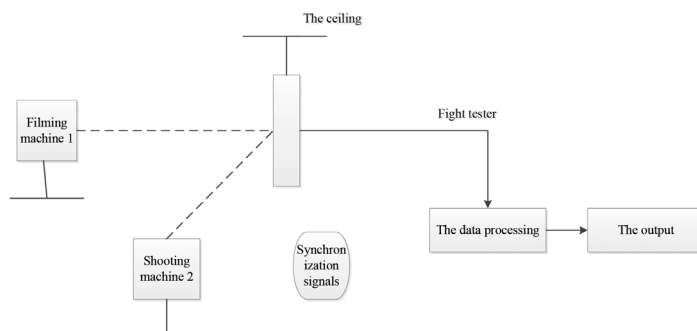


Figure 1 – Shooting process diagram

technical movement. The height of striking target is adjusted appropriately according to the height of athletes and action parameters are output directly after acquired data is processed by the computer.

2.3. Data processing

Action time	Action stage	Action stage division process
T_1	Appel	From the start to the end of the step left foot pads to the body centre of gravity forward
T_2	Knees up	Attacking leg knee, leg folding
T_3	Pretty hip knee buckle	Crus pop-up and inner buckle, and at the same time pretty hip
T_4	hit	Offensive ability to target
T_5	Strike action after recovery	Strike action over, attacking leg natural ground into the left position

Table 1 – Transverse kicking technique into five phases

3-D image analysis includes such process as synchro shooting, acquisition, synchronization, cutting, point print, 3D and data smoothing processing of body motion and frame image, and the factor of digital smoothing depends on actual situation, normally 10. After acquiring original data, use software such as excel to secondarily process the data. Then calculate mean value (X) and standard deviation (SD) of every indexes to correct individually.

3. Data analysis

3.1. Structure and phase division of flank kick movement

Taekwondo flank kick technique can be divided into left flank kick and right flank kick based on limb used; front flank kick and back flank kick based on the position of attacking leg being in front of or behind body; flank kick and high flank kick based on the height of striking position. Generally, an athlete has his own preferred leg and most athletes normally use their right leg as preferred one. The subject of this article is right flank kick, the attacker makes full use of the rotation of hip and trunk to complete striking movement in the order of action of hip, thigh, shank and foot. The process of action is that upon finishing appel, the centre of gravity moves to left leg quickly, while supporting leg pedaling and stretching, left fore sole internally rotating on the ground, raise right leg and forward hip, appropriately fold thigh and shank with right hip turning left. As the supporting leg pedals and stretches and extend of internal rotation increases, raise the knee joint of attacking leg forwards-up to horizontal, the shrank quickly and strongly kick out horizontally, with strength at the back of foot, hitting the target, then retract the attaching leg quickly, returning to posture of actual combat.

	T_1	T_2	T_3	T_4	T_5
Time(s)	0.254	0.210	0.044	0.049	0.298
	0.01788	0.002546	0.025648	0.002565	0.026854

Table 2 – Kicked in different stages of the length of time

According to structural principles of actions, any complex technical movement is combined by a series of different simple actions. For analysis purpose, based on characteristics of flank kick movement whole process is divided into 5 phases including appel, bending knees and raising a leg, erecting hip and buckling knees, hitting and action retracting. Based on chronological order, 1. During T_1 , begin from preparatory position to appel of left foot till finish shifting centre of body weight; 2. During T_2 , raise attacking leg and bend its knee, with its thigh and shank folding; 3. During T_3 , the shank of attacking leg quickly kick horizontally with hip moving forwards to form quick whipping action; 4. During T_4 , the back of attacking leg hits the target; 5. During T_5 , the attacking leg completes hitting and drops down to left-hand posture. (As shown in Figure 2).



Figure 2 – Kicked hormone action phase diagram

3.2. Displacement parameters of center body weight

Displacement variation of centre of body weight closely relates to technical movement, being an important indicator to assess technical quality of action. This research concludes the graph of 3D and displacement variation on 3 coordinate axis of centre of weight. Due to the position of experimental frame and DV placement and standing position of athletes, the X axis is parallel to the frontal axis of body, the direction of Y axis is opposite to that of heading of subject, and Z axis is in accordance with vertical axis of body.

It is easy to find from Fig 3 that displacement of centre of body weight on different ordinate axis varies. In the direction of sagittal axis, during appel phase (T_1), displacement of centre of body weight moves forwards more slowly and varies evenly. During T_2 and T_3 , the range of centre of body weight moving forwards is much wider compared to T_1 . After T_4 , the range of centre of weight moving forwards becomes slightly narrow again. During entire process of movement, centre of body weight moves forwards about 85.7 cm. In the direction of sagittal axis the range is smaller, 24.5 cm. Narrow range

of movement of centre of body weight avoids wag from side to side, having positive influence in maintaining stability of body. After finishing T1, in order to start attacking leg (right) quickly, body weight falls on the supporting leg (left) again, resulting in left shift of centre of body weight, it shows slightly upward trend; during T2, T3 and T4, the attacking leg is in the air and the trunk goes on inclining left, with the curve of centre of body weight goes on to rise. When the attacking leg hits the goal, with retracting the attacking leg on ground, centre of body weight begins to shift right. So, the displacement diagram of centre of body weight on sagittal axis slowly rises first, after a very long plateau begins declines slowly again. In the direction of vertical axis, the displacement diagram declines somewhat first, then begins to rise again, when height diagram of centre of body weight “reached the highest point is also when target is hit,” the height of centre of body weight begins to decline immediately till there are two supporting legs. During entire flank kick movement, the range of height variation of centre of weight is different at different time: during T1, the purpose of lowering centre of weight is, on one hand, to increase the included angle of knee joint of attacking leg to created longer working distance for attacking leg pedal the ground to increase the velocity of attacking leg leaving the ground; on the other hand, to create better working conditions for tweaking waist and erecting hip. During T3, centre of body weight rises rapidly to create conditions for attacking leg to hit target, with total height variation about 25.7 cm, and within 0.22 seconds of T3 and T4, height variation of centre of body weight is about 12.3 cm, which is the result of combination of protraction of ankle joint and knee joint.

3.3. Velocity parameters of centre of body weight

Displacement parameter variation of centre of body weight can simply reflects rough kinematic status of entire body. To further describe kinematic characteristics of centre of body weight, it needs to further describe such aspects as velocity variation of centre of body weight. Because velocity variation of any limb and trunk can influence the velocity of centre of weight, analysing velocity of centre of weight has bigger reference for understanding kinematic situation of every taches. (because the motor direction of athletes is opposite to that of Y axis, the velocity on Y axis in Fig 3 is negative).by analysing velocity variation trend of centre of weight in 3D system of coordinate, it is easy to conclude that variation trend of velocity diagram on every coordinate axis is basically consistent. Although the velocity on Y axis is negative, its peak value is basically in accordance with that of other curves: first increase, then decrease.

	X(m/s)	Y(m/s)	Z(m/s)	3D(m/s)
T ₁	0.3277±.2612	-0.8758±.4997	0.1447±.2871	1.1418±.3211
T ₂	0.4913±.2533	-1.6030±.2119	1.1643±.2021	1.5655±.1411
T ₃	0.4045±.2836	-0.8427±.2727	0.0997±.1372	1.0723±.3728
T ₄	0.2020±.0963	-1.1150±.1080	0.4945±.4987	1.2370±.0888
T ₅	-0.1392±.2403	-0.1474±.1915	-0.5433±.5033	1.0014±.2542

Table 3 – The body centre of gravity speed parameters

Analysing curve variation in Fig 4, all curves quickly join at one point at about 0.08 second and the velocity at that moment is almost 0, indicating that the subject has finished adjustment of posture and been prepared for subsequent actions within 0.08 second. In the direction of X axis, beginning from 0.08 s (afterward discussion will all begin from 0.08 s unless otherwise specified), during the phase with left foot forward (T₁), body is in the status of right supporting, attacking leg quickly pedal the ground to make body incline left, in order to prevent body from excessive inclination, left arm stretches out quickly. Beginning from left foot touching ground, body is in the status of double supporting again, making velocity of left shift of centre of weight decrease quickly, slope of centre of weight curve is greater and negative at this phase. As such ensures stability of centre of body weight on X axis, providing stable working condition for bending knee and raising leg as well as buckling knee and erecting hip. Centre of weight curve on Y axis varies ups and downs with small amplitude, but overall variation trend is the velocity curve of centre of weight increases first, decreases then on Y axis. During T₂ (bending knee and raising leg) phase, the velocity of centre of weight is maximum value, while after hitting, the velocity of body moving forwards decreases significantly. In the direction of Z axis, the velocity curve of centre of weight is wave-shaped at every phase with fewer ups and downs, indicating the height of centre of body weight varies regularly at these action phases.

	X(m/s)	Y(m/s)	Z(m/s)	3D(m/s)
T ₁	0.0464±.4733	-0.9549±1.1341	0.0422±.1889	1.2087±.9695
T ₂	-0.0651±.8042	-0.5609±1.1944	0.9208±.8118	1.8266±.5661
T ₃	-0.0513±.3920	-1.0383±.4795	0.0427±.2703	1.1250±.4244
T ₄	-0.3373±.8227	-1.3440±.1656	-0.5010±.1540	1.6240±.1721
T ₅	0.1531±.7747	-0.4591±.4209	-0.3726±.5498	1.0813±.4910

Table 4 – Supporting leg hip speed change table

3.6.Velocity parameters of hip joint

Hip joint angle refers to the included angle between the femur and ipsilateral trunk. Connecting trunk and lower limb, hip joint is the pivot transferring strength of waist to thigh, so analysis of hip joint angle variation reflects not only the extent of incline of trunk, but also kinetic state of lower limbs. Because the projection of hip joint included angle on coordinate axis relates to multiple factors, in order to simplify analysis, this article only analyses angle variation of hip joint after 3D integration. During appel phase, the supporting leg (left) leaves the ground, and variation process of hip joint is to increase first then decrease and increase again, but the variation trend is not very obvious, because sharp variation of hip joint angle adversely influences subsequent action. Main role of appel is to conquer inertia of body, push centre of body weight forwards, giving attacking leg certain initial velocity prior to attack. After appel finishing, the angle curve of hip joint reaches a small peak value till phase T₂. During phase T₂, due to bending knee and raising leg of attacking leg, hip joint angle quickly increases first then decreases

sharply, it is because the phase of attacking leg moves from the back side of trunk to front side within 0.2 second; in the next phase T3, in order to increase hitting depth, it needs supporting leg actively pedal the ground and quickly twist waist to form waist tweaking action with hip actively erected forwards (tweaking waist and erecting hip), during this process, hip joint angle go on increasing. When attacking shank finishing whipping action, hip joint angle begins to decrease till the attacking leg lands.

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4. Conclusion

So far, the current status of research on taekwondo in our country remains limited to traditional method of exercise physiology. This research method is mostly end analysis and assessment of kinetics and dynamics of technical movements and seldom conducts research on elements such as process of taekwondo technical movement and intermediate taches producing effect of actions by using image analysis system, with the depth and extend needing to further expand. Based on this current status, it is undoubtedly an urgent and hard task facing us to strengthen analysis and research on sports biomechanics characteristics of taekwondo technical movements, deeply discuss factors influencing movement effects, establish scientific assessment system, and perfect training methods. So, we carry out scientific research by starting from analysing

biomechanics characteristics of taekwondo flank kick movement, using 3-D image analysis method.

Combining research on taekwondo technique with 3D image technology, the following is concluded:

Scientific and reasonable sequence of power generation of muscle is an important guarantee of good striking effect. Reasonably control power generation sequence of muscle in every taches during flank kick, following the sequence of large (muscle block) leading small the sequence of attacking leg's hip leading thigh, thigh leading shank, shank kick out with strength

Two arm swings of upper limbs is the basis of secondary power generation of hip. Rotational inertia of upper arms resulting from two arm swings is transferred to attacking leg through twist of waist (trunk). Appropriate range and timing of waist rotation organically connects rotation of upper and lower limbs, significantly increasing hitting effect of attacking leg.

Retracting attacking leg to the ground is the most important link deciding fight back. The process of retracting attacking leg is a link easiest to fight back for the opponent.

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Study of B to C E-Commerce Logistics Distribution Modes

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Pages: 179–191

Abstract: In this paper, the dialectical development relationship between the E-commerce and logistics distribution is analyzed based on the theory; second, several E-commerce logistics distribution modes are introduced, and the operational principle and application scope for each E-commerce logistics distribution mode are described separately; third, the development and existing problems of E-commerce logistics distribution in our country are studied with several solution suggestions concluded; fourth, the quality superior sequence of logistics distribution mode is calculated, and then a new up + down mixed logistics distribution mode is concluded; and finally, the E-commerce logistics distribution for an E-commerce company is analyzed by means of hierarchy process and quantification treatment to verify the rationality of up + down mixed logistics distribution mode compared with other types of logistics distribution modes.

Keywords: B to C, e-commerce, logistics distribution modes, mixed modes.

1. Introduction

With the development of computer network and price decreasing of PC price, the traditional trade cannot adapt the fast-paced society anymore, which simulates the occurrence and development of online transaction, thus the future business will transfer from the offline to online. Online transaction has brought great changes on good transaction in virtue of its short duration, fast speed and low cost. E-commerce offers convenience both to the buyer and the seller, and it is future simulated for development under the “win-win” situation.

Growth in E-commerce is not a straight line trend, but hindered by changeable defects and shortcomings. A complete business transaction process consists of four aspects: information flow, logistics, commodity flow and capital flow, and those are essentially changed due to the E-commerce, for example, the information flow, commodity flow and capital flow are electronized along with the popularization of computer and internet (King et al, 1999). However, as the most special one of the four aspects, the logistics must be realized through real “wheels”. The “logistics bottleneck” has become the key factor which restricts the development of E-commerce, so the study of the relationship between logistics and E-commerce is the direction of future development (Liu and Arnett, 2000; Sá et al., 2016).

In the essay, first, the dialectical development relationship between the E-commerce and logistics distribution is analyzed based on the theory; second, several E-commerce logistics distribution modes are introduced, and the operational principle and application scope for each E-commerce logistics distribution mode are described separately; third, the development and existing problems of E-commerce logistics distribution in our country are studied with several solution suggestions concluded; fourth, the quality superior sequence of logistics distribution mode is calculated, and then a new up + down mixed logistics distribution mode is concluded; and finally, the E-commerce logistics distribution for an E-commerce company is analyzed by means of hierarchy process and quantification treatment to verify the rationality of up + down mixed logistics distribution mode compared with other types of logistics distribution modes.

2. Problems of e-commerce logistics in china

In China, the relationship between E-commerce and logistics distribution is required to be more harmonious due to the rapid development of economy, but the convenience of E-commerce is hindered by the low quality of logistics distribution, and how to lubricate the relationship between the E-commerce and logistics distribution is the main problem in the further development (Li, 2013). The development of E-commerce is severely restricted by the imperfect policy, shortage of talent, poor service concept, low informatization level, high distribution cost and serious resource waste.

1. Imperfect policy

The essential factor affecting the E-commerce logistics development is the imperfect policies and systems (Dan et al, 2008). The government has issued many policies and regulations related to the logistics distribution to make the reform in many aspects, however, the reform is far inadequate to meet the development of E-commerce logistics development (Belanger et al, 2002). The overall deficiency cannot be covered up by the achievements in terms of market access & withdrawal system and taxation system. The development of modern logistics cross-regional work is hindered by the regional protectionism from the beginning to end.

2. Shortage of talent

Talent is the first competitive power that decides the survival and development of enterprises. As for E-commerce logistics, the employees should be ideal complex talents who not only have the professional E-commerce knowledge, but also master high logistics management skill as well as the knowledge involved in logistics operation and management (Grandon and Pearson, 2004). In foreign countries, much attention is attached on the logistics in institutes, and many practical and professional logistics talents are cultivated through combining the theory and practices. Nevertheless, the logistics education development in our country is unsmooth due to the late start time, incomplete education system and little attention paid on the practice. Moreover, the sustainable development of E-commerce logistics distribution cannot be supported by insufficient professional logistics talents with low quality.

3. Low IT level

The modern internet management software is not adequately applied on E-commerce but only limited to the order sheets and affair treatment because the E-commerce in our

country was started relatively late. However, the informatization is necessary for vehicle route planning, distribution cost control, inventory control, logistics operation mode, management mode, etc. (Oliver, 2015).

4. Complex distribution mode, and high distribution cost

First, there are many factors affecting the selection of the distribution mode, which makes the purpose not clear; second, the scale effect is very important for distribution, and the cost will be high due to small scale; third, the warehousing cost takes a large proportion in E-commerce; and finally, the cost and service are conflicted to each other, and compromise is necessary to made on cost for better service.

3. Decision-making study of e-commerce logistics distribution mode

3.1. SWOT analysis method

SWOT analysis method is an effective method to choose the best operation strategy thorough combining the internal and external factors of enterprise and analyzing systematically. When the SWOT analysis method is applied on the logistics distribution mode, the E-commerce enterprise should look for and evaluate the internal and external affecting factors during distribution process based on the strategy methods of themselves and judge the advantages, disadvantages, opportunities and threats of the enterprise before selecting the most suitable logistics distribution method as shown in Figure 1.

According to the Figure 1, the enterprises are divided into four types based on the four factors, and in the following are the detailed introductions of the four types of enterprises.

1. Type-I enterprises

The Type-I enterprises are strong and large-scale enterprise with obvious internal advantages and a large number of external opportunities, and most of them choose to establish them own logistics system as the logistics service become essential for improving

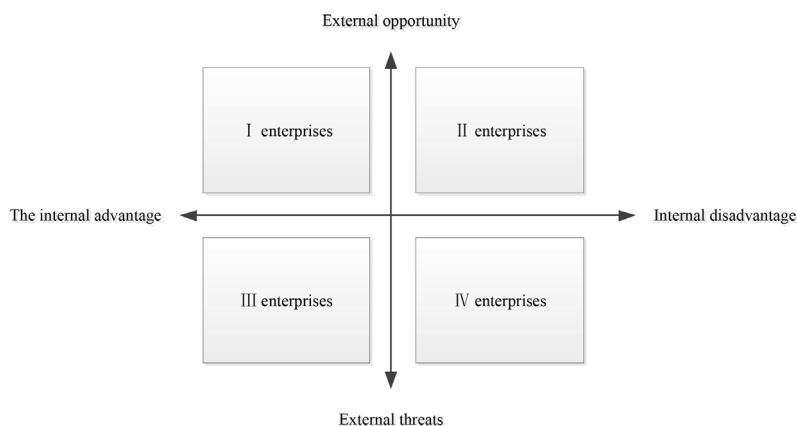


Figure 1 – SWOT matrix

the core competitive force (Rao et al, 2013). With the development for many years, most of electric appliance enterprises, manufacturers and pharmaceutical manufacturers in China have accumulated their favorable logistics technology & internet, wide marketing channel and modernized management experience. Those enterprises tend to perfect their own logistics system through integrating resources and making use of other's experiences under the era that the information technology is widely applied, so they finally have their logistics distribution system adapting their own development.

2. Type-II enterprises

Most of Type-II enterprises own their distribution system by making use of external opportunities, but sometimes their scale benefits are hindered by the internal disadvantages. Therefore, the joint distribution mode is the best choice for them. The joint distribution can also make up their own disadvantages, lower the logistics cost, improve the distribution efficiency, as well as enhance the connection between enterprises, and realize "win-win cooperation" through sharing advantages among them (Tan and Thoen, 2000).

3. Type-III enterprises

The Type-III enterprises are mostly medium and small enterprises faced not only the internal disadvantages, but also the external threats. To lower the internal disadvantages and avoid external treats, the Type-III generally choose the logistics distribution modes of Party H, or entrust the professional logistics company to undertake the logistics business, so as to improve their core competitiveness (Chircu and Kauffman, 2015).

4. Type-IV enterprises

The Type-IV enterprises have internal advantages, but they are restricted by external factors. Due to large investment and wide distribution area of logistics system, the enterprises almost transfer logistics to professional third-party logistics companies. But they're also worried about the high dependence on logistics companies, therefore, they always tend to build warehouses and distribution centers based on the need for strategic development to strengthen real-time control of inventories and emergencies. This kind of own-running and third-party logistics mode has not only improved enterprise management, but also improved customer services.

3.2. Matrix diagram decision-making method

Matrix diagram decision-making method is similar to Bellow method, which has no specific data and only uses the matrix diagram to combine two different factors to form different areas, thus to select logistics distribution modes. This method is mainly to carry out analysis around enterprises' distribution abilities and the importance of distribution to the enterprises, as shown in Figure 2.

From Figure 2, it can be seen that four different areas can be divided into based on the two different factors. The four areas are introduced in details below.

1. Area I

Enterprises have strong abilities of distribution and the distribution is very important to the enterprises, and also the enterprises are capable of choosing the

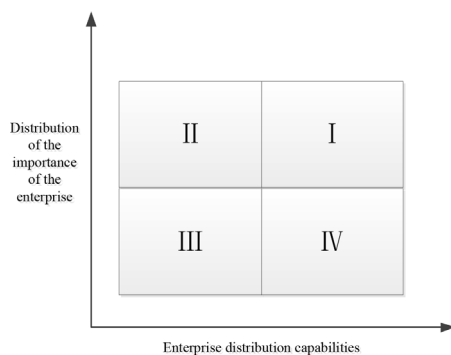


Figure 2 – Matrix decision method

own-running logistics distribution mode to improve distribution efficiency and customer satisfaction.

2. Area II

Enterprises have weak distribution abilities, but the distribution is very important to the enterprises, so how to make up for their shortcomings become their focuses. In general, such enterprises have three options: the first being to independently build a own-running logistics mode, increase capital investments, improve the logistics system and improve their distribution abilities; the second being to look for strategic partners to form a joint logistics mode and strengthen their own distribution abilities; the third being to transfer distribution businesses to professional logistics enterprises and use a third-party logistics mode.

3. Area III

Enterprises have weak distribution abilities and the distribution is not so important to them, so there is no need to spend too much energy and time on distribution. Therefore, they need to choose a professional third-party distribution mode to transfer their distribution businesses to a third party (Awad and Ragowsky, 2008).

4. Area IV

Enterprises have strong distribution abilities, but the distribution is not their main business, so there are two development directions for them: one being to use their own distribution advantages to expand distribution businesses and form a joint logistics; the other being to bring their distribution departments to the market and adjust their business directions to form specialized distribution enterprises.

4. Application of e-commerce distribution mode - taking company A as an example

4.1. Enterprise e-commerce business background

To expand the sales market, e-commerce enterprise A improves its market share and customer satisfaction and decides to start from the logistics distribution, increase

capital investments, improve the level of enterprise logistics distribution and the satisfaction of customer individual demands. There are five logistics distribution modes to choose from, i.e (Li et al, 2001). distribution of the postal system, third-party logistics distribution, own-running logistics distribution, joint logistics distribution and mixed logistics distribution. The enterprise has organized experts for several times successively to analyze and compare all distribution modes for better decisions.

4.2.E-commerce mode selection of enterprise A

1. Establish a mode selection hierarchy

A hierarchical chart is built through analysis and research on documents and data, as shown in Figure 3.

Index system: C1 - C4, . D1 - D8.

Decisions: distribution of the postal system (T1), third-party logistics distribution (T2), own-running logistics distribution (T3), joint logistics distribution (T4) and mixed logistics distribution (T5).

Here, we follow the specific situation of enterprises and invite experts to determine the matrix. The final determined matrix is shown in Table 1;

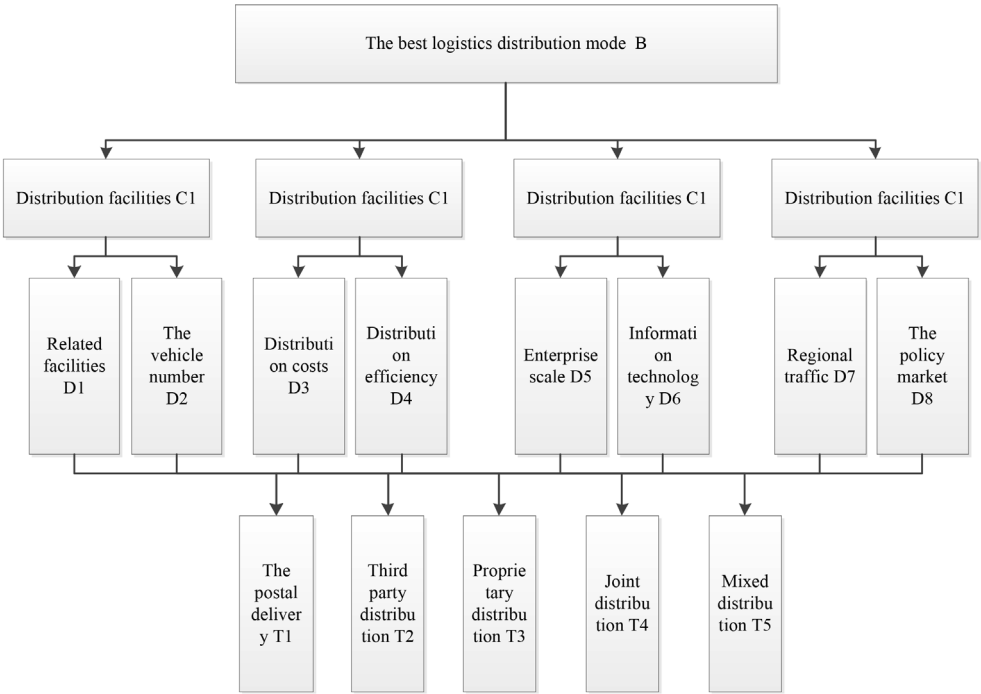


Figure 3 – hierarchical model

B	C1	C2	C3	C4
C1	1	1/4	1/2	1/2
C2	4	1	1	2
C3	2	1	1	2
C4	2	1/2	1/2	1

C1	D1	D2
D1	1	2
D2	1/2	1

C2	D3	D4
D3	1	1
D4	1	1

C3	D5	D6
D5	1	3
D6	1/3	1

C4	D7	D8
D7	1	1/3
D8	3	1

D1	T1	T2	T3	T4	T5
T1	1	1/2	1/4	1/2	1/5
T2	2	2	1/2	1/3	1/3
T3	5	3	2	1	1/3
T4	3	1	1/3	2	1/2
T5	6	4	1	3	1

D2	T1	T2	T3	T4	T5
T1	1	1/2	1/4	1/2	1/3
T2	3	2	1/3	1/3	1/2
T3	2	1	2	2	1/3
T4	5	2	1/3	2	1/2
T5	4	3	2	3	3

D3	T1	T2	T3	T4	T5
T1	1	3	1/4	1/2	1/3
T2	2	2	1/2	1/3	1/2
T3	1/2	3	2	1/3	1/4
T4	1/3	1/2	1	2	3
T5	1	1/5	1/3	3	2

D4	T1	T2	T3	T4	T5
T1	2	1/2	1/3	1/2	1/3
T2	1	1/3	2	1/3	1/2
T3	3	3	3	1/4	1/5
T4	1/3	4	1/2	2	2
T5	1/2	2	1	1	3

D5	T1	T2	T3	T4	T5
T1	2	2	1/4	2	1/3
T2	1	1	1/3	1/2	1/5
T3	4	4	3	1/3	1/2
T4	1/3	1/3	2	3	2
T5	1/2	1/2	1	4	2

D6	T1	T2	T3	T4	T5
T1	2	2	1/4	2	1/3
T2	1	1	1/3	1/2	1/5
T3	4	4	3	1/3	1/2
T4	1/3	1/3	2	3	2
T5	1/2	1/2	1	4	2

D7	T1	T2	T3	T4	T5
T1	1	2	2	2	1/4
T2	2	3	3	3	1/2
T3	4	1/3	1/3	1	3
T4	1/2	1/2	1/2	2	1/2
T5	1/3	1	1/4	1/2	1/2

D8	T1	T2	T3	T4	T5
T1	3	1	1/2	1/3	1/3
T2	2	2	1/4	1/4	1/2
T3	2	3	1/2	2	2
T4	1	3	1	3	1
T5	2	1	2	1/3	1/3

Table 1 – Judgment matrix table

4.3. Single hierarchical arrangement & consistency inspection

Weights and consistency inspection results calculated from the formula above are shown in Table 2;

It can be seen from Table 2 that CR is lower than 0.1, therefore, the matrix consistency is determined as acceptable.

B	C1	C2	C3	C4	λ	CI	CR
The weights of single order	0.015	0.352	0.321	0.188	4.152	0.026	0.025

C1	D1	D2	λ	CI	CR
The weights of single order	0.625	0.333	2	0	0

C2	D3	D4	λ	CI	CR
The weights of single order	0.5	0.5	2	0	0

C3	D5	D6	λ	CI	CR
The weights of single order	0.75	0.25	2	0	0

C4	D7	D8	λ	CI	CR
The weights of single order	0.25	0.75	2	0	0

D1	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0524	0.0952	0.2541	0.1524	0.4102	5.2012	0.0163	0.0140

D2	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0725	0.1250	0.2415	0.1858	0.3260	5.1203	0.0362	0.0285

D3	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.1362	0.1154	0.4152	0.1026	0.2052	5.2154	0.0396	0.0325
D4	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0725	0.1250	0.2415	0.1858	0.3260	5.1203	0.0362	0.0285
D5	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0825	0.1236	0.3205	0.2054	5.1021	0.0214	0.0325	0.0142
D6	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0625	0.1204	0.3652	0.1852	0.2485	5.1752	0.0362	0.0142
D7	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.4012	0.2015	0.0485	0.1125	0.2014	5.0125	0.0032	0.0014
D8	T1	T2	T3	T4	T5	λ	CI	CR
The weights of single order	0.0725	1.8215	0.1548	0.2012	0.4058	5.0136	0.0158	0.0154

Table 2 – Weight and consistency test result

4.4. Total hierarchy arrangement & consistency inspection

The synthetic weight of T relative to B = the weight of T relative to B. Here the calculation process is not listed and only the weight of the total hierarchy arrangement and inspection results are given. As shown in Table 3 and Table 4:

Let's inspect the consistency: as $CI = 0$ in layer C, it's very easy to calculate CI in layer D and I with the formula, i.e. $CI = 0$. Therefore, the total arrangement $CR = 0 < 0.1$, so the matrix is consistent overall and the total arrangement results are acceptable.

D1	D2	D3	D4	D5	D6	D7	D8
0.078	0.036	0.182	0.185	0.241	0.085	0.045	0.145

Table 3 – D layer the total order weight table

T1	T2	T3	T4	T5
0.1025	0.1309	0.2905	0.1862	0.3025

Table 4 – D layer the total order weight table

4.5. Process analysis

From the arrangement result of layer T, it can be seen that the weight of T₅ is the highest, so the optimal scheme of the enterprise is to choose the mixed logistics mode. For layer C, the weights of distribution efficiency (C₂) and enterprise strength (C₃) are higher, showing that it is important to consider the distribution efficiency and enterprise strength for the enterprise during selection of distribution schemes. However, the weights of distribution facilities (C₁) and other factors (C₄) are lower, which will be added into consideration only during decision selection and will not influence the final decision. For layer D, the weights of distribution cost (D₃), distribution efficiency (D₄) and enterprise scale are higher relatively, which shall be firstly considered during scheme selection.

For layer D, the weights of distribution cost (D₃), distribution efficiency (D₄) and enterprise scale are higher relatively, which shall be firstly considered during scheme selection. The weights of relevant facilities (D₁), the number of vehicles (D₂), information technology (D₆), regional traffic (D₇) and policies & markets (D₈) are lower relatively, among which the weight of policies & markets is higher. Therefore, in addition to costs, efficiency and scale, the effects of policies and markets on the final decision shall be taken into consideration.

We can see from the process analysis that the enterprise, during mode selection, focuses on the effects of distribution efficiency and enterprise scale, and then distribution facilities and other factors. If these factors are refined and quantified, the distribution costs, distribution efficiency and enterprise scale will become the factors to be considered firstly. For these three factors, the mixed logistics distribution mode is the best choice.

5. Conclusions

A right distribution mode affects the individualized pursuits of consumers; an appropriate distribution mode is critical to the future development success of e-commerce enterprises success and a suitable distribution mode decides the competition status of China's e-commerce enterprises in the international market; therefore, the selection of distribution mode is very important. Before selecting an appropriate e-commerce logistics distribution mode, firstly be familiar with the operation methods and characteristics of all distribution modes, analyze application environments and limits of these modes and then give the optimal scheme through comprehensive consideration of all factors. In this paper, several distribution modes relatively popular in China are introduced firstly and their advantages and disadvantages are analyzed; and then, qualitative and quantitative methods are given for the selection of e-commerce logistics distribution modes after comprehensive consideration of factors; finally, detailed research steps and the final scheme are given through the research on e-commerce enterprise A.

Through case analysis, this paper clearly describes the selection of China's e-commerce enterprises under the current conditions from different emphasis points, providing valuable experience for the development of China's e-commerce enterprises and e-commerce industries.

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Empirical Analysis Model of the Relationship between Internationalization of Higher Education and Students' Cross-cultural Competence

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Pages: 192–203

Abstract: Internationalization is the trend as well as the characteristics of higher education, which calls for the international understanding and cross-cultural competence of its undergraduates. A scale was devised including the general cross-cultural competence and the business management and communication abilities. Based on the scale of cross-cultural competence designed by the author, the paper explores the correlations between the 6 dimensions of internationalization and 4 dimensions, 8 main factors of cross-cultural competence. A regression analysis model has been established to assess the relationship of internationalization of university and eight dimensions of cross-cultural competence. Empirical results show that there is no salient correlation between the curriculum internationalization and students' cross-cultural competence, while students' engagement in internationalization has direct effect on their ability improvement. Based on the research, some suggestions are proposed.

Keywords: Internationalization of higher education, Cross-cultural competence, Correlation analysis, Regression analysis model.

1. Introduction

Since the mid-term of 1980s, a notable phenomenon in the field of higher education research is the attention focusing on the internationalization which is a manifestation of globalization on institutional levels (Poy-Castro et al, 2015). As Morrow and Torres (2000) note, the internationalization of higher education (IHE) is indeed becoming a key factor in the contemporary educational landscape. One of the important goals of internationalization is to cultivate students' cross-cultural comprehension and communication ability, which is emphasized by all the universities domestic and abroad, when setting up the development goals for the IHE. For example, in the *Goals 2000-Educate America Act* established in the 1990s, the US government emphasized internationalization of the education, by adopting a brand-new method to cultivate knowledgeable students to meet the world-class standards in knowledge area, and to

improve students' global awareness and international understanding. To keep in pace with development of IHE, Korea established a special branch called the *21st Century Committee* to promote students' studies on political, economic, social, historical and religious issues of the world and to enhance their international communication and cooperation and to strengthen the cross-cultural understandings. Japan also proposed its training objects in IHE—cultivating the talents, who will master foreign languages, the advanced technologies and know the enterprises' operation and management, have strong international awareness, and know about international trade, finance and law and can adapt to the globalized world.

Currently, the research universities in China have made it a strategic goal to nurture the talents equipped with international horizons and cross-culture ability. For instance, Peking University proposed to cultivate some leading talents in different sections with international horizons and innovation spirit. Zhongshan University aimed at developing the high-quality and compound-type top-notch innovative personnel with great international horizons, who can meet the demand of the nation and society. Thus, developing the cross-culture ability of undergraduates has become an intrinsic character of the IHE.

2. Research question

2.1. Internationalization of higher education

IHE is a concept with rich connotations, thus scholars can hardly reach a consensus on what exactly internationalization is. It could be a description of status, a goal or a process. In the late 1980s and beginning of 1990s, internationalization mainly referred to a series of activities that took places among the institutions. The definition proposed by Arum and Van de Water (1992) is a collection of international activities and programs, referring to “multiple activities, programs and services that fall within international studies, international educational exchange and technical cooperation”. Later on, in mid and late 1990s, under the impacts of globalization, every country was plunged into global competition in every aspect with education as the main battlefield. So van der Wende (1997) claimed that the internationalization should be redefined and expanded. So he defined internationalization considering its interrelated relationship with globalization as “any systemic, sustained effort aimed at making higher education (more) responsive to the requirements and challenges related to the globalization of societies, economy and labour markets”. After the beginning of 21st century, Knight (2003), a famous Canadian scholar, introduced her classical process definition of the internationalization as “the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of postsecondary education”. Knight's definition emphasized the integrity of international progress and cross-cultural aspect of internationalization, providing a systematic way of thinking to assess institutional efforts of IHE. International programs and activities were considered as an integrated whole, not separated parts operated by different schools and centers within the institution (Gonçalves et al., 2015). With deep consideration of the evolution of defining internationalization, internationalization of the university is defined for this study as the process of integrating international, cross-cultural and global perspectives into various dimensions of university practices.

As the IHE develops further and deeper, its concept and connotation has been extended more. One is the cross-boundary education, and the other is home internationalization, with the later one focusing more on the internationalization of the campus activities home universities, which mainly includes integrating international and multi-cultural education contents into educational activities to help the home students develop cross-cultural competence. This new connotation of internationalization explains and underlines the cross-cultural dimension and cross-cultural competence. This article is a responding to the new trend by empirical research on the home internationalization of universities.

2.2. Cross-cultural competence

After 1990s, with the development of globalization, cross-cultural competence has attracted more attentions and became a popularly used concept. Although the term intercultural competence is now widely used in the field of intercultural communication; it is still not widely understood, nor do intercultural lists agree upon a common definition. But what is the cross-cultural competence?

Gertsen (1990) defined it as ‘the ability to function effectively in another culture’. As for Bodycott and Walker (2000), they described the development of intercultural competence in learning and teaching as a self-reflective process which prompted learners and teachers “to rethink and confront their beliefs and biases”. Turner and Trompenaars (2000) claimed that cross-cultural competence referred to turning the value of conflicts into the value of complementation, recognizing the cultural differences, respecting them and finally fusing all the differences. Cross-cultural competence is a learning ability to view the cultural differences critically. There were also some scholars who defined the cross-cultural competence from its main contents. That is cross-cultural competence involved human relationships and situational environments, the degree of decency and the effectiveness of the interaction, plentiful knowledge, power and actions. The ability was decided by the relationship and situation when the interaction happened. Gertsen (1990) thought it consisting of three interdependent dimensions: an affective dimension (personality traits and attitudes), a cognitive dimension (how individuals acquire and categorize cultural knowledge), and a communicative, behavioral dimension (being an effective communicator). Koester and Olebe (1998) pointed out that there are eight elements of cross-cultural competence: “display of respect, interaction posture, and orientation to knowledge, empathy, and task related roles, relational roles, individualistic roles, interaction management and tolerance for ambiguity”. All in all, to be a successful communicator means to be able to analyze the environment and choose a suitable behavior model. Scholars’ definitions of cross-cultural competence generally involved motivation, knowledge and social skills. So, Cross-cultural competence is a comprehensive ability reflected by knowledge, skills, attitude and cultural awareness. It includes not only the knowledge, skills, attitudes about the culture of native ethnic and goals, but also the comprehension, insights and evaluations of general cultural phenomena, characteristics and relationships. Hence, this article defines cross-cultural competence as the capability to reasonably use its own cross-cultural resources, namely knowledge, skills, awareness and attitudes to interact effectively and appropriately under different cultural backgrounds.

2.3. Problem descriptions

Generally, universities tend to take the task of realizing the internationalization and cultivating talents with cross-cultural competence and global awareness as the goals of their development plan. But they do not explain clearly what is the cross-cultural competence or global awareness. They only measure the internationalization by numbers, while lack of a deeper research and further evaluation on the effects of internationalization. Although the numbers are important evaluation indexes of internationalization, but the numbers themselves cannot represent for the real effects of internationalization. As Harari (1992) pointed out the international students on the campus do not stand for the realization of the internationalization of the university. Hence, this study will focus on the following two issues: (1) what is the correlation between the internationalization of universities and the Cross-cultural competence of students? (2) what are the differences of the effects on students' cross-cultural competence under different practices of internationalization?

3. Research design

Based on the discussion, this article describes the internationalization practices from six different dimensions: Cultural curriculums (the cross-cultural lessons that students take), International vision integration (the international knowledge and vision shared by the teachers in the class), Lectures given by foreign teachers (those academic courses and language courses taught by foreign teachers), Overseas Study (the exchange or study abroad program over a month period), Communication with foreigners (the communication between the students in home country and international students as well as foreign teachers), Engagement in international activities (students' participation in international conferences and international communication programs). The scale of students' cross-cultural competence is based on two aspects. One is the research literature, and the other is from the interviews with the policy-makers and practitioners of the universities. The whole questionnaire consists of 65 questions, among which 12 questions are about the personal information of the interviewees, 53 questions concerned about constitutes of the cross-cultural competence, including skill, attitude, knowledge and awareness. The first to 15th questions measure the skills, from 16 to 29; 13 to the 40; 41 to 43 are for knowledge, attitude and awareness respectively. SPSS19.0 is used when carrying out the correlation analysis of the test results of internationalization practices and the cross-cultural competence.

The validity of the research depends on whether the sample can provide what researchers precisely needed. In order to achieve this, the researcher adopted purposive sampling to select suitable research objects. Purposive sampling, also known as theoretical sampling, is a kind of non-probability sampling method, namely selecting out those research objects that can provide most needed information for the research. Based on the principles of purposive sampling, this article eventually chose senior students as research objects. The development of cross-cultural competence is an important result of university study, and senior students with the learning experience in university will be well-equipped with cross-cultural awareness and skills. Hence, senior students are most suitable objects for the study.

4. Empirical analysis

1000 questionnaires were sent out and 818 pieces were retrieved, among which 680 were valid. Descriptive statistics are based on these 680 questionnaires with the results as following.

4.1. Reliability and validity analysis

- Reliability analysis

The reliability tests were conducted for the scale as a whole and each part respectively, and the Cronbach's Alpha of the Cross-cultural competence scale as a whole is over 0.95, which indicates a high level of reliability. Besides, the Cronbach's Alphas of the four sections-skill, knowledge, attitude and awareness are all higher than 0.8 as shown in Table 1, which means that the reliability of the four individual parts is high too. Thus, the scale is scientific and reasonable.

ReliabilityCoefficient	Cronbach'sAlpha	NofItems
<i>Skill</i>	0.850	15
<i>Knowledge</i>	0.860	14
<i>Attitude</i>	0.829	11
<i>Awareness</i>	0.843	12
<i>Total</i>	0.954	52

Table 1 – The results of reliability tests of the scale

- Validity analysis

Factor analysis was carried out in Table 2 by using cumulative variance contribution rates to decide on whether the scale meets the requirement of validity. It is generally believed that the scale meets the requirement if the cumulative variance contribution rates of two factors reaches 40% or higher. The cumulative variance contribution rate of first two factors in this study has already reached 40%, indicating the validity of this scale.

Factor	Characteristic root	Variance contribution rates	Cumulative Variance Contribution Rates
1	16.069	30.901	30.901
2	4.854	9.335	40.236
3	3.423	6.583	46.819
4	2.871	5.521	52.340
5	2.322	4.466	56.806
6	2.230	4.288	61.095
7	2.045	3.932	65.027
8	1.834	3.527	68.554

Factor	Characteristic root	Variance contribution rates	Cumulative Variance Contribution Rates
9	1.674	3.218	71.772
10	1.456	2.800	74.572
11	1.410	2.711	77.283
12	1.286	2.473	79.755
13	1.032	1.984	81.739

Table 2–The variance contribution rates of the factors (characteristic root>1)

4.2. The fundamental analysis of home internationalization practices

- High popularizing rate of cultural and communication courses

81.8% of the surveyed students have taken the cultural and communication courses systematically including Chinese History, British and American Society and Culture, International Relationship, Public Relationship, Foreign Affairs, Etiquette courses and so on.

- The rate of internationalization integration in class is not high

The distribution of the rate of internationalization integration in class looks like a spinner bait with two small heads and a big middle as shown in Figure 1. “Sometimes” accounts for a largest proportion, much more than other choices. Also, the proportions of “Never” and “Seldom” are greater than those of “Usually” and “Often” (Figure 1). The frequency of sharing experience abroad is much higher than the frequency of integrating international visions. These data illustrate that, on the whole, it is not so often for the internationalization elements to be integrated into class teaching. Internationalization is mainly demonstrated by the teachers’ sharing of their international experience in the class and the true immersion is insufficient. So, the internationalization in the class teaching should be improved, especially the international vision integration should be enhanced.

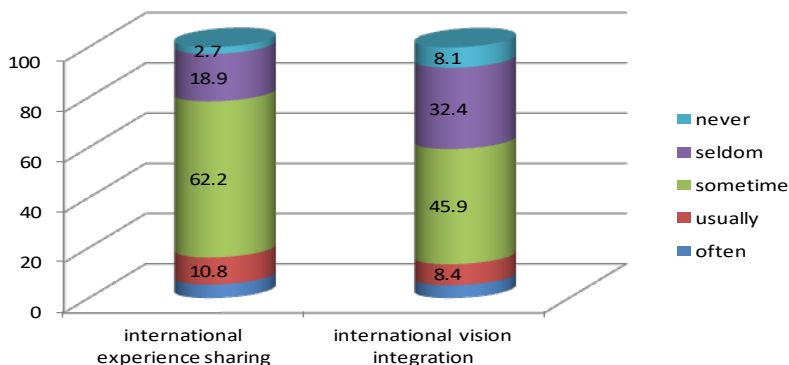


Figure 1 – Whether the class teaching is filled with international experience sharing or international vision integration

- International communication and international activities

Among all the students surveyed those who have exchanged experience abroad only accounts for a little more than one quarter. In the home internationalization practices, the enthusiasm of students communicating with foreigners or participating in the international activities is low, the percentages of “Never” and “Seldom” add up to over 60%, while the total percentage of “Often” and “Usually” is only around 16%--17% as shown in figure 2. The results can be partly accounted by the insufficient international communicative platform provided by universities, benefiting only a small number of students and partly be explained by the lack of enthusiasm of students to participate in the international activities. It is necessary for the university to further enhance the establishment of the international communicative platform and promote the publicity of internationalization, and finally to improve students’ enthusiasm towards international engagement.

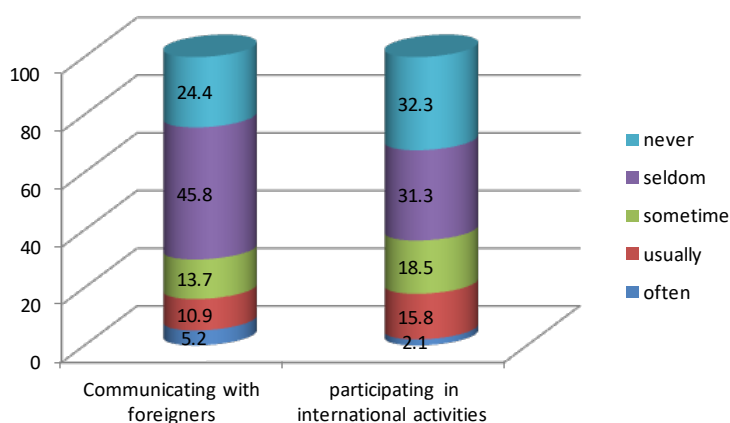


Figure 2 – Communicating with foreigners or participating in international activities

4.3. The fundamental analysis of cross-cultural competence

- The students have certain cross-cultural competence

Table 3 shows that the average of students’ Cross-cultural competence is 3.41, and the differences among scores of the four parts are not very significant. Roughly, the scores of the four parts rank as following: attitude>awareness>skill>knowledge. The rating result of interviewees’ cross-cultural competence is close to the level of “Relatively agree”, and the average and mode are mainly between 3 and 4; the minimum is between 2 and 3, namely between “Relatively disagree” and “Not sure”, while the maximum is close to 5, namely “Totally agree”. These results show that generally the interviewees have some cross-cultural competence but such ability is not very prominent, or they cannot sense the existence of cross-cultural competence.

Dimensions	Average	Mode	Minimum	Maximum
Cross-cultural competence	3.41	3.69	2.38	4.50
Skill	3.37	3.67	2.20	4.53
Knowledge	3.32	3.21	2.07	4.50
Attitude	3.49	3.00	2.45	4.45
Awareness	3.48	3.75	2.42	4.50

Table 3 – Ratings of cross-cultural competence of different dimensions

Students have positive attitudes towards cross-culture, but the ability needs to be improved

After factor analysis on the Cross-cultural competence scale, eight most important factors are picked out in table 4. The average ratings of each cross-cultural factor are as follows: open and sharing attitude> awareness of cultural difference> respecting for cultural difference=foreign language proficiency>communicative skills> cultural knowledge> willingness of cross-cultural communication > the ability of establishing relationship. This inequality shows that students have a positive open and sharing attitude but their ability of establishing relationship requires further improvement. In terms of mode, the modes of open and sharing attitude and awareness of cultural difference are approximately 4, which illustrates that students' cross-cultural competence in these two aspects are relatively high, much better than abilities in other aspects. However, the mode of respecting cultural difference appears to be barely satisfactory and is only 2.5, which means that students cannot sense the cultural differences from different perspectives.

Factors of Cross-cultural competence	Issue	Average	Mode	Minimum	Maximum
Communicative skills	Q1	3.22	3.10	2.24	4.45
Respect for cultural difference	Q5	3.30	2.51	2.38	4.53
Ability of establishing relationship	Q11	3.05	3.05	2.07	4.45
Foreign language proficiency	Q12	3.30	3.19	2.38	4.50
Cultural knowledge	Q17	3.19	3.15	2.19	4.50
Open and sharing attitude	Q32	3.73	4.05	2.45	4.45
Willingness of cross-cultural communication	Q36	3.16	3.10	2.20	4.53
Awareness of cultural difference	Q42	3.59	3.90	2.43	4.50

Table 4 – Ratings of each factors of cross-cultural competence

4.4. Regression analysis of internationalization and cross-cultural competence

- General correlation analysis of internationalization of university and Cross-cultural competence

Kendall rank correlation test is a non-parametric statistical method, using two groups of ranks to test the degree of correlation between two samples, and it requires the data to be a sequencing variants. When the P value for inspection is on the 0.05 level of significance, there are four dimensions standing for the internationalization of university which are significantly correlated to students' cross-cultural competence: courses taught by foreign teachers, abroad exchange experience, communication with foreigners and participation in international activities. However, other two dimensions, cultural courses and international vision are not significant as shown in table 5, and this shows that whether students have learned cultural courses systematically or whether teachers integrate international visions and horizons into class teaching have no significant impacts on the students' cross-cultural competence. From the value of correlation coefficient, it can be found that the effects of internationalization of university towards students' cross-cultural competence are all positive. Among all the factors, the abroad exchange experience is most correlated to the cross-cultural competence, and the coefficient has reached 0.521, a very significant level.

Cross-cultural competence	Correlation coefficient	Pvalue
<i>Cultural courses</i>	0.148	0.286
International visions	0.126	0.331
Courses taught by foreign teachers	0.285	0.04
Study abroad	0.521	0
Communication with foreigners	0.265	0.038
Participation in international activities	0.277	0.03

Table 5 – Results of Kendall rank correlation test on internationalization and cross-cultural competence

- Regression analysis of internationalization and eight dimensions of cross-cultural competence

Based on the results in table 5, a regression analysis model has been established from the four aspects: courses taught by foreign teachers, study abroad, communication with foreigners, and participation in international activities to analyze the effects of internationalization of university on the cultivation of students' cross-cultural competence, as following:

$$Y_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \varepsilon$$

Where, Y_i stands for the courses taught by foreign teachers, study abroad, communication with foreigners or participation in international activities; α_0 to α_8 are the variable

coefficients; X_1 to X_8 are eight major factors of cross-cultural competence: communication skill, respecting for cultural difference, ability of establishing relationship, foreign language proficiency, cultural knowledge, open and sharing attitude, willingness of cross-cultural communication and awareness of cultural difference. All the factors are classified independent variants, and ε is the error term which is assumed to be uncorrelated with other independent variants.

Correlation coefficient and P value (Y_i)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Correlation coefficient(Y_1)	0.221	-0.05	0.388	0.508	0.369	0.277	0.201	0.203
P value(Y_1)	0.15	0.764	0.012	0.001	0.017	0.073	0.195	0.183
Correlation coefficient(Y_2)	0.447	0.451	0.426	0.488	0.372	0.347	0.303	0.271
P value(Y_2)	0.004	0.003	0.006	0.002	0.016	0.024	0.051	0.075
Correlation coefficient(Y_3)	0.473	0.155	0.308	0.447	0.173	0.173	0.097	0.055
P value(Y_3)	0.001	0.267	0.031	0.002	0.221	0.222	0.498	0.694
Correlation coefficient(Y_4)	0.491	0.228	0.547	0.362	0.233	0.108	0.179	0.124
P value(Y_4)	0.001	0.101	0	0.011	0.1	0.445	0.21	0.377

Table 6 – Results of regression analysis on internationalization and cross-cultural competence in eight dimensions

Consistent with results of previous general or dimensional analysis, the overseas experience has the most significant impacts on students' cross-cultural competence. The correlation between overseas experience and the first six factors are significant on the 0.05 significant level, and the correlation between overseas experience and the last two factors are significant on the 0.1 significant level. Besides, the correlations with the first four factors are greater than those with the last four factors. The international horizon integration is significant correlated to only one factor, and the P value of correlation tests on international horizon integration is much greater than 0.1 level of significance. Given the analysis above, these results further prove that international horizon integration does not have significant impacts on students' cross-cultural competence. Whether having learned cultural courses systematically before is not significantly correlated to students' cross-cultural competence generally and dimensionally, but the cultural courses significantly influence abilities of establishing cross-cultural competence and awareness of cultural difference, thus having influence on improving cross-cultural competence. The courses taught by foreign teachers influence the ability of establishing relationship, foreign language proficiency and cultural knowledge. The communication with foreigners and participation in international activities both affect communication skill, ability of establishing relationship and foreign language proficiency.

Generally, all the representative variants of internationalization are significantly correlated to the ability of establishing relationship and foreign language proficiency, which means that every perspectives of internationalization can have significant impacts on the ability of establishing relationship and foreign language proficiency. All the representative variants of internationalization are not significantly correlated to the

willingness of cross-cultural communication, which means that every perspective of internationalization cannot have significant impacts on this willingness. It is probably because the willingness of cross-cultural communication is a kind of subjective feeling, which cannot be improved under a non-overall popularized internationalization. Respects for cultural difference and open and sharing attitude are only significantly correlated with the overseas experience, which illustrates that only overseas exchange such an international approach can improve students' respects for cultural difference and open and sharing attitude. Communication skills, cultural knowledge and awareness of cultural difference are all correlated with two or three aspects of internationalization, so there can be several ways to improve certain cross-cultural abilities of students.

5. Conclusion

It is the personnel that weigh much in the internationalization of universities, namely the teachers and students. Their international engagement practices are correlated to students' cross-cultural competence to some extent. From the above analysis, it can be drawn that the integration of teachers' international visions and the students' learning of the courses are not very helpful in improving students' cross-cultural competence. For one thing, the integration of teachers' international horizons is insufficient, which cannot provide substantial help and for another, teachers have misunderstanding in the internationalization practice of the university curriculum, in which teachers' sharing is much more often than integration. However, sharing is just a kind of simple explanation of knowledge, while the connotation of the internationalization integration is richer, including "what to teach" and "how to teach", with the former is mainly concerned with the international curricular system and educational contexts, and the latter "How to teach" requiring that teachers should master advanced teaching philosophy, methods and evaluation approaches. Based on the regression analysis model, the experience of participation in the internationalization practice of the students can have prominent effects on their cross-cultural competence, especially the four engagement aspects, courses taught by foreign teachers, study abroad, communication with foreigners, and participation in international activities, having salient effects on the cross-cultural competence. Duo to the comprehensive nature of internationalization practices, universities should carry out all-dimensional internationalization practices to increase students' participation in the internationalization, to improve their cross-cultural competence and finally to achieve the aim of cultivating talents with global horizons and competences.

Acknowledgments

The authors would like to thank the anonymous reviewers. The research was supported by Science Foundation of Ministry of Education for Young Scholars of China (Grant No.13YJC630250), the grant was from Development Program for Young Teachers in Central University of Finance and Economics (Grant No.JFJ1501), and the foundation for Key Research Items in Teaching reform Program of Central University of Finance and Economics (Grant No.JG201610).

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Production and Application of Animations for Behavior Cultivation of College Students Using Multimedia Computer

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Pages: 204–212

Abstract: Computer is now an essential in our everyday life and work. Multimedia computers can synthesize multimedia materials like text, image, sound, animation and video, set logical relationship between these materials and realize human-computer interaction. Taking the animation for behavior cultivation of college students made by Qujing Normal University for an example, this paper studies the development of advertising animation with multimedia computers. Made by a number of the most commonly used multimedia software, the advertising animation is witty and teaches civilized behaviors to students so that they can get rid of bad habits and strive to become civilized students.

Keywords: Multimedia Computer, Animation, Production.

1. Introduction

In the information era, computers have more functions other than word and data processing, and hence human-computer interaction interfaces are not merely keyboard and display. Multimedia computers, namely personal computers equipped with multimedia processing functions, can synthesize image, text, animation and video. The differences between multimedia computers and ordinary ones lie not in hardware composition but configurations. A multimedia computer adopts a CPU with more powerful functions and faster processing speeds, and A/D and D/A converters that can synthesize music and integrate sound sources. It can also be linked with an external musical instrument digital interfaces, and other devices like camera, VCR and TV so as to receive, process and present video cards of various animations and digital video media, as well as display cards generating richly colored display images on the same screen.

The case studied in this paper is made by using a multimedia computer and multimedia technologies, with the most commonly used software applied. Multiple techniques of Adobe After Effects are applied to produce the beginning part, including particle, masks, solid layer, adjustment layer and key frames, etc. Memory and multiprocessing is used for rendering, and several frames are rendered simultaneously. Flash is applied to make animations. Figures are edited with films controlled by different time shafts, involving a large number of key techniques like boot animation. Scenes and materials of the

animation are drawn with Photoshop, a software with powerful image processing which can beautify images. Noiseware is also used to increase image quality. Corel VideoStudio is also utilized for post production because of its great linear editing capability. Its abundant transition special effects make image switch more smooth; volume control can harmonize background and sound; custom action can create animations that cannot be made by flash; time lapse makes it possible to coordinate the image and sound accurately. The format of rendered animation is wmv because a wmv file has a high compression rate and excellent image quality. In addition, it can also be played while being download, and thus can be more easily disseminated among students.

2. Current situation of college students' behavior

Improper behavior can be observed everywhere on college campus nowadays, mainly including (1) violating disciplines and relative regulations, such as smearing on or carving the desks in classroom, phone ringing in class or self-learning periods, eating in teaching zones and throwing garbage everywhere, having people of the opposite gender lingering in the dormitory, wasting public resources, and even worse, taking away lab equipment or the reagents; (2) taking up public resources. In some self-learning areas in the library, taking up seats by putting books on the desk is frequently noticed. Besides, many students do not return the books they have borrowed on time, and what's worse, some even draw and write on the books randomly; (3) disobeying public orders. Some students take up seats before they queue up to buy food in the public dining room, some push against each other on the stairs, and some just put their bikes everywhere and disobey traffic rules.

Students do not have enough consciousness of improper behavior. In the renovation program against the Six Disorders in urban areas carried out in Xiangtan, Hunan Province in 2012, questionnaires were handed out to investigate the improper behavior in the daily life of college students on campus, which found that 55% students had wasted food, 41% had taken up seats, 20% made noise in dormitory and thus disturbed others, and 70% had been late for class or left early before. It could be observed that college students have more or less made improper deeds, but they themselves do not realize that what they are doing is improper. Moreover, 74.6% students consider it unnecessary or no need for now to strengthen the college civilizing construction, revealing a fact that most college students lack enough attention to improper behavior. In particular, during the survey, only 6.4% students could list all the improper deeds on campus, while 67.65% students did not have a clear awareness of the improper deeds on campus, which suggests that contemporary college students need to build up their awareness of improper phenomenon (Yue et al, 2013).

College is the key stage for students to form their world view, outlook on life and viewpoint of value. Higher education institutes are important constitutes of ideological and moral education. They are responsible for providing solid theoretical and ideological foundation for the formation of fine moral and ideological qualities of college students, and meanwhile, they also shoulder the burden of providing the goal and example of socialistic ideological and moral construction. Proper deeds are the embodiment of college students' ideological and moral qualities; high quality is requisite for building a positive image of college students and college education. The animation video was

produced with a hope that students could learn proper deeds and understand the problems that they need to pay attention to on campus, so as to eliminate inappropriate habits and strive to be excellent students (Pu, 2008).

3. Contents, important and difficult points, and innovation of the research

To propagate campus civilized behavior via animation is the innovation of this research, which was determined by the audience structure of animation in China. With easier access to animation products and diversified media, animation now is not the privilege of young children any longer. Instead, it becomes a favor of teenagers and adults as well. The animated film *Monkey King: Hero Is Back* (2015) followed typical Hollywood structures and combined a classical oriental story with the 3D special effect. With the oriental charm of its martial arts design, it created a sense of chivalrous spirit beyond the generally known fairy tale itself (from *New Express Daily*) (Zhou, 2015). Right after being released on the screen in mainland China on July 10th, 2015 in the forms of 2D, 3D and the Chinese Giant Screen, it attracted huge public attention and wide reports from the media for its outstanding performance. *People's Daily* considered it to be a rare work and phenomenon of Chinese animated films in the past decade. In September, 2015, it won the Award for Best Animation at the 30th Golden Rooster Award (Ma, 2015), and the gold award for Best Animated Feature at the 12th Golden Dragon Award Original Animation & Comic Competition (I Have Something to Say, 2015). Surveys reveal that in terms of the "absolute age" of readers for comic books within China, readers of 13 years old or younger account for 11%, readers of 14-17 take up 59%, while 30% of the readers are 18 or older (Ying and Liu, 2010). Its expressive power is superior to text terms alone.

The focus of this research is how to describe the daily life of students of our university vividly, and further differentiate the proper deeds from the improper ones. The difficulties are: (1) Producing characters. It is difficult because of the multiple angles. All developers were computer science majors instead of art majors, which posed great difficulty on the drawing and making of characters. In addition, one single character would be shown from different perspectives in different scenes, which required different character elements. This was the biggest obstacle that developers had gone through. The frequent result would be that only one element could be completed in one week, and the developers would discuss it in group and make further modification. (2) Buildings displayed in all scenes are from this university. It was an urgent issue to draw the cartoon images of them vividly. Generally speaking, it took a developer one or two weeks to make a draft drawing of one building, and further modifications were also needed. (3) For the design of elements including scenes, soundtracks and background music, as all developers were computer science majors, the lack of professional background of these fields and limited relevant knowledge required them to skillfully combine these elements, which was also a problem. (4) As students, all developers of the research team had to use their limited spare time to make the animation, so the production period was relatively long.

It might seem easy to develop an animated video. Nevertheless, each scene and each element need the developers to gather point by point, match line after line and combine surface after surface. From bigger elements like a building to smaller ones like one single expression of the characters, they all require the delicate craft of the developers, which is

a time-consuming and energy-taking task that needs the most careful work. For example, 80% of the shots in *Monkey King: Hero Is Back* had been modified before. During the production of the scene where the monster chased the little monk Jiang Liuer in the mountainous woods, whose overwhelming complication frustrated so many people that four or five animators resigned, and eventually, it took the producing team half a year to complete the 1500 or so frames of this approximately one-minute episode of film.

4. Thoughts and methodology of the research

The technical route of developing this animated propaganda video could be divided into five steps. First, learn the current situation of college students' civilized deeds, as well as the behavior of students from other universities and colleges through investigation, studying, gathering and collecting literature documents. Second, design and produce the main body of the video with Flash, Photoshop, Gold Wave and Corel VideoStudio. The picture was made in scenes, and the elements modeling the campus were made with Photoshop, thus adding rich animation features to the video. Third, make the post-stage special effect with Corel VideoStudio. The main technical indexes include duration of 6 six minutes or so, PLA format and the output format ".avi" which provides better image definition. Forth, transform the video in ".avi" format into ".rmvb" with Format Factory. Last, post this video on the official website of Qujing Normal University (<http://www.qjnu.edu.cn>) and Youku (<http://www.youku.com>). The technical route is demonstrated in Figure 1.

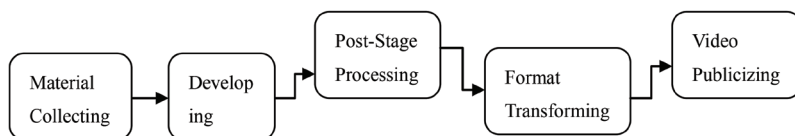


Figure 1 – Technical route of producing the video “Proper Behavior Norm for College Students”

Materials all from students' life, this video focused on regulating college students' behavior and tried to maintain originality and be creative and rich in animation features as well.

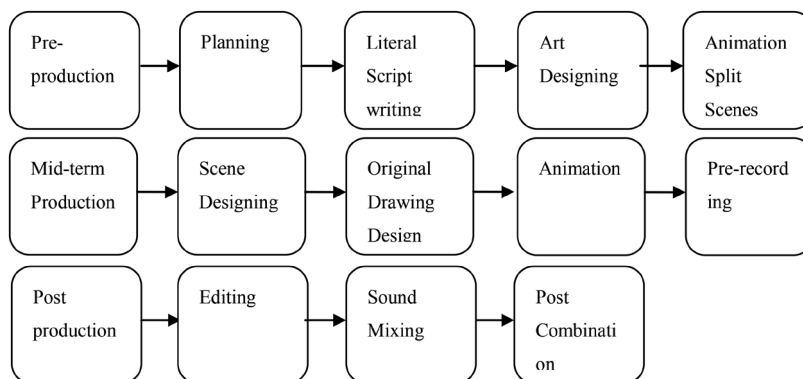


Figure 2 – Flow chart for the production of the video “Proper Behavior Norm for College Students”

The production of this two dimensional animation video can be divided into 3 steps: pre-production, mid-term production and post-production, as demonstrated in Figure 2.

5. Major interfaces design and key codes writing

The propaganda video Proper Behavior Norm for the Students of Qujing Normal University followed the daily routine of college campus life and demonstrated the proper behavior on campus. AE techniques including particle, masks, solid layers and adjustment layer key frames were used to make the opening of the video, and memory and multiprocessing were used in rendering to simultaneously render multiple frames, and to output the pictures in Alpha format. The effect pictures are demonstrated in Figure 3 and 4.



Figure 3 – Opening One Made with AE

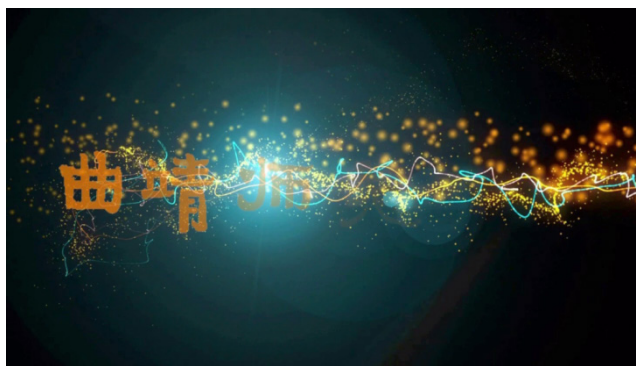


Figure 4 – Opening two made with AE

Character elements made with Flash often use Timeline Controlled film editing. Bootable animation could be added in Flash to make the elements move following the routes we need, and the adding of key frames enables us to produce the animation more conveniently and effectively. Last, save the animation made with flash as .swf

documents, which not only adds features of vector graphics to the animation, but also outputs pictures with super high resolution. The following picture is the title page made with Flash CS6.



Figure 5 – Title Page made with Flash CS6

The powerful image processing ability of Photoshop can make the images beautiful, while Noiseware can add to the exquisiteness of the images. All of the following pictures were drawn using Photoshop, with prototypes from this university, such as the teaching buildings, library, dormitory and dining house. Animation is easier for college students to accept and the prototypes from this campus also raise a sense of familiarity among students.



Figure 6 – Pictures made with Photoshop CS6

The video followed the daily life of students at this university, and produced two openings with AE. In total eight scenes were created with Flash CS6, including the title, getting up in the morning, having class, having lunch in the dinner house, doing experiment in the lab, library after 4:30pm and dormitory at night. The two openings made with AE and the title made with Flash CS6 were combined with Corel VideoStudio. The other seven scenes were combined with Flash CS6 by programming, and mounting film editing function.

This animated video was made with Flash CS6 and programmed with AS2.0. The scenes are skipped directly without buttons inserted, so GOTO sentence was used generally. However, during production, the author found a problem with scene skipping with GOTO sentence. When the video was played, if the background music of the previous scene was not finished yet, then it would mix with its counterpart of the next scene. To avoid this problem, it was decided to realize scene changes by mounting the film editing command. When the scene “getting up in the morning” was finished, a layer was added to the main scene, and the last frame of this layer was turned into a key frame. Then open the action panel and input the following codes:

```
on (release) {
    //load Movie Behavior
    if(this == Number(this)){ loadMovieNum(“shangxuelu.swf”,this);
    } else {
        this.loadMovie(“shangxuelu.swf”);
    }
    //End Behavior
}
```

The other six scenes were all mounted like this. On the last frame of each scene, input the following codes:

```
on (release) {
    //load Movie Behavior
    if(this == Number(this)){
loadMovieNum(“XXX.swf”,this);
    } else {
        this.loadMovie(“XXX.swf”);
    }
    //End Behavior
}
```

Five broadcasting majors, grade 2013, from Qujing Normal University provided the dubbing for the video. It was recorded in the studio with reference to the video first, and edited with GoldWave later.

The recording and video was combined with Corel VideoStudio in post-production stage. With its powerful linear editing, this software can process the materials ideally in that its abundant special effects for scene change can smoothly change the scenes and its volume adjuster can match the background video with the dubbing harmoniously. Besides, its custom action can make up for some disadvantages of Flash, as the timeline can facilitate the developers to adjust the matching of video and dubbing precisely, enhancing the artistic charm of the animation, and in rendering it also offers .wmv format, which provides high compression and fine images as well. Videos of .wmv format

can be played and downloaded simultaneously on the internet, which will contribute to the spreading of this propaganda video. The developers encountered several obstacles during combination. During post combination, for each section, the developers had to choose one from tens of special effects to add to the video. Another problem developers had was how to mix the background music and dubbing.

6. Conclusions

Our work has three features: first, it propagates in the form of animation video with all prototypes from this university, which contributes to its effectiveness and acceptance among students; second, exquisitely combining several popular multimedia, this video is consistent with the orientation of college education and can strike a responsive chord among students, and thus receive great educational effects; last, it involves many multimedia materials that are time-consuming to gather, produce and combine, and developers made multiple revises in post production. It could be concluded that this video is an exquisite work presented by the developers.

The efforts of the interest group finally paid off. In June 2016, the video won the second place at the Ninth Chinese College Students Computer Technology Design Competition (Yunnan) & HANBO College Students Computer Technology Design Competition in Yunnan. In July, 2016, it won the third place at the Ninth Chinese College Students Computer Technology Design Competition. On September 12th, the video was played in the entrance education for the 2016 freshmen of Qujing Normal University. Laughing and responding warmly, students learned civilized behavior norms, understood the problems they should pay attention to on campus and were educated to eliminate improper habits and try to be civilized students through this humorous video. Professor Ning Dejin, deputy director of the Propaganda Department of Yunnan Provincial Party Committee, made high remarks on the video, affirmed the remarkable innovation of this video in its form, methodology and effects, and proposed that this propaganda approach was worthy of being expanded to the whole province.

Acknowledgment

This paper is supported by three project funds:

1. Yunnan province education department scientific research fund project in general (Project number: 2015y432);
2. National College Students Innovation and entrepreneurship training program of Ministry of Education of the People's Republic of China in 2015 (Project number: 201510684001);
3. Qujing normal college scientific research fund special project (Project number: 2016zx001).

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Research into the Influence of CSFs on the Performance of PPP Projects from a Viewpoint of Data Mining

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Pages: 213–224

Abstract: The Critical Success Factors for Public–Private Partnership (PPP CSFs) is a hot discussion therefore this paper aims to identify five key PPP CSFs by using data mining. Based on the five key PPP CSFs, this paper analyzed the impact of CSFs on PPP project performance and the moderating role of funding types and relational attitudes. The result showed that CSFs positively affect the PPP project performance, but the influence of CSFs affect the PPP project performance varies, and the risk allocation had most significantly. It can be concluded that funding types diminish the effects of risk allocation and political support on performance, but it strengthens the effects of strong private consortium, public support and transparent procure on performance. While relational attitudes strengthen the effects of strong private consortium, public support and transparent procure on performance. Research results can also enrich the theory of PPPs and provide a theoretical reference to public sectors and private sectors for improving the performance.

Keywords: PPP CSFs, project performance, data mining, funding types, relational attitudes.

1. Introduction

For the past decades, there's a hot discussion about the PPP CSFs, which is help to enhance the performance. It's widely acknowledged that PPP CSFs as a major research area (Ke, 2009; Tang, 2010). What's more, many infrastructure sectors have been implemented their CSFs explored (Abdul-Aziz, 2011; Liu, 2013; Meng, 2011). Despite researchers had conduct a systematic and critical review of literature on the CSFs (Osei-Kyei and Chan, 2015), little empirical research studies has explored the influence of CSFs on the performance. Besides, the previous studies, however, have overlooked the funding types of PPP projects, and have received little attention in relational attitudes of public sector and private sector. At least three gaps on PPP CSFs can be found in previous studies.

Data mining generally refers to the process of automatically searching information hidden in a particular relationship from a large amount of data, which is helpful for the identification of PPP CSFs. In the era of large data, data mining is the most critical work. Large data mining is a process of discovering valuable and potentially useful information and knowledge from large, incomplete, noisy, fuzzy and random large databases. Large data mining methods are commonly used classification, regression analysis, clustering, association rules, neural network methods, cloud computing services, and web data mining (Fortes, 2016).

Considering that little empirical research studies has explored the influence of CSFs on the performance from a viewpoint of data mining, the funding types and relational attitudes may affect performance, these problems have to be addressed further. Therefore, we attempt to make full use of data mining and bridge these gaps through the guidance of the following research questions:

- How use data mining to find the PPP CSFs?
- How do PPP CSFs affect performance in PPP projects?
- How do funding types and relational attitudes modify the linkage between PPP CSFs and the performance?

This paper is organized as follows. Section 2 is literature review and hypothesis. Section 3 details the research methodology. Section 4 provides the analytic results. Section 5 presents a discussion. Section 6 makes a conclusion of this research.

2. Literature review and hypothesis

2.1. Identification the five top CSFs by data mining

The CSFs were regarded as an effective means of reaching managers' goals, much empirical evidence confirmed that the CSFs had a positive influence on PPP projects' affordability and success (Ng, 2012; Raisbeck, 2013; Tang, 2013). On the basis of previous studies, we find that there were many CSFs, such as appropriate risk allocation and sharing, strong commitment by both parties, choosing the right partner, good leadership and entrepreneurship skills, financial accountability, reliable service delivery, environmental impact of project, strong private consortium, political support, public support, transparent procurement, favorable legal framework and so on. In addition, we combined expert scoring and data mining to identify five key CSFs, which are appropriate risk allocation, strong private consortium, political support, public support and transparent procurement.

2.2. The relationship between CSFs and performance in PPP projects

It was recognized that risk allocation was one of the fundamental components of PPP arrangement (Jin, 2008). Appropriate allocation of risks in PPPs could improve the PPP success rate and risks should be allocated adequately to parties which could manage them effectively (Cheung, 2012). Besides, fairly allocate risks between parties of PPPs would create a 'win-win' solution (et al, 2014). More important, identifying risk allocation preferences of the stakeholders was crucial for confirming value-for-money for the public sector and revenue flows for the private sector (Roumboutsos, 2008). Thus:

H1. Risk allocation positively affects the performance.

It was found that strong private consortium equipped with strong technical, operational and managerial capacity can effectively achieve improvement in undertaking PPP projects (Zhang, 2005). Besides, it emphasized that a reliable and well-structured private sector company is very important for PPP success (Osei-Kyei and Chan, 2015). Therefore:

H2. Strong private consortium positively affects the performance.

For the past decades, there's a hot discussion about paradigmatic change in the way responsibilities for delivering services and public goods (Besley, 2001). Such political support reduced the difficulty for an approval for public expenditure on public project (Jacobson, 2008), and ensures timely deliveries with low cost. Thus it is understandable that political support is crucial to the performance. Thus:

H3. Political support positively affects the performance.

The acceptance by the public community enables the progress of PPP projects to be effectively (Osei-Kyei and Chan, 2015). Besides, by minimizing any sort of delays at the initial stages and reducing the cost of production as local people could be engaged as workers (Osei-Kyei and Chan, 2015), the public sector and private sector can accomplish their tasks effectively and deliver high quality products. Therefore:

H4. Public support positively affects the performance.

It's widely acknowledged that PPP is a procurement process, and this process should be transparent. In PPP projects, transparent procurement can help the projects' delivery and strengthen the successful implementation of projects through the public sector and private sector should be transparent and open to the external stakeholders or users (Osei-Kyei and Chan, 2015). Thus:

*H5. Transparent procurement positively affects the performance.***2.3. Moderating roles of funding types and relational attitudes**

It was found that the CSFs had a positive influence on PPP projects' affordability and success (Ng, 2012; Raisbeck, 2013; Tang, 2012). However, when funding types are different, the influence of CSFs affect the performance varies. The funding types could be classified into three types, namely, governmental funding, viability gap funding, and user funding. Three funding types items were designed with responses on a three-point scale ranging from "governmental funding (represented by 1)" to "user funding (represented by 3)". The governmental funding projects are usually public welfare program. Besides, public sector should take responsibility for site availability and political risks, and providing political support.

However, the user funding projects are usually profit-oriented projects, which have good financial benefits. Then, there are many reliable and well-structured private sector companies which are enthusiastic in participating in PPP projects. Thus, the private sector' pre-quantification is strictly and competitive procurement, consortium equipped with strong technical, operational and managerial capacity will be chose to undertake

PPP projects. What's more, in order to achieve good services, the non-governmental organizations will enthusiastic in providing support, local people will be engaged as workers to reduce the cost of production, and the media will actively engaged in propaganda. Therefore:

H6a. Higher funding types lower the positive influence of risk allocation on the performance.

H6b. Higher funding types higher the positive influence of strong private consortium on the performance.

H6c. Higher funding types lower the positive influence of political support on the performance.

H6d. Higher funding types higher the positive influence of public/community support on the performance.

H6e. Higher funding types higher the positive influence of transparent procurement on the performance.

According to Suprpto et al., relational attitudes could be defined as the 'senior management committed to provide necessary resources and support, shown consistent and passionate leadership, and actively resolved potential conflicts when needed etc.' (Suprpto, Bakker, Mooi, and Hertogh, 2015). Findings reveal that through better relational attitudes, projects with a partnering/alliance contract were perform better than those with lump-sum and reimbursable contracts (Suprpto et al., 2015). In addition, trust had positive affects in appropriate allocation of risks(Cheung, 2011).

Trust is the critical factor for fostering cooperation(Sai On Cheung, 2011). Yet the bad relational attitudes of the public sector and private sector affect private participation (Chou and Pramudawardhani, 2015) and the willing of cooperation. Similarly, relational attitudes also affect the influence of political support, public support, and transparent procurement on the performance. Therefore:

H7a. Better relational attitudes higher the positive influence of risk allocation on the performance.

H7b. Better relational attitudes higher the positive influence of strong private consortium on the performance.

H7c. Better relational attitudes higher the positive influence of political support on the performance.

H7d. Better relational attitudes higher the positive influence of public support on the performance.

H7e. Better relational attitudes higher the positive influence of transparent procurement on the performance.

2.4. Control variable

Three control variables, namely, project cost, duration, and industry type from PPP projects are applied in this research. Project duration and cost are seen as two crucial

aspects of the iron triangle and the important characteristics of PPP projects' size. McFarlan confirmed that the project size influenced project performance. In conclusion, controlling the effect of project cost, duration, and industry type on project performance is necessary.

Fig. 1 brings all the above hypotheses together. The CSFs positively affect the PPP project performance. Besides, the positive effects are strengthened by the appropriate risk allocation. What's more, the research model applies a mediation structure with trust as independent variables, cooperation as mediator and PPP project performance as dependent variable.

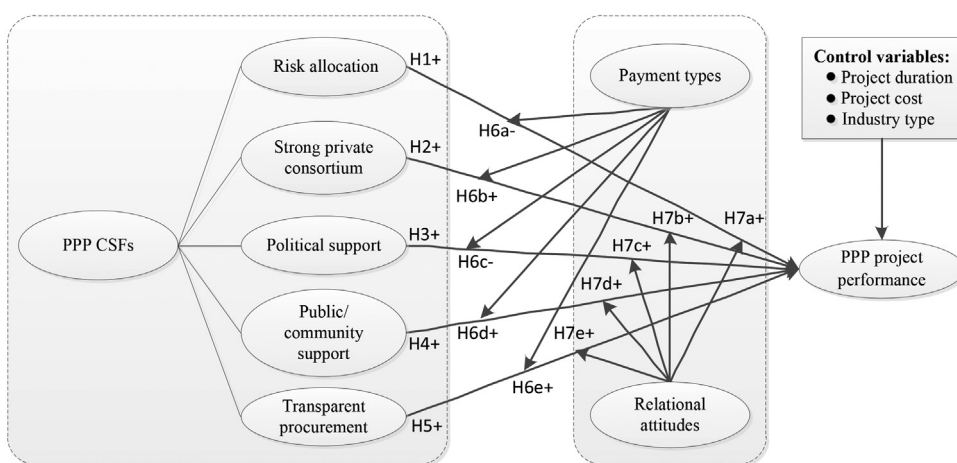


Figure 1 – Research model

3. Research methodology

3.1. Data collection

In order to test the hypothesis, quantitative data were collected by online questionnaire. In order to make sure the responses are valid, we took the following measures. On the basis of literature review, the questions were derived from the research model, and a five-point Likert scale was applied in the questions to extract the data on trust, cooperation, risk allocation, and PPP project performance. Between January 2016 and May 2016, a total of 300 responses were received, and we use the data mining to delete the uncompleted ones. As a result, the 216 remaining responses were found to be valid and could be used in the analysis. The response rate is 72%. The characteristics of the sample are presented in Table 1.

Country	%	Industrial Type	%	Project Duration	%	Sectors	%
U.K.	20	transport	25	0–2 years	13	Public sector	44
US	17	Water	10	3–5 years	16	Private sector	42
China	14	Electrical Power	12	6–10 years	30	<i>Others</i>	14
Australia	10	Agriculture	15	More than 10 years	41	Positions	
Singapore	9	Education	11	Project cost	%	CEO	27
Egypt	7	Healthcare	8	≤\$ 500,000	24	Project managers	31
New Zealand	7	Ecological environment	10	\$ 500,000 to 5,000,000	42	Technicians	29
Germany	5	<i>Others</i>	9	>\$ 5,000,000	34	<i>Others</i>	13
Japan	6					Length of time in this position	%
<i>Others</i>	5					0–3 years	25
						4–10 years	42
						More than 10 years	33

Note: CEO = Chief executive officer.

Table 1 – Sample characteristics (n = 216)

3.2. Measures

We rely on existing measurement scales that have been validated in earlier studies. All items are designed with responses on a five-point Likert scale ranging from “strongly disagree (represented by 1)” to “strongly agree (represented by 5).”. Measures of risk allocation items were based on scales presented by Ke et al. (Ke et al, 2010), Roumboutsos (Roumboutsos, 2008). Measures of strong private consortium were based on scales presented by Zhang (Zhang, 2005), Robert Osei-Kyei and Albert P.C. Chan (Osei-Kyei and Chan, 2015). Political support items and public support items were based on scales presented by Robert Osei-Kyei and Albert P.C. Chan (Osei-Kyei and Chan, 2015). Transparent procure items were based on scales presented by Robert Osei-Kyei and Albert P.C. Chan (Osei-Kyei and Chan, 2015). Three funding types items were designed with responses on a three-point scale ranging from “governmental funding (represented by 1)” to “user funding (represented by 3)”. Relational attitudes items were based on scales presented by Suprpto et al. (Suprpto et al., 2015). PPP project performance items were based on scales presented by Carvalho et al. (Carvalho and de Souza, 2015), Hale and Shrestha (Hale, 2009).

4. Results

4.1. Reliability and validity

Firstly, we examined reliability. The Cronbach’s α and composite reliabilities (CRs) were adopted to test reliability, table 2 shows the means, standard deviations, Cronbach’s α , and CRs. The values of Cronbach’s α and CRs were higher than 0.8, which means the

reliability is good. Secondly, we checked convergent validity and discriminant validity. Table 2 shows the loading between each item and constructs. All cross loadings are higher than 0.70 and exceeds the loadings between other constructs and the items. Besides, the other loadings are lower than 0.50, which means convergent validity was good. Discriminant validity was checked by determining if the square root of AVE exceeded the construct correlations. Table 2 reveals that discriminant validity is acceptable for our measures. In conclusion, satisfactory properties are achieved in the measurement model.

CO	ME (SD)	C α	RA	SP	PS	CS	TP	PT	PR	PP
RA	3.24 (0.52)	0.86	C = 0.90 A = 0.72							
SP	3.09 (0.69)	0.87	0.52**	C = 0.92 A = 0.73						
PS	3.02 (0.57)	0.85	0.50**	0.52**	C = 0.88 A = 0.67					
CS	2.91 (0.61)	0.84	0.48**	0.57**	0.49**	C = 0.86 A = 0.65				
TP	2.88 (0.55)	0.83	0.51**	0.47**	0.48**	0.46**	CR = 0.85 A = 0.64			
PT	2.22 (0.66)	—	0.34**	0.35**	0.37**	0.34**	0.35**	—		
PR	2.87 (0.56)	0.84	0.49**	0.46**	0.41**	0.41**	0.52**	0.39**	C = 0.87 A = 0.73	
PP	2.95 (0.54)	0.85	0.53**	0.52**	0.53**	0.51**	0.55**	0.61**	0.51**	C = 0.90 A = 0.68

Note: Two-tail t-test was performed. * Significant at $\alpha=0.05$. ** Significant at $\alpha=0.01$.

CO= Construct; ME = Mean; SD = Standard deviation; C α = Cronbach's α ; C = CR; A = AVE.

Table 2 – Descriptive statistics, reliability and correlations

4.2. Hypothesis testing

We applied hierarchical regression analysis and PLS to check the hypothesis. First of all, on the basis of the research of Liu and Wang (Liu and Wang, 2015), we adopted predictors systematically to ensure the explanation of the variance of the dependent variable. In addition, the effect of control variables was checked, and then we checked the effect of independent variables. Last but not least, the interactive effects by introducing the moderators were examined.

Model1 was used to test the effect of the control variables. Model 2 was developed to test H1, H2, H3, H4, and H5. Besides, models 6a, 6b, 6c, 6d, and 6e checked the moderating role of funding types, and used models 7a, 7b, 7c, 7d, and 7e to check the moderating role of relational attitudes. Table 3 showed the path coefficients, explained variances, and the values of F hierarchical, which were calculated by comparing the changes in the explained construct variances between each model (Liu and Wang, 2015). In model 1 of Table 3, the control variables insignificantly influence the performance of PPP projects. Thus, the performance does not differ in terms of project duration, cost and industrial type. As shown in model 2 of Table 3, the path coefficients of risk allocation, strong

private consortium, political support, community support and transparent procurement with performance are significant. Besides, significant incremental variance ($\Delta R^2 = 21\%$) was explained for the dependent variable. Therefore, H1, H2, H3, H4, and H5 were supported.

Models 3,4,5,6, and 7 displayed significant variance for the dependent variable. The interaction terms between risk allocation and funding types ($\beta = -0.16$, $p < 0.01$), between strong private consortium and funding types ($\beta = 0.18$, $p < 0.01$), between political support

To	PPP project performance											
From	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Block 1: Control variables												
<i>Duration</i>	-0.07	-0.07	-0.09	-0.11	-0.09	-0.11	-0.12	-0.10	-0.12	-0.11	-0.09	-0.10
<i>Cost</i>	0.08	0.09	0.11	0.08	0.07	0.09	0.11	0.10	0.11	0.12	0.11	0.09
<i>Type</i>	-0.06	-0.07	-0.06	-0.06	-0.09	-0.07	-0.06	-0.08	-0.07	-0.08	-0.09	-0.08
Block 2: Main effects												
<i>RA</i>		0.30**	0.29**	0.28**	0.27**	0.25**	0.25**	0.26**	0.27**	0.30**	0.28**	0.29**
<i>SP</i>		0.25**	0.24**	0.24**	0.25**	0.24**	0.24**	0.25**	0.24**	0.25**	0.24**	0.25**
<i>PS</i>		0.20*	0.21*	0.20*	0.21*	0.19*	0.19*	0.21*	0.21*	0.20*	0.21*	0.19*
<i>CS</i>		0.15*	0.14*	0.15*	0.15*	0.16*	0.15*	0.14*	0.15*	0.14*	0.15*	0.14*
<i>TP</i>		0.12*	0.13*	0.14*	0.16*	0.13*	0.14*	0.12*	0.14*	0.12*	0.11*	0.13*
<i>PT</i>			0.14*	0.13*	0.12*	0.12*	0.13*					
<i>PR</i>								0.24**	0.26**	0.25**	0.26**	0.27**
Block 3: Moderation effects												
<i>RA</i> × <i>PT</i>			-0.16**									
<i>SP</i> × <i>PT</i>				0.18**								
<i>PS</i> × <i>PT</i>					-0.22**							
<i>CS</i> × <i>PT</i>						0.19**						
<i>TP</i> × <i>PT</i>							0.15**					
<i>RA</i> × <i>PR</i>								0.17**				
<i>SP</i> × <i>PR</i>									0.24**			
<i>PS</i> × <i>PR</i>										0.26**		
<i>CS</i> × <i>PR</i>											0.28**	
<i>TP</i> × <i>PR</i>												0.30**
<i>F</i>		12.43**	12.23**	12.13**	14.56**	10.46**	14.52**	12.62**	13.33**	13.45**	17.36**	12.64**
<i>R</i> ²	0.047	0.21	0.26	0.27	0.19	0.27	0.25	0.27	0.23	0.30	0.31	0.31
ΔF		12.43**	12.23**	12.13**	14.56**	10.46**	14.52**	12.62**	13.33**	13.45**	17.36**	12.64**
ΔR^2		0.21	0.26	0.27	0.19	0.27	0.25	0.27	0.23	0.30	0.31	0.31

Note: * Significant at $\alpha = 0.05$. ** Significant at $\alpha = 0.01$. *M* = Model.

Table 3 – Hierarchical regression results

and funding types ($\beta = -0.22, p < 0.01$), between public support and funding types ($\beta = 0.19, p < 0.01$), and between transparent procurement and funding types ($\beta = 0.15, p < 0.01$) were significant. The results showed that the effects of strong private consortium, public support, and transparent procurement on the performance were positively moderated by funding types, and the effects of risk allocation and political support on the performance were negatively moderated by funding types. An excess of 19% to 27% of explained variance in the dependent variable (i.e., PPP project performance) was produced by the interaction terms. Besides, the interaction terms between risk allocation and relational attitudes ($\beta = 0.17, p < 0.01$), between strong private consortium and relational attitudes ($\beta = 0.24, p < 0.01$), between political support and relational attitudes ($\beta = 0.26, p < 0.01$), between public support and relational attitudes ($\beta = 0.28, p < 0.01$), and between transparent procurement and relational attitudes ($\beta = 0.30, p < 0.01$) were positive and significant. The results showed that the effects of strong private consortium, public support, and transparent procurement on the performance were positively moderated by relational attitudes, and an excess of 23% to 31% of explained variance in the dependent variable was produced by the interaction terms. Thus, all moderating effects are significant. The significance level of F hierarchical in each model further validates the results. Therefore, H6a, H6b, H6c, H6d, H6e, H7a, H7b, H7c, H7d, and H7e were supported. We summarized the results of the hypotheses testing in Table 2 and Fig.2.

5. Discussions

5.1. Contribution and implications

Firstly, data mining is helpful to identify the key PPP CSFs quickly and accurately. It is value to identify five key PPP CSFs by using data mining, and data mining provides a checklist of CSFs for PPP projects which could be adopted for further empirical research studies.

Secondly, important finding is regarding the positively influence of the CSFs on the performance of PPP projects. This finding supports the existing observations that the CSFs exert positive influence on the performance of PPP projects (Osei-Kyei and Chan, 2015; Rockart, 1982). Especially, risk allocation is one of the fundamental components of PPP arrangement (Jin, 2008). Hence, public sector and private sector should spend considerable time to monitor the development process and frequently participate in project meetings to allocate risk effectively and efficiently.

Lastly, funding types and relational attitudes have moderating roles in the correlation of CSFs with performance. More important, funding types diminishes the effects of risk allocation and political support on performance in PPP projects, but it strengthens the effects of strong private consortium, public support and transparent procure on performance in PPP projects.

5.2. Limitations and future research

There are some limitations in this study's results and conclusions. First, the relatively small sample size may limit our findings. It's difficult for us to obtain data at the project level (Liu and Wang, 2015), we apply the pair-wise design in order to reduce the threat

of sample size. Second, the characteristics of data applied in this research may limit our findings. Every country has different characteristics of regulations and cultures, thus may lead to a biased evaluation and response (Liu and Wang, 2015). The same limitation also applies to the industrial type of PPP projects because the majority (62%) of infrastructure projects is in the sample. Therefore, it is necessary to replicate the findings with a larger sample, in more different countries, and the types of PPP projects and considering regulations and cultures should be enriched in future researches (Suprpto et al., 2015).

6. Conclusions

This research provides some important insights into existing literature by the CSFs, funding types, relational attitudes and performance in PPP projects. Firstly, data mining is helpful to identify the key success factors of PPP project quickly and accurately. Besides, this research finds that the CSFs positively affect the performance. It is supported that the CSFs have an important role in performance. In addition, we find that funding types and relational attitudes have moderating roles in the correlation of CSFs with performance. More important, funding types diminishes the effects of risk allocation and political support on performance, but it strengthens the effects of strong private consortium, public support and transparent procure on performance in PPP projects. However, the relational attitudes strengthen the effects of the CSFs on performance in PPP projects. Last but not least, the control variables (project duration, cost and industrial type) insignificantly influence the performance of PPP projects. Thus, the performance of PPP projects does not differ in terms of project duration, cost and industrial type.

Acknowledgements

This study was supported by the grants from Key National Social Science Foundation of China (Grant No. 14AZD024). We thank all practitioners who have kindly contributed valuable data to this research. We thank the editor and referees for their helpful and constructive feedback.

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Research on the Crisis of Public Opinion in the Network of Social Contradictions in the Mongolian-Chinese Bilingual Large Data Platform

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Abstract: On the basis of bilingual recognition of Mongolian and Chinese, we analyze the typical cases of social contradiction to explore the impact of the number of netizens who concern about it and attitude intensity of netizens on the level of network public opinion crisis of social contradictions. Our study found that: in the initial stage, the number of netizens who concern about it can be regarded as the only explanatory variables to explain the level of crisis caused by public opinion news; At the stage of development, the level of crisis caused by official responses to the process is explained by both the number of netizens who concern about it and attitude intensity of netizens. In the calm phase, attitude intensity of netizens can be regarded as the only explanatory variables to explain the level of crisis caused by official responses to the result.

Keywords: Crisis level, Big data

1. Introduction

With the advent of the Internet era, the Internet has become a hub for the exchange of ideas, cultural communication and information distribution. Network public opinion gradually become a barometer of social public opinion and weather vanes. However, the tendency of clustering is inevitable in the process of network public opinion dissemination. If once it is malicious manipulation, it will cause great disturbance and harm to social stability and people's life. In such circumstances, the early warning of the network public opinion crisis about social contradictions is particularly important. Accurate and effective evaluation of the crisis level become the prerequisite and key to identify and deal with network public opinion crisis. With the development of the minority culture, the application of the Mongolian people to the Internet is also increasing. Therefore, this study is based on the bilingual identification of Mongolian and Chinese, and is devoted to the evaluation of the level of network public opinion crisis of social contradictions, to explore the influencing factors and evaluation methods of accurate evaluation of crisis

level. We strive to find potential public opinion crisis, timely alarm, and make effective response measures.

2. Theory

2.1. Mongolian-Chinese bilingual identification

As a minor ethnic group in China, Mongolians formed their own unique writing system-Mongolian. Mongolian and English, Russian and other phonetic characters are phonemes text. However, it is different from English writing. Moreover, there are many differences between Mongolian and Chinese. For example, Mongolian is phoneme and Chinese is morpheme. The number of Chinese characters is much larger than Mongolian. Mongolian is a word for the unit, there is no kerning; and Chinese characters is the word for the unit, there is no word pitch, only kerning (Hou, 2012).

In order to promote the development of science, education and culture in minority areas, and to broaden the knowledge of minority students, to facilitate their access to a wider range of information, many scholars have done much research on bilingual recognition of Mongolian and Chinese. Wang, Mecklinger, Hofmann & Weng found that language does not function in semantic accessibility (Wang et al, 2010). HUU You & BAI Xue-jun studied the role of semantic activation in Chinese, and found that both high-frequency and low-frequency vocabularies are earlier than semantic activation and conducive to semantic integration when the stimulus is very short (Hu and Bai, 2012). In the field of Mongolian-Chinese machine translation, CHEN Lei proposed to combine the manually-written sequence rules with the rules of automatic acquisition of Mongolian-Chinese bilingual parallel corpus to reduce the influence of the machine translation of Chinese and Mongolian caused by the size of less than parallel corpus and a large number of long distance transfer (Chen, 2013). SU Chuan-jie used the Mongolian-Chinese bilingual parallel corpus automatic study synchronous context-free grammar to realize Mongolian Chinese machine translation (Su, 2014).

At present, the most widely used software is a series of software developed by Inner Mongolia Mengke Li Software Company. "Mengke Li" specializes in ethnic minority text information, digital, network technology development and services. Therefore, the Mongolian people can use this kind of software to access the Internet information, express their attitudes and perspectives and enrich the cultural life.

2.2. Social contradictions and early warning

The social contradiction is the situation of mutual promotion, mutual complement and mutual development, and there is opposition, mutual exclusion and mutual struggle between different social groups or social classes in a social community (Wu, 2015). The early warning mechanism of social contradiction is to find out the inherent law by analyzing the existent or potential social contradictions, and then select the corresponding evaluation index, establish the social contradiction early warning system. Finally, through the accurate identification and tracking of social contradictions, we can judge the network public opinion crisis of social contradictions as early as possible so as to minimize the crisis level and adverse effects. Through the analysis of network public opinion on

the information resources of cyberspace communication, we can actively divert the unexpected situation and issue early warning information to the relevant administrative departments, so as to provide sufficient information support for decision-making.

3. Literature review

Internet anonymity and interaction makes the rapid development of network public opinion, the network public opinion research has also been widespread concern of scholars at home and abroad. In the construction of the network public opinion early warning index, Zeng Run-xi & XU Xiao-lin thought that the detection, the collection, the analysis, the warning, the precontrol, five subsystems constitute the network public opinion unexpected event early warning mechanism (Zeng and Xu, 2009). They use the Analytic Hierarchy Process (AHP) to construct the warning index system of network public opinion emergencies, which are warning source, warning sign and police intelligence, and weight each index according to its importance (Zeng and Xu, 2010).

ZHANG Yi-wen & QI Jia-yin aiming at the characteristics of unconventional events, this paper constructs an index system to measure and evaluate the public opinion hotspots of unconventional emergencies, and to clarify the deep-seated causes of public opinion fluctuation (Zhang and Qi, 2010). DAI Yuan & HAO Xiao-wei constructs the network public opinion security evaluation index system from the four dimensions of spread, public attention, content sensitivity and attitude tendency (Dai and Hao, 2010). Chen Yue & Li Ling-chao introduced the interval number to customize the quantitative indicators, using AHP method to determine the weights of indicators at all levels, and the establishment of the network public opinion threat assessment and ranking model based on the TOPSIS method (Chen and Li, 2012). Shi Gui-yun & Zhao Hai-yan conducted a risk analysis on the urban-rural fringe in the areas of economy, environment and government governance, and sorted out the main social risks in the urban-rural fringe, and set up the “social risk early-warning index system” (Shi and Zhao, 2012). Wang Lin, Huang Li-fang using the causal relationship forcing the method found that social contradictions can be attributed to the various subsystems of social instability. They proposed to establish the quantitative analysis model of each subsystem of the society, to determine the weight of each index system, to construct the social contradiction early warning index system, and finally to give the threshold of social contradiction early warning index (Wang and Huang, 2014). Shi Sen-chang detailed analysis of the traditional social warning and social contradictions early warning difference, not only defines the two objects of study, the real goal, the service object also introduced from the analysis of the difference between the two models (Shi, 2015). Wu Zhong-min defines the concept of social contradictions. He believes that the most appropriate and effective explanation is the meso-level social contradictions. The basic content of social contradiction theory is the social contradiction in the middle level. He discusses the concept of social contradiction and social conflict and social movement (Wu, 2015).

At present, many scholars have designed the evaluation index system of the network public opinion crisis level from different dimensions (Faria et al., 2015). These studies have laid a solid foundation for the research of this paper. However, most of these studies remain in the establishment of indicators and quantification of indicators, the research literature on the early warning of social contradictions is not much, the follow-up application research also needs to be solved.

4. Hypothesis, model and data

4.1. Hypothesis

The comprehensive evaluation index of the previous network public opinion crisis and the current network public opinion crisis evaluation method, we believe that the level of public opinion crisis is determined by the number of netizens who concern about it and the intensity of users' attitudes, that is, "crisis level = number of attentions + attitudes intensity." At the same time, according to "crisis communication and press release," Dr. Shi Anbin thinks that public opinion news and official response are important factors affecting the crisis. We believe that public opinion news, official process response and the official result response as the most important factors affect the trend of public opinion crisis.

Put forward the hypothesis:

1. The level of public opinion crisis caused by public opinion news is explained by the number of netizens who concern about it.
2. The level of public opinion crisis caused by public opinion news is explained by attitude intensity of netizens.
3. The level of crisis caused by official responses to the process is explained by the number of netizens who concern about it.
4. The level of crisis caused by official responses to the process is explained by attitude intensity of netizens.
5. The level of crisis caused by official responses to the result is explained by the number of netizens who concern about it.
6. The level of crisis caused by official responses to the result is explained by attitude intensity of netizens.

4.2. Model

We use the linear model to represent the potential variables of the level of public opinion crisis caused by the public opinion news and public response. The parameter estimation of the multiple regression model is to solve the parameter by the least squares method under the premise that the square of the required error (Σe) is the minimum. The model variables are listed in Table 1.

$$Y_1 = \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \mu_1$$

$$Y_2 = \alpha_2 + \beta_3 X_3 + \beta_4 X_4 + \mu_2$$

$$Y_3 = \alpha_3 + \beta_5 X_5 + \beta_6 X_6 + \mu_3$$

	Crisis level	The number of netizens	Attitude intensity of netizens
Public opinion news	Y1	X1	X2
Responses to process	Y2	X3	X4
Responses to result	Y3	X5	X6

Table 1 – Model variables table

In the model, the coefficient β_i ($i=1\cdots 6$) represents the degree of influence of each independent variable to the crisis level. α ($\alpha=1, 2, 3$) is the intercept term, μ ($\mu = 1, 2, 3$) is a random error term.

4.3. Selection of samples

“2015 China Internet public opinion analysis report” (the report covers the period from January 1, 2015 to October 31, 2015) pointed out that in social contradictions, public management, public security, official anti-corruption and other eight categories. The number of social contradictions hot events was 103, the hot event accounted for up to 20.6%, ranking second. Disputes of social moral, social violence and labor disputes are the three most important social conflicts.

The samples selected in this study are the three typical cases of social conflicts, social violence and labor disputes in the social contradictions from January to October in 2015. The sample data is from the People’s Network Public Opinion Monitoring Room coverage period of 500 pieces of public opinion hot events analysis. People’s network public opinion monitoring room is one of the earliest professional institutions engaged in Internet public opinion monitoring. It is in the leading position in the field of public opinion monitoring and analysis research, so the research conclusion has certain persuasive power.

4.4. Variables and data

Dependent Variable

The three dependent variables of this study are crisis level Y1 caused by public opinion news, crisis level Y2 caused by official process response, and crisis level Y3 caused by official outcome response. Experts, who work in the People’s Network public opinion monitoring room, according to the event development process trigger point: public opinion news and official response, considering the number of users concerned about the attitude of users, using Delphi method to determine the value of the dependent variable. Taking into account the international practice and China’s regulatory requirements and the development trend of network public opinion, we use 0-100 points to represent crisis levels. Blue represents the lowest score, the lowest degree of crisis. Red marks the highest score, the highest degree of crisis. As shown in Table 2.

Fraction	Crisis level	Color
50—60	I	Blue
61—70	II	Yellow
71—80	III	Orange
81—100	IV	Red

Table 2 – Crisis level representation

Explanatory Variables and Data

The explanatory variables of this study include two parts: the number of netizens who concern about it and attitude intensity of netizens. Detailed data for each case are shown in table 3.

Events	Time and factors	Crisis level	The number of netizens	Attitude intensity of netizens
<i>Illegal vaccine case in Shandong</i>	2016.03.18 Public opinion news	76	74.9	89.1
	2016.03.19 Process responses	80	77.3	82.1
	2016.03.21 Process responses	79	77.9	79.4
	2016.03.21 Result responses 08:03:50	45	70.9	44.3
	Result responses 19:20:45	40	75.4	37.6
<i>8.12 major explosion in Tianjin port</i>	2016.08.13 Public opinion news	79	78.1	90.1
	2016.08.13 Process responses	89	89.4	88.9
	2016.08.13-2016.08.15 Process responses	89	90.9	89.0
	2016.08.16 Process responses	88	95.2	80.2
	2016.08.20 Result responses	41	69.1	40.3
<i>Lei Yang case</i>	2016.05.09 Public opinion news	77	76.9	87.1
	2016.05.09 Process responses	84	83.3	88.7
	2016.05.11 Process responses	88	87.9	89.0
	2016.05.13 Process responses	73	74.2	70.5
	2016.06.30 Result responses	38	68.1	36.3

Table 3 – Data tables of dependent variables and explanatory variables

4.5. Assessment of attitude intensity and the number of netizens

Assessment of the number of netizens

We use the public opinion event heat which is invented by people's network public opinion monitoring room to indicate the number of users concerned. Public opinion event heat from newspapers, network news, forums, blogs, micro-blog, WeChat, the six major media keyword search volume weighted and normalized. The weights of the media are as follows: Newspapers: 0.3200; network news: 0.2038; Forum: 0.0752; blog: 0.0954; micro-blog: 0.1409; WeChat: 0.1647. According to the data sources, we believe that public opinion event heat can be expressed as the number of netizens who concern about it.

The experimental evaluation of attitude intensity

We judge the attitude intensity of netizens through the user's comments after public opinion news and official responses to process and result. In this paper, "the network public sentiment text processing and emotion analysis system" is used to analyze the attitude intensity of netizens.

As shown in Figure 1, the system starts from building a corpus, extracting feature words, and then, through the classifier module to classify the text, and finally it will classify the results to the Excel, to achieve visual processing.

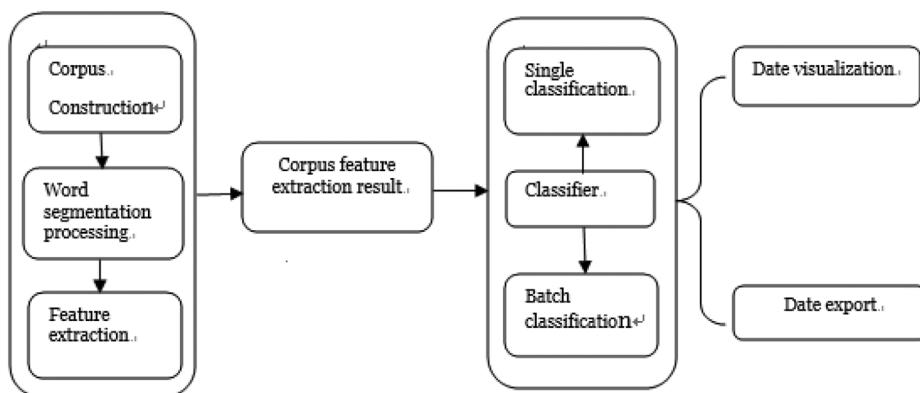


Figure 1 – General framework of the system

The classification method: support vector machine (SVM)

SVM is developed from the optimal classification surface from the linear separable case (Zhang, 2000). SVM can be used to classify the linear separable data. SVM is widely used in the fields of pattern recognition, function estimation, text recognition, time series prediction and so on. Its principle is shown in figure 2. Two different types of samples are represented by solid and hollow points, and the classification line is represented by H. H1 and H2 are the straight lines that are closest to the classification line and are parallel to the classification line, and the distance between them is called margin. The

optimal classification line requires that the classification line not only separate the two classes correctly (the training error rate is 0), but also make the classification interval the maximum. The classification line equation is $x \cdot w + b = 0$.

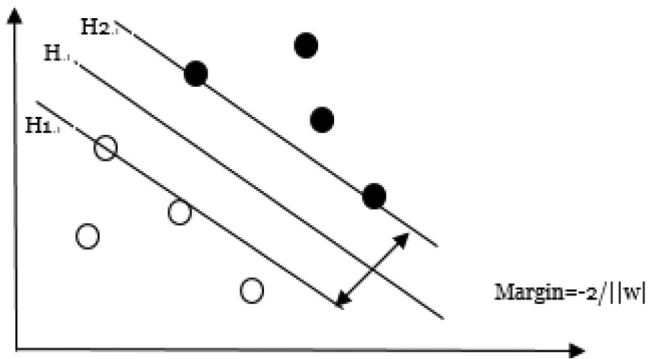


Figure 2 – Schematic diagram of optimal classification surface

Emotional classification assessment

	Actually positive	Actually negative
Judgment is positive	a	b
Judgment is negative	c	d

Table 4 – Experimental results of affective classification

The evaluation methods are as follows: the average accuracy is (1), positive rate of positive and negative are (2), (3), positive and negative recall rate are (4), (5).

$$\text{Accuracy} = \frac{a+b}{a+b+c+d} \text{Accuracy} = \frac{a+b}{a+b+c+d} \tag{1}$$

$$\text{Precision(pos)} = \frac{a}{a+b} \text{Precision(pos)} = \frac{a}{a+b} \tag{2}$$

$$\text{Precision(neg)} = \frac{d}{c+d} \text{Precision(neg)} = \frac{d}{c+d} \tag{3}$$

$$\text{Recall(pos)} = \frac{a}{a+c} \text{Recall(pos)} = \frac{a}{a+c} \tag{4}$$

$$\text{Recall}(\text{neg}) = \frac{d}{b+d} \text{Recall}(\text{neg}) = \frac{d}{b+d} \quad (5)$$

The way of data acquisition

In this paper, we select three typical hotspot events in the field of social contradictions. Then, we use the crawler software to collect the netizens online comments about three hot events. These comments come mainly from the comments section after relevant articles in mainstream media related news, post bar, blog, micro-blog and WeChat. In order to ensure the validity of the experimental results, we collect 1000 representative comments for every events of public opinion news, official response to process and result. The collected data is stored in Notepad ++ in text form. The collected comment samples are sorted on the NLConc++. A case study on the attitude intensity of netizens in the case of “illegal vaccine case in Shandong “. The operation is as follows.

- Locate the initial number to 10.
- Set the number of categories to 2.
- Set the feature interval to 50.
- Output the result data.

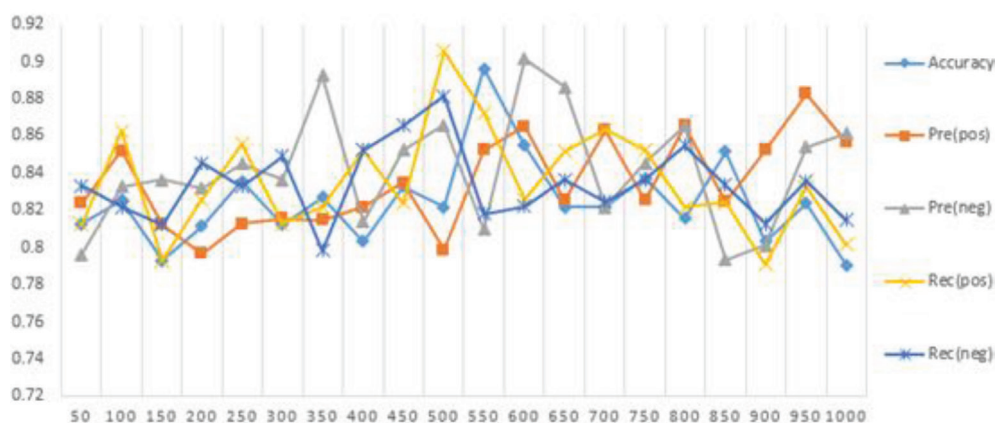


Figure 3 – The visualization of results of experiment classification

In Figure 3, the experimental results show that the Average accuracy = 0.83560, which shows that the establishment of the emotional evaluation model accuracy rate is 83%, it can meet the experimental requirements. We have made an experiment on attitude intensity of netizens caused by public opinion news in the case of “illegal vaccine case in Shandong “. In the collection of 1000 comments, the number of comments which the classifier determines positive comments as positive comments is 109, the number of comments which the classifier determines negative comments as negative comments is 891. We believe that the negative comments can reflect the intensity of emotions,

so, attitude intensity of netizens = the number of negative comment / total number of comments *100%, attitude intensity of netizens = $891/1000*100\%=89.1$. Subsequently, we use the same method to test these three typical cases, the results shown in the table 5.

Events	Time and factors	Positive comments	Negative comments	Attitude intensity of netizens
<i>Illegal vaccine case in Shandong</i>	2016.03.18 Public opinion news	109	891	89.1
	2016.03.19 Process responses	179	821	82.1
	2016.03.21 Process responses	206	794	79.4
	2016.03.21 Result responses 08:03:50	557	443	44.3
	Result responses 19:20:45	642	376	37.6
<i>8.12 Major explosion in Tianjin port</i>	2016.08.13 Public opinion news	91	901	90.1
	2016.08.13 Process responses	111	889	88.9
	2016.08.13-2016.08.15 Process responses	110	890	89.0
	2016.08.16 Process responses	198	802	80.2
	2016.08.20 Result responses	597	403	40.3
<i>Lei Yang case</i>	2016.05.09 Public opinion news	129	871	87.1
	2016.05.09 Process responses	113	887	88.7
	2016.05.11 Process responses	110	890	89.0
	2016.05.13 Process responses	295	705	70.5
	2016.06.30 Result responses	637	363	36.3

Table 5 – The attitude intensity of netizens table

5. Model estimation and interpretation

5.1. Model description

We use Statistics SPSS 19 to carry on the multivariate regression test to the dependent variable and the explanatory variable. We conducted three sets of multivariate regression models, (1) the level of crisis caused by public opinion news Y1 as the dependent variable, the number of netizens who concern about public opinion news X1, Attitude intensity of netizens caused by public opinion news X2 as the explanatory variable; (2) the level of crisis caused by process responses Y2 as the dependent variable, the number of netizens who concern about process responses X3, attitude intensity of netizens caused by process responses X4 as the explanatory variable; (3) the level of crisis caused by result responses Y3 as the dependent variable, the number of netizens who concern about result responses X5, attitude intensity of netizens caused by result responses X6 as the explanatory variable;

		Regression equation test			Regression coefficient	Regression coefficient test	Collinearity diagnosis test		
		Adjust R ²	F	D-W	B	t	D	CV	CI
1	constant				-11.955	-3.872	1	2.997	1.000
	concerned level	0.998	995.080	1.152	0.909	42.628	2	0.002	38.271
	attitude intensity				0.221	7.039	3	0.000	78.380
2	constant				7.052	2.049	1	2.994	1.000
	concerned level	0.987	259.797	1.956	0.525	12.279	2	0.003	29.442
	attitude intensity				0.388	8.119	3	0.002	35.290
3	constant				-2.350	-0.454	1	2.995	1.000
	concerned level	0.985	100.106	2.307	0.151	1.354	2	0.004	26.248
	attitude intensity				0.823	14.016	3	0.001	65.020

Note: D-W: Durbin-Watson; CV: characteristic value; CI: condition index; D: Dimension

Table 6 – Operation result analysis of linear regression model

5.2. The results of Analysis

In table6 (1), we get the following conclusions by the regression analysis of the level of crisis caused by public opinion news Y1, the number of netizens who concern about public opinion news X1, attitude intensity of netizens caused by public opinion news X2. Adjust $R^2=0.998$, $F=995.080$, $p=0.000$. It can pass the significance test, and it shows that the fitting degree of regression is very high, which can explain the overall 99.8%.

In theory, we think that if the number of netizens who concern about public opinion news and attitude intensity of netizens are zero, the level of public opinion crisis is zero, so the constant term α_1 does not have practical meaning in the model, the constant term does not affect the validity of the model. The same applies to (2) and (3).

The coefficient of the number of netizens who concern about public opinion news is $\beta_1=0.909$, the coefficient of attitude intensity of netizens caused by public opinion news is $\beta_2=0.221$. This shows that when the other factors remain unchanged, with X1 changes in a unit, the crisis level Y1 changes 0.909 units. Similarly, with X2 changes in a unit, the crisis level Y1 changes 0.221 units. So, hypothesis 1 and hypothesis 2 are correct. Moreover, when the dimension (D) is 3, the condition index (CI) is 78.380, indicating that the data has a serious collinearity. In summary, we believe that the number of netizens who concern about it can be regarded as the only explanatory variables to explain the level of crisis caused by public opinion news.

In table6 (2), we get the following conclusions by the regression analysis of the level of crisis caused by official responses to process Y2, the number of netizens who concern about official responses to process X3, attitude intensity of netizens caused by official responses to process X4. Adjust $R^2=0.987$, $F=259.797$, $p=0.000$. It can pass the significance test, and it shows that the fitting degree of regression is very high, which can explain the overall 98.7%.

The coefficient of the number of netizens who concern about official responses to process is $\beta_3=0.525$, the coefficient of attitude intensity of netizens caused by public opinion news is $\beta_4=0.388$. This shows that when the other factors remain unchanged, with the X3 changes in a unit, the crisis level Y2 changes 0.525 units. Similarly, with the X4 changes in a unit, the crisis level Y2 changes 0.388 units. That is, hypothesis 3 and hypothesis 4 are correct. Moreover, when the dimension (D) is 3, the condition index (CI) is 35.290, indicating that the data does not have a serious collinearity. In summary, we believe that the level of crisis caused by official responses to the process is explained by both the number of netizens who concern about it and attitude intensity of netizens. Moreover, the number of users concerned about the impact of the degree of 0.525, the impact of attitude intensity of 0.388.

In table6 (3), we get the following conclusions by the regression analysis of the level of crisis caused by official responses to result Y3, the number of netizens who concern about official responses to result X5, attitude intensity of netizens caused by official responses to result X6. Adjust $R^2=0.985$, $F=100.106$, $p=0.000$. It can pass the significance test, and it shows that the fitting degree of regression is very high, which can explain the overall 98.5%.

The coefficient of the number of netizens who concern about official responses to result is $\beta_5=0.525$, but $t = 1.354$, $p > 0.1$, it does not pass the significance test, indicating hypothesis 5 is rejected. The coefficient of attitude intensity of netizens caused by official responses to result is $\beta_6=0.823$, $p < 0.01$. It can pass the significance test. This shows that when the other factors remain unchanged, with the X_6 changes in a unit, the crisis level Y_3 changes 0.823 units. That is, hypothesis 6 is correct. Moreover, when the dimension (D) is 3, the condition index (CI) is 65.020, indicating that the data has a serious collinearity. In summary, we believe that to a certain extent, attitude intensity of netizens can be regarded as the only explanatory variables to explain the level of crisis caused by official responses to the result.

6. Conclusions and Recommendations

We analyze the public opinion of social contradictions, and use the regression model to test the hypothesis, the conclusions are as follows:

1. In the initial stage, the number of netizens who concern about it can be regarded as the only explanatory variables to explain the level of crisis caused by public opinion news.
2. At the stage of development, the level of crisis caused by official responses to the process is explained by both the number of netizens who concern about it and attitude intensity of netizens. Moreover, the number of users concerned about the impact of the degree of 0.525, the impact of attitude intensity of 0.388.
3. In the calm phase, attitude intensity of netizens can be regarded as the only explanatory variables to explain the level of crisis caused by official responses to the result.

According to the above characteristics, we propose that in the initial stage, the national government and relevant departments in the network public opinion testing, should focus on the number of netizens who concern about public opinion news. At the stage of development, we should pay attention to both the number of netizens who concern about it and attitude intensity of netizens. In the calm phase, we should focus on attitude intensity of netizens.

Acknowledgments

This work was mainly supported by National Social Science Foundation “Research on the warning of social contradictions in the Mongolian and Chinese bilingual base on the big data analysis” (16CGL060); Natural Science Foundation of Inner Mongolia, China (2013MS1009); Subject of Ministry of Education (16XJC710002); Key Scientific Research Project of Inner Mongolia Education Department (NJSZ16026). Inner Mongolia youth talents of science and technology support plan of China (NJYT-15-Bo8); Inner Mongolia department of soft science project of China “Research on the Key Technologies of Social Governance in Inner Mongolia Network” (2015); Inner Mongolia department of soft science project of China “Research on Contribution of Intangible Assets to Inner Mongolia’s Enterprises” (2012); Subject of Inner Mongolia Center for Internet Economic Research.

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Survey on E-commerce Development in Areas Inhabited by Ethnic Minorities of Qujing City, Yunnan Province, Based on Computer Data Analysis

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Pages: 239–247

Abstract: Through issuing questionnaires in areas inhabited by ethnic minorities of Qujing city, Yunnan Province, and then sorting out and analyzing data with computer technologies, this paper finds that problems like poor infrastructure, residents' low awareness of e-commerce and lack of e-commerce talents hinder e-commerce development in these areas. Based on the realities of these places, the paper puts forward solutions to the problems.

Keywords: Computer Data Analysis, Qujing, ethnic minority area, E-business, survey.

1. Introduction

As China's economy and e-commerce industry develop rapidly, people's consumption concept has been reshaped. E-commerce makes our everyday life more convenient and efficient. It is notable that the development of e-commerce varies greatly in different regions, especially in those inhabited by minorities (Sá et al., 2016). Even though great progress has been made, e-commerce development of the areas with minorities is still impeded by a number of problems. Group members of this project investigated the situation of e-commerce development in areas inhabited by ethnic minorities of Qujing city, Yunnan Province, through releasing questionnaires at two more populated counties of the city, namely Fuyuan county and Luliang county. Then, the members applied computer technologies to sort out and analyze these questionnaires, thereby summing up problems regarding e-commerce development in these areas and proposing solutions to these problems.

2. The E-business Current Situation of Qujing ethnic minority areas

Research group members did the survey in two national minority concentrated counties-Fuyuan county and Luliang county. The group gave out 500 questionnaires and got back 395 questionnaires. The reason of the low response rate is that citizens over 40 years old cannot write these for they are illiterate let alone the E-business. Accordingly, there are 270

women consumers occupying 68.4% of the total number. There are 125 men consumers occupying 31.6%. The frequently-used on-line shopping sites are Taobao, JD.COM, Vipshop and so on. In addition, Taobao is the mostly used with an occupation of 51.9%.

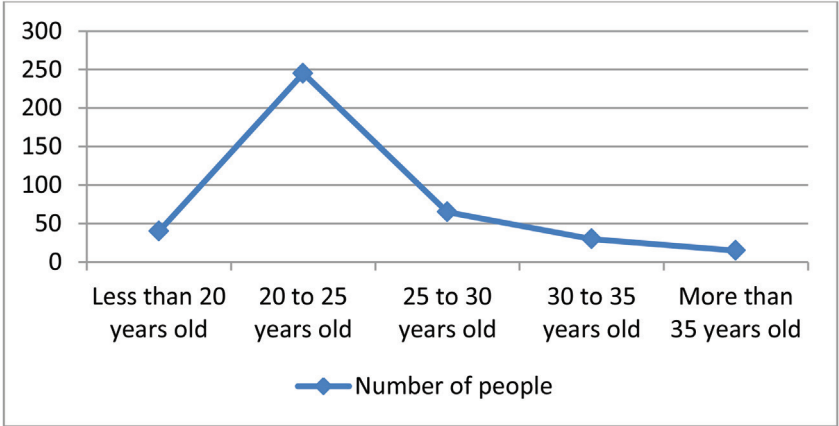


Figure 1 – The age distribution of the netizen in Qujing ethnic minority area

According to figure 1, the age of online shoppers of Qujing concentrates on the people under 35 years old. What’s more, the people under 20 years old are 40 people of 10.1% percent, 20 to 25 is 245 of 62%, 25 to 30 is 65 of 16.5% percent, 30 to 35 is 30 of 7.6%, and over 35 is 15 of 3.8%.

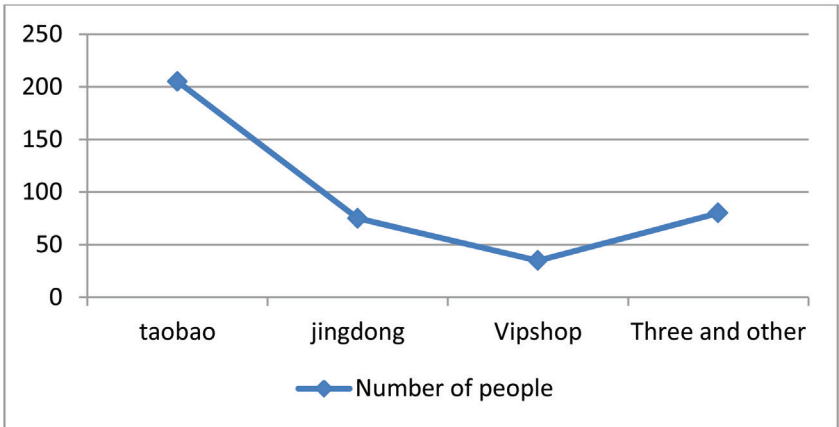


Figure 2 – The frequently used shopping site of netizens in Qujing ethnic minority area

According to figure 2, Taobao is the first choice of netizen when shopping online. Among 79 questionnaires, there are 75 people shopping these three shopping sites-Taobao

JD.COM and Vipshop. However, there are 41 people on Taobao occupying 51.9% of the total number, 15 in JD.COM of 19%, 7 in Vipshop of 8.9% and 16 in all of the three sites of 20.2%.

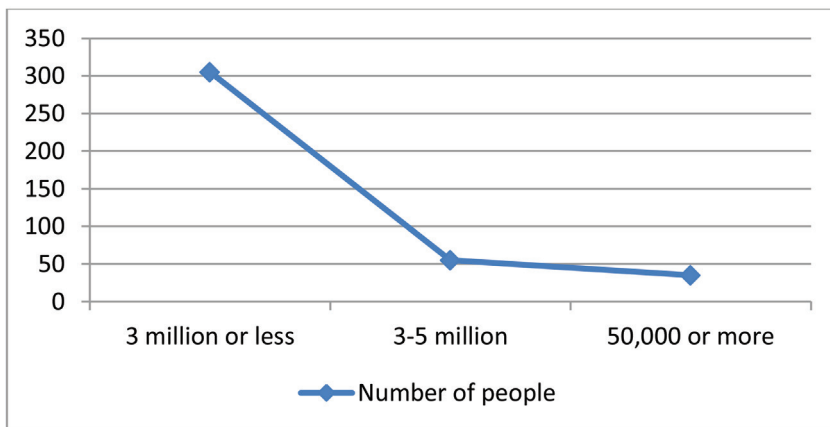


Figure3 – The annual income of netizens in Qujing ethnic minority area

According to figure 3, the annual income of Qujing ethnic minority area as follows: among the surveyed people, there are 305 people having an income under 30, 000 RMB of 77.2% of the total number, 55 people having an income between 30, 000 to 50, 000 RMB of 13.9%, 35 people having an income over 50, 000 RMB of 8.9%.

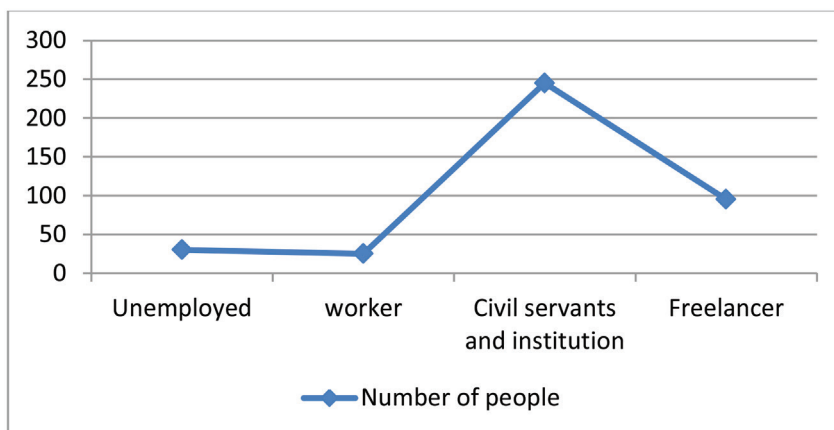


Figure 4 – The career distribution of the netizens in Qujing ethnic minority area

According to figure 4, among the 395 questionnaires, the career distribution of the on-line shoppers in Qujiang national minority areas as follows: there are 30 unemployment

people which is of 7.6% of the total number, 25 workers which is of 6.3%, 245 civil servants which is of 62% and 95 freelance which is of 24%.

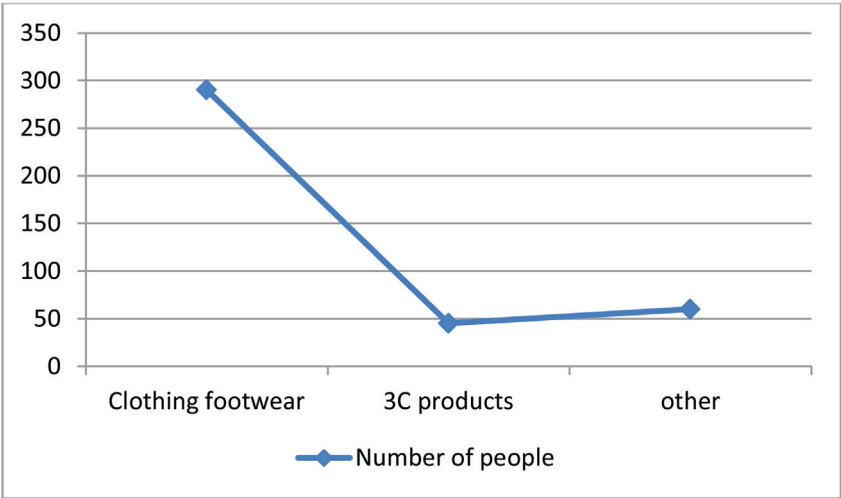


Figure 5 – The on-line shop products of netizens in Qujing ethnic minority area

According to figure 5, the surveyed people mainly buy clothing and shoes, makeup, furniture and kitchen wear, 3C (computer, communication and so on) and books and audio products and so on. There are 290 people, which is 73.4% of the whole number, buying clothing and shoes, makeup, furniture and kitchen wares. There are 45 people, which is 11.4% of the whole number, buying 3C products. And there are 60 people, which is 15.3% of the whole number, buying books and audio products.

According to the research, the on-line shopping frequency of netizens in Qujing as follows: there are 75 people several times half a year covering 19% of the total number, 185 people several times a month covering 46.8%, 30 people several times a week covering 7.6% and 105 people several times a year covering 26.6%.

Among the 395 surveyed people, 40.5% said that buying things without going out is the reason of their on-line shopping. 30.4% said the products on on-line shopping site are much cheaper. While only 23% people said they choose on-line shopping because of the product quality.

The figure shows that mostly on-line shoppers in Qujing spend hundreds of RMB in a single purchase and the number of people is 230 and covers 58.2% of the total number. Then, the single purchase of a few tens of RMB is 130 people and covers 32.9% of the total number. The single purchase of thousands of RMB is the last. Only 35 people spends thousands RMB and the people are only 8.9% of the total number.

According to the figure above, the mainly used method of payment is the third-party payment platform such as Alipay when netizens come to on-line shopping. Among the

395 surveyed people, there are 240 using the third-party platform payment which is 60.8% of the surveyed people, 35 people choosing pay on delivery which is 8.8% of the surveyed people, 95 people using e-bank which is 24.1% of the surveyed people and 25 people letting others pay for them which is 6.1% of the surveyed people.

3. The Problems of the E-business in Qujing ethnic minority area

It has been three years since Qujing launched and implemented the plan of “Internet + Rural E-business”. Qujing ranks the number two with a trading volume of 44 billion RMB, which includes 9.97 billion sales volume. Qujing and Alibaba signed a Cooperation Frame Agreement in 2016. With the sign of the agreement, Qujing works to accelerate its E-business in selling and buying, perfect its service system, strengthen the training and incubating of talents and fasten the development of the E-business platform. However, the E-business of Qujing, especially the ethnic minority area, has many obstacles and still has a long way to go.

3.1. Poor internet infrastructure and internet penetration under national average

The characteristic of E-business is real-time trading. And the real-time trading needs the condition of fast and broad network, which is the hard facility of E-business. After years of construction and development, Yunnan has made some progress in internet infrastructure. But the undeveloped regions face the lack of internet or low internet usage and high cost. The 27th Report of China Internet Development Situation, which is issued by China Internet Network Information Center in January, 2011, shows that the number of China netizens has reached 4.57 billion and the penetration is 34.3% to December 31st, 2010. As for Yunnan Province, it ranks 29th with 10, 210, 000 netizens, development rate in the 17th place and a penetration of 22.3% which is under the average penetration in China. Up to June, 2014, China netizen had broken through 6 billion and internet penetration above 50%. The E-business trading volume is up to 5.23 trillion with a growth of 30%. And the agriculture products are up to 142 billion and with a growth of 30% compared to the last year. The E-business of agriculture products develops at a fast speed, but the average rural area has poor internet condition (Li Ziqiong, Liu Donghuang, 2012). Up to June, 2015, rural netizens only cover 27.9% of the total number with a penetration of 30.1%. What's more, the rural E-business trading volume is only 0.5% of the total transactions (Yuxin, 2015).

3.2. People's weak sense of E-business

Qujing is concentrated with national minorities. Despite the central city and Zhanyi county, the economy of this region lags behind. People are unenlightened and think the E-business is not essential. Most people even don't believe E-business for it is impalpable and invisible. It is tradition shopping way and lack of enthusiasm to E-business that hinders the development of E-business. The companies in ethnic minority areas only take the website building as a task needed to be fulfilled. These areas haven't noticed the charm of the E-business, lack the sense of developing E-business and only pay attention to the short-term economic benefits. Thus, the E-business lags behind in these areas.

3.3. E-business talents is in badly need

According to the data of China Internet Network Information Center, the rural areas lack talents. 62.7% rural netizens have the education background of junior school and even a lower education background. And only 4.8% has a university degree and beyond. The research of Yunan Economic and Trade Commission shows that 76.7% of the surveyed enterprises have less than 5 technology personnel, while the national average is 62. So the gap is apparent. Tai Junlin, the chairman of Yunan Puer Tea Co. Ltd, said that their E-business operation team is in Shenzhen for it is too hard to find E-business personnel acquitted with marketing ability and experience in Yunnan. Zhang Yong, the chairman of the Yunan Yimencongshan Edible Mushrooms Co. Ltd, said he found professional personnel in Beijing and founded the E-business team to be in charge of the E-business operation. Zhang Yong said: "Yunnan lacks professional personnel in E-business." As mentioned above, people in ethnic minority areas are illiteracy. However, the E-business personnel need the combination of IT and business knowledge, management and technology, and law and commercial knowledge. E-business personnel need to be trained and the combination of traditional industry and E-business is in need of trained personnel. Qujing, because of its location and undeveloped economy, lacks the attraction to the profession people. Both the lack and brain drain hinder the development of E-business badly.

3.4. High logistic costs

Logistic costs consist of transportation cost, storage cost and management cost. Transportation cost includes all the costs happening in the process of transportation. The transportation cost consists of transportation expanses and the charges of the owner. The storage cost is all the cost happening during the storage. The management cost is calculated out according to the transportation cost, storage cost and the management cost rate. Qujing is a resource industry city with the heavy industry as its backbone. The staying high logistic costs has impeded the export and investment, restricted the transformation and upgrade as well as the competition ability of Qujing. In developed countries, the logistic cost is 9% of its GDP, while in developing countries, the logistic cost is about 30% of its GDP. China logistic cost is 18% of its GDP and Yunnan is 24%. According to the research, the logistic cost of Qujing is about 25% of its GDP, which is 2.8 times of the developed countries. In addition, it is 7% higher than the nation and 1% higher than the province. According to the calculation, through the development of the logistics industry, the logistic cost will reduce 10% percent in GDP and increase 158 billion RMB outcome (using the 1583.94 billion GDP of 2013). So the high logistic cost is the constriction of the direct foreign investment attraction.

4. Suggestion to the E-business development in Qujing ethnic minority area

The development of the E-business is a complex social engineering. It is the government who can solve the problem of safety and E-business law and regulations. Qujing should try its best to solve the problems mentioned above.

4.1. Training of the E-business personnel in ethnic areas and perfecting the infrastructure

Considering the fact that it is hard to introduce E-business personnel from outside in ethnic minority areas, school-enterprise cooperation may be the answer. Through the school-enterprise cooperation, a group of E-business personnel who are familiar with the local condition and acquainted with IT, management, economy, market and law, will come into being. On December 9th, 2015, as the first Alibaba Rural Taobao exemplary county in the east part of Yunnan, Zhanyi county service center held its opening ceremony in Qujing E-business incubator. Alibaba takes the method that a county with a service station and E-business personnel acquainted with E-business knowledge. Alibaba should consider the cooperation with the Qujing Normal University and cultivate a group of comprehensive talents. The enterprise can reward the ethnic minorities and brings out incentive system to let them have a sense of belonging (Peng, 2013).

4.2. Developing the WeChat business based on mobile internet

Mobile internet is an internet platform on which users communicate with the use of mobile phones and tablets PC through mobile and internet technology. It is the production of mobile communication and internet technology. WeChat of the Tencent is the most successful among the major mobile internet. Up to the first quarter of 2015, WeChat has 5.49 billion active users and covers more than 200 countries with more than 20 languages. In addition, the official accounts of all kinds of brands are over 8, 000, 000 and the butted mobile applications are over 85, 000. What's more, about 4 billion people choose to pay through WeChat (Zhou, 2015). The business of WeChat covers the fields of selling, communication, finance, government, logistics, media and so on. The traditional E-business giants, such as Amazon, JD.COM, Suning.com and GOME, are fighting for the WeChat. WeChat is becoming another big business platform. WeChat has the feature of popularization and young. In terms of age, the average age of users is 26 years old. 97.7% users are under 50 years old and 86.2% users are between 18 to 36 years old. The young users pursue life quality and convenience, so they are the real potential consumers (Wei and Xu, 2014).

4.3. Developing the logistic

Except logistic, E-business can be operated on internet. The quality of logistic has a great influence on the ethnic minority areas to its E-business. That is to say, logistic is the bottleneck to E-business. The "last kilometer" is brought about by JD.COM according to this issue. The reason for high logistic cost in Qujing is the small logistic company. It has not come to scale operation. Thus, in order to reduce the logistic cost, the major method is to enlarge the company scale. Qujing can enlarge the company scale through the reorganization according with the market discipline. In addition, Qujing can achieve scale economy, reduce logistic cost and accelerate the transformation and upgrade of logistic enterprise through investment invitation and introduction of large-scale logistic company.

4.4. Government enhance the support to the ethnic minority areas

Government should support the ethnic minority areas in policy and capital. Government should encourage the ethnic areas to better its E-business and highlight the national characteristic products. The merchant in these areas should increase the occupations on the large platforms such as tmall.com, JD.COM and so on. In addition, in order to win the trust of the consumers, they should provide consumers with high quality service and no reason to return right. What's more, they should enlarge the selling platform and diversify the national characteristic products (Liuwei, 2016).

4.5. Increasing the propaganda of E-business to ethnic minority areas

Despite the distrust of E-business among a small part of ethnic minorities, part of the civil servants, teachers, businessmen, workers and especially students have already shopped on line. And the transmission function of the Moments accelerates the E-business in these areas. Government and E-business websites, especially the agriculture E-business websites, should encourage farms to shop on the E-business sites. When farmers get benefit, they will accept the new shopping method of E-business and accelerate the E-business in ethnic minority areas (Chen and Li, 2015).

5. Conclusions

The E-business in Qujing ethnic minority area is facing the problem of poor infrastructure, lack of E-business personnel, weak sense of E-business idea and poor logistic system. If the problems mentioned above are solved, people in these areas get benefit and work under the scientific direction of E-business personnel, the E-business of Qujing will be better and better.

Acknowledgment

This paper is supported by three project funds:

1. Yunnan province education department scientific research fund project in general (Project number: 2015y432);
2. National College Students Innovation and entrepreneurship training program of Ministry of Education of the People's Republic of China in 2015 (Project number: 201510684001);
3. Qujing normal college scientific research fund special project (Project number: 2016zx001).

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Research on Government's Response Capability to Network Opinion on Public Emergencies: Measurement Model and Empirical Analysis

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Pages: 248–262

Abstract: Because of the drawbacks in the current old, ineffective and inefficient ways of coping with public opinion, the paper tends to summarize the key elements of government coping ability based on the characteristics of domestic public emergencies and tries to build the initial concept measure index system towards government ability in coping with public opinion on emergency. Then by applying rough set theory, fuzzy C-means clustering and other theoretical methods to discretize the index data, the original secondary index was reduced to 13. Finally, based on questionnaire data, a regression analysis model was built to explore indices' significance. A measurement index system of government response capability consisting of five first-level indicators such as authority, accuracy and transparency, and 11 second-level indicators such as response level, situation guidance and professional level was established. And the empirical results showed that the index system was effective and feasible.

Keywords: network opinion, government's response capability, public emergencies, empirical analysis.

1. Introduction

At present, our country is experiencing an important period where economy is developing rapidly. The economic structure change in interest's pattern and values highlights the social contradictions, resulting in frequent network emergencies. Via new media, the public have expressed their opinions around the natural disasters, public safety, corruption and other public emergencies. Under the new media environment, diffused and uncontrollable information communication, weakening doorkeeper role and public selfhood agenda-setting, all these factors caused the traditional government guide inapplicable, which challenged the traditional methods and thus brought a great

impact on the government response capability on network opinion (Tsai, 2016, Sá et al., 2016).

Facing the high rocketing network public opinion, governments at all levels basically followed the traditional media management philosophy, mainly by means of technology to control network media content and source of information (Shao and Wang, 2016). What's more, government strengthened supervision and controlled censorship on the network public opinion and the Internet information content and finally formed the Internet governance structure basing on the content management (Xu et al. 2013). However, in the process of the government dealing with the network opinion, there are still some problems, for example their negative attitude, improper measures and low efficiency. From the domestic emergency cases, the academia carried on research on the characteristics and evolution of network public opinion, Internet users' network voice and behavior, network communication carrier, Internet space served as public area together with the management path and mode by referring to crisis management and public management theory. Although domestic and foreign scholars analyzed the characteristics, types, process in which government dealt with the network public opinion from the theoretical, practice and macro aspects. Though most of them proposed countermeasures in theory, however, there still lack of structured and quantitative analysis to practice as policy design tools (Su, 2015).

Therefore, to solve these problems, combined with characteristics of public emergencies, it is conducive to carry out effective strategy of government's response to the network public opinion under new situation to improve the management level on network public opinion and virtual social management mode. And it also has important practical significance and theoretical value to establish and improve the comprehensive management of social system.

2. Related research

The interactive, open and grass-roots characteristics of public opinions spread of new media pose new challenges for management of public opinion on emergencies. The fixed top-to-bottom management mode on public opinion, when applied to Internet public opinion management, demonstrates some problems like shortage of emergency preparedness, excessive information control, the lack of mainstream media guide, the out-date means of dictation and analysis, and so on. Thus, Chinese government began synthetically using legislative, administrative and technical means and applied network monitoring and analysis of Internet and regulation on public opinion. While classical communication theory is hard to explain the communication practice of networks and their potential impact on the public opinion and so it fails to provide theoretical support for online public opinion guidance and response. Because of these defects, scholars begin to study the public opinion on Internet from management, response, detection, guidance and control from the perspective of government by using the theory of public management and good governance, and by adopting the methods of system dynamics, game theory, differential equations, etc. (Hofmann et al, 2016).

Li and Wang (2014) used a structured description method to analyze the generation of public opinion and its spread dynamic system and then established structure description frame of the Game relationship and the decision behavior, and adopted the evolution game theory to study the Game relationship of the public and the public with the Government; and finally the case has proven the effectiveness of this model.

Yu et al. (2015) proposed the netizens--Internet media--Government model of network public opinion emergency for Government based on system dynamics, with the emergency of the water chemical pollution as empirical object, exploring the regulation of Internet public opinion spread and evolution as well as the effective strategy of emergency management, and he held the view that the improvement of official news transparency, Government crisis processing efforts, and Government response efficiency can control and guide Internet public opinion from diffusion and spread effectively.

Based on capacity views, Chen and Ye (2013) established a system dynamics model of the government response capability on the Internet public opinion by using the theory of system dynamics from four dimensions of Government, netizens, Internet media and traditional media. The simulation results showed that, timely and accurate response of public demands, improving the governments' attention on public opinion and response speed and credibility can effectively enhanced governments' efficiency and effect.

As it can be seen from the above analysis, the government response ways on public opinions have been changing with the change of transmission mode, the shifting of modern society and the change of public opinion expression. Therefore through the case study, this paper tries to define the concept of the government's response capability on network opinion and establish a concept model from the capacity views.

3. Construction of the concept model of the government response capability to network opinion

3.1. Government response capability and its key elements

Many scholars described government response capability to network opinion from emergency management, government functions and other aspects, but has not yet achieved a unified definition. For example, Cao and Huang (2015) thought that emergency management ability means the local governments' response performance with collaborative departments shown in natural disasters and emergencies, fulfillment degree of public safety responsibility and public management functions in risk society. It reflects the subjective conditions and the comprehensive quality of the government emergency management. Du (2013) hold that "Government response capability" is the comprehensive ability when facing with a challenge from network opinion supervision, all levels of government organs and their staff should effectively mobilize the most social resources to carry out prevention, detection, analysis, treatment and rehabilitation of the network public opinion crisis in a relatively short period of time, real properly collect and disclose public information, scientifically and effectively construct and execute system, as well as communicate and coordinate well.

References	Definition	Critical Factor
Xie (2009)	It is the ability of the government to provide effective public goods and service in time to the public according to demand.	Timeliness; the level of service
Hu, and Huang (2010)	It is the ability of the government to meet the proper requirements of society by public power and social resources within its own duty.	Reaction; response
Wang (2004)	It is the ability of the county government to react to the changes of society.	Response
Niu, et al. (2003)	It is the ability of the government to deal with emergencies, to react without delay aimed at minimizing the loss while facing public emergency events.	Timeliness; comprehensive management; the level of service
Cao, andHuang (2015)	It is behavior of the local government along with its synergetic departments in reacting and dealing with natural calamities and public emergencies and the level of performing in public secure duty and public management function in a risk society. It reflects subjective conditions and comprehensive diathesis of government emergency management.	Coordination; comprehensive diathesis
Qi, andLi (2008)	It is the management of details in the government in dealing with emergencies, including the predictions, estimates, control and others after the emergencies.	Prediction; supervision;control
Han (2007)	The essence of government emergency management is the function that the government exerted in resource action and spirits capacity in public emergencies.	Openess; government image
Du (2013)	Facing the challenge of network supervision of public opinion, the ability to mobilize the most social resources effectively in a relatively short period of time to carry out prevention, detection, analysis, treatment and rehabilitation of the network public opinion crisis. Also to properly collect and appropriate disclosure of public information, ability of executive ability construction of science the effective system, comprehensive ability and good social communication skills etc..	Timeliness; information disclosure; communication and coordination

Table 1 – Critical factor of government's response capability

In order to reflect the consistency and prevent confusion, this paper deals with the concept of government response capability and key elements of network opinion through the relevant literature review, the use of content analysis method to refine the connotation and key factors. Table 1 lists some concepts of government response capability to network opinion.

From Table 1, this paper holds, government response capability to network opinion is the ability to deal with network opinion in the Internet era. It is a creative ability for governments to keep its energy, adapt to always changing online environment, insist on people oriented, and realize the value of the whole society. The response capacity of network opinion government consists of many factors such as timely response, open information and emergency coordination.

3.2. Index system construction

In the process of government's response to network opinion, if there are no scientific and reasonable indicators to measure government's response capability to network opinion, and no dynamic reflections of government's response capability in different stages of network opinion evolution, not only the response to network opinion cannot achieve the corresponding effect, but also the government will lose enthusiasm due to the difficulties of responding. Due to this reason, based on the concept and key elements of the government's response capability to network opinion and combined with the case summary, this paper holds that when disposing such network opinion arising from public emergencies, government departments at all levels should be concerned about the emotions and aspirations of public Internet users, publish relevant information content of emergencies efficiently and effectively to make information open and transparent, as well as enhance their credibility by coordinating with related departments and responding in accordance with specified procedure. By integrating common points of different perspectives, this paper considers authority, exactitude, diaphaneity, trust, timeliness, standardization, coordination as the key elements of the effectiveness of government's response capability to network opinion on public emergencies, namely, seven basic dimensions.

Target Layer	First Level Index	Second Level Index
Government's capability to response to network opinion	Authority(I1)	Response hierarchy(I11)
		Affair Guidance (I12)
		Official accountability (I13)
	Exactitude(I2)	Professional level (I21)
		Network public relations(I22)
		Media literacy(I23)
	Diaphaneity (I3)	Information disclosure(I31)
		Press conference(I32)
		Media coverage(I33)
	Trust (I4)	Service quality(I41)
		Actions by regulation(I42)
		Integrity degree (I43)
	Timeliness (I5)	Speed of response(I51)
		Response attitude(I52)
		Response frequency(I53)
	Standardization (I6)	Regulatory framework(I61)
		Emergency plan(I62)
		Resource reservation(I63)
	Coordination(I7)	Information sharing(I71)
		Department linkage(I72)
		Professional institutions(I73)

Table 2 – Index System of response capability to network opinion on public emergency (preliminary)

Embarking on the above seven basic dimensions and based on plenty of literature reference and analysis of typical public emergencies, this paper establishes an index system to measure government's response capability which is composed of 7 first level indexes and 21 second level indexes (as shown in table 2).

4. Government's response capability measurement

The initially constructed index system (Table 2) consists of some major information of response to network opinions on public emergencies. However, there is often a strong correlation and repeatability among indexes and a wide range of indexes will affect the efficiency and exactitude of the calculation of indexes. Therefore, this paper uses rough set to simplify the original index system, and improve the efficiency of response capability measurement.

Rough set is a mathematical tool to describe the incompleteness and uncertainty, which can analyze imprecise, inconsistent, incomplete and all kinds of imperfect information efficiently and can carry out the identification of the equivalence relation, attribute reduction and implicit knowledge discovery under the premise of retaining information (Pawlak, 1982). Compared with analytic hierarchy process, fuzzy comprehensive evaluation, neural network, etc., rough set doesn't need any prior information such as fuzzy membership function, basic probability assignment and relevant statistical probability distribution other than a decision table. Under the premise of retaining the key categories of knowledge, it can reduce attributes, simplify decision table and find minimum expression of classification knowledge by identifying and evaluating dependency relations, so as to overcome the shortcomings of traditional methods, such as strong subjectivity, poor testability and so on (Hu et al. 2001; Hu and Yi, 2016).

Based on the characteristics of rough set above and combined with the uncertainty of evaluation of response capability to network opinion, this paper simplifies the initial indexes of government's response capability to network opinion on public emergencies, screens and refines minimum index set for classification knowledge of government's response capability to network opinion on public emergencies by referring to attribute reduction algorithm of rough set for reference, so as to improve the calculation efficiency of evaluation and prediction.

4.1. Building decision table system

Based on network opinion monitoring data from People's Daily and public opinion database of Communication University of China, according to rough set theory, the measurement of response capability to network opinion on public emergencies can be abstracted as 4 tuples: $S = \langle U, R, V, f \rangle$. Decision table S is an evaluation system of government's response capability to network opinion on public emergencies (as shown in Table 3). $U = \{e_i | i=1, 2, \dots, m\}$ is discourse domain, which is composed of emergencies e_i . R is an attribute set, with $C = \{I_i | i=1, 2, \dots, n\}$ being condition attributes, I_i being the i th index and $D = \{d\}$ being decision attributes. V is the domain value of attribute indexes. $f: U \times R \rightarrow V$ specifies every attribute value of e_i in the U .

4.2. Attribute discretization

Before doing attribute reduction via equivalent class relation in rough set theory, attributes must be discretized into a finite number of semantic symbols. Commonly used discretization methods include the equal distance method, the equal frequency method, etc. (Zhang et al. 2005). Equal distance (equal value domains of continuous attributes) and equal frequency (each discrete interval with the same object) are common unsupervised discretization algorithms. Though easy to implement, they can't set the interval boundary on the most appropriate breakpoint because of ignoring the sample distribution information, therefore data discretization performance are influenced (Wang 2007).

For this reason, this paper uses Fuzzy C-means clustering analysis method to discretize attribute value. On the basis of maintaining the distribution characteristics of the original sample, it aims to divide similar samples into a class and distinguish dissimilar samples. It provides discrete value of data, center of each fuzzy region and degree of membership of each attribute values in cluster center and takes the class number of each column attribute value as the characteristic values after the discretization, which are often described as "1", "2", "3". Based on the algorithm, by applying the fuzzy logic toolbox in matlab to complete the operation of the cluster. Index system after discretization is as shown in Table 3.

	e1	e2	e3	e4	e5	e6	e7	e8	e9	e10
I11	3	1	1	1	3	3	2	2	2	2
I12	3	2	1	1	3	2	2	1	2	1
I13	3	3	3	1	3	3	2	2	1	2
I21	3	2	1	2	1	2	2	2	2	3
I22	1	1	2	2	2	1	1	2	2	2
I23	2	1	1	1	3	2	2	2	2	3
I31	2	2	2	3	2	2	2	3	1	1
I32	1	2	1	3	1	1	2	3	1	1
I33	1	2	2	3	1	1	2	3	1	1
I41	1	2	2	3	2	1	2	1	1	1
I42	2	1	3	1	3	1	2	3	2	1
I43	1	2	2	3	2	1	2	3	1	1
I51	1	1	2	3	2	1	1	3	1	1
I52	1	1	2	3	2	1	1	3	1	1
I53	1	1	2	3	2	1	1	3	1	1
I61	1	2	2	3	2	1	2	3	1	1
I62	1	2	2	3	2	1	2	1	1	1
I63	1	2	2	3	2	1	2	3	1	1
I71	1	2	1	3	1	1	2	3	1	1
I72	1	1	1	3	1	1	2	3	1	1
I73	1	1	2	1	2	1	1	1	1	1
d	1	4	4	4	0	0	3	3	3	2

Table 3 – Index decision table after discretization

4.3. Index selection based on the discernibility matrix

Definition1: Decision table $S = \langle U, R, V, f \rangle$, discourse domain $U = \{e_i | i=1, 2, \dots, m\}$, attribute set $R = C \cup D$, condition attribute $C = \{a_i | i=1, 2, \dots, n\}$, decision attribute $D = \{d\}$, $a_i(e_j)$ is the value of the object e_j in the attribute a_i , $C_D(i, j)$ represents the element of row i , column j in an identifiable matrix, and discernibility matrix C_D :

$$C_D(i, j) = \begin{cases} \{a_k \mid a_k \in C \wedge a_k(e_i) \neq a_k(e_j)\}, & d(e_i) \neq d(e_j); \\ 0, & d(e_i) = d(e_j). \end{cases} \quad (1)$$

After the discernibility matrix is obtained, decision table can be simplified. Specific steps are as follows:

Step 1: Based on given discourse domain, construct the corresponding decision table S .

Step 2: Calculate the discernibility matrix C_D of decision table S .

Step 3: For every element $C_D(i, j)$ of a non-empty set in discernibility matrix, establish corresponding expression of disjunctive logic $L(i, j)$

$$L(i, j) = \bigvee_{a_i \in C_D(i, j)} a_i \quad (2)$$

Step 4: Put all the disjunction logic expressions $L(i, j)$ in conjunction operation and get the conjunctive normal form L

$$L = \bigwedge_{C_D(i, j) \neq 0, C_D(i, j) \neq \Phi} L(i, j) \quad (3)$$

Step 5: Transform conjunctive normal form L to the conjunctive normal form L' ,

$$L' = \bigvee_i L_i \quad (4)$$

Step 6: Output the result of attribute reduction. Attributes in every conjunctive items form a condition attribute set after reduction.

Based on the concept of discernibility matrix, according to formula (1) to (4), an index system reduction is done. Here we take authority, a first level index, and its second level index I_{11} , I_{12} , I_{13} as an example (as shown in Table 4.). And then, we construct discernibility matrix C_D according to formula (1) (as shown in Table 5). According to Table 5, we get expression of disjunctive logic:

$$L_{1,2} = I_{11} \vee I_{12}, \quad L_{1,3} = I_{11} \vee I_{12}, \quad L_{1,4} = I_{11} \vee I_{12} \vee I_{13}, \dots, L_{9,10} = I_{12} \vee I_{13}$$

Get the disjunctive normal forms L'_H , using formula (2) - (4)

$$L'_{I_1} = I_{11} \vee I_{12}$$

The three main implications of the formula are all reductions, and attribute reduction {I11, I12} is obtained. Combining the result of case analysis, this paper considers I11, I12, i.e. Response hierarchy, Affair guidance as the second level index of authority.

e	I11	I12	I13	d
e1	3	3	3	1
e2	1	2	3	4
e3	1	1	3	4
e4	1	1	1	4
e5	3	3	3	0
e6	3	2	3	0
e7	2	2	2	3
e8	2	1	2	3
e9	2	2	1	3
e10	2	1	2	2

Table 4 – Authority’s first level index decision table

o	I11I12	I11I12	I11I12I3	o	I12	I11I12I13	I11I12I13	I11I12I13	I11I12I13
	o	o	o	I11I12	I11	I11I13	I11I12I13	I11I12I13	I11I12I13
		o	o	I11I12	I11I12	I11I12I13	I11I13	I11I12I13	I11I13
			o	I11I12I13	I11I12	I11I12I13	I11I13	I11I12	I11I13
				o	o	I11I12I13	I11I12I13	I11I12I13	I11I12I13
					o	I11I13	I11I12I13	I11I13	I11I12I13
						o	o	o	I12
							o	o	o
								o	I12I13
									o

Table 5 – Discernibility matrix C_d (under the first level index: authority)

By repeating the above steps, similarly, we can get attribute reduction of second level index of the six dimensions: exactitude, coordination, diaphaneity, timeliness, standardization and trust. It can be found that when deleting any index $I_j \in \{I22, I33, I41, I43, I61, I63, I73\}$ from network public relations (I22), media coverage(I33), service quality (I41), integrity degree (I43), regulatory framework (I61), resource reservation (I63), professional institutions (I73), $POS_{(C-\{I_j\})}(D) = POS_{(C)}(D)$.Therefore index I_j isn’t necessary to decision attribute d .Network public relations (I22), media coverage (I33), service quality (I41), integrity degree (I43), regulatory framework (I61), resource

reservation (I63) and professional institutions (I73) can be deleted from table and we can get an index system after reduction, which is made up of 7 first level indexes and 12 second level indexes, as shown in Table 6.

Target Layer	First level index	Second level index
Index System	Authority (I1)	Response hierarchy (I11)
		Affair guidance (I12)
	Exactitude (I2)	Professional level(I21)
		Media literacy (I22)
	Diaphaneity(I3)	Information disclosure(I31)
		Press conference (I32)
	Trust (I4)	Actions by regulation (I42)
		Speed of response (I51)
	Timeliness (I5)	Response attitude (I52)
		Response frequency (I53)
	Standardization (I6)	Emergency plan (I62)
		Information sharing (I71)
	Coordination (I7)	Department linkage(I72)

Table 6 – Index system of government’s response capability to network public opinions (after reduction)

5. Empirical analysis

To test the effectiveness of government’s response to network public opinion, this paper takes the rankings of 2011-2012 local government’s response capability to network opinion released by *People’s Daily* (www.people.com.cn). Then this paper selects 50 network public emergencies from 2011 to 2012 to design corresponding questionnaires and distribute them to experts for assessment.

Lasting for 3 months, this questionnaire survey combines paper version questionnaires with electronic version questionnaires. Respondents cover domestic municipal governments and some middle-level cadres of state owned enterprises. 400 questionnaires are sent out, including 200 electronic version questionnaires and 200 paper version questionnaires. After 3 rounds of distribution, 273 valid questionnaires are received and the response rate is 68.25%. We use SPSS for data preprocessing, which can analyze the validity and reliability of each measurement variable and can get a factor loading matrix after rotation. As Table 7, the design of the questionnaire is reasonable and the questions can basically reflect the classification of the first level index. Besides, the validity of the second level index to first level index is reflected on the variance contribution rate of the first principal component. The higher the variance contribution rate is, the better the construct validity of the questionnaire is. A general criteria for variance contribution is 40%. The reliability of each variable can show the reliability of the questionnaire itself. From Table 7, we can find that the value of the reliability coefficient of each variable is between 0.7 and 0.9.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Cumulative contribution rate of the first principal component variance	Cronbach's α
X1	<u>.710</u>	.113	.261	.176	.101	.152	.230	60.170	0.70
X2	<u>.772</u>	.030	.142	.198	.166	.090	.185		
X3	.130	<u>.763</u>	.219	.157	.117	.265	.194	67.021	0.75
X4	.205	<u>.814</u>	.246	.039	.285	.219	.125		
X5	.071	.213	<u>.720</u>	.155	.129	.202	.175	68.283	0.76
X6	.214	.109	<u>.727</u>	.131	.046	.029	.173		
X7	.114	.203	.119	<u>.801</u>	.170	.220	.189	63.589	0.72
X8	.173	.037	.053	.283	<u>.716</u>	.102	.133		
X9	.106	.243	.032	.154	<u>.750</u>	.013	.119	71.301	0.79
X10	.162	.132	.253	.098	<u>.801</u>	.115	.177		
X11	.031	.129	.227	.150	.209	.710	.139	78.714	0.82
X12	.118	.292	.195	.071	<u>.085</u>	.294	.740		
X13	.220	.216	.171	.351	.047	.235	<u>.703</u>	65.385	0.74

Table7 – Validity and reliability analysis of factor loading matrix after rotation

According to the established index system above, we construct a multiple linear regression model between Network opinion incidents' effect and 13 second level indexes. As shown below:

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \alpha_{10} X_{10} + \alpha_{11} X_{11} + \alpha_{12} X_{12} + \alpha_{13} X_{13} + \varepsilon$$

In the formula above, Y represents the effect of government's response, which values 1 when positive while 0 when negative. Elements between α_0 and α_{13} are coefficients of the explanatory variables. X_1 to X_{13} represent response hierarchy, affair guidance, professional level, media literacy, information disclosure, press conference, actions by regulation, speed of response, response attitude, response frequency, emergency plan, information sharing and department linkage respectively. All variables are independent categorical variables. ε is error term, assuming that it is not related to the other independent variables.

During the regression, the 13 second level indexes of the index system after reduction and the effect of government's response are regressed and the result is shown in Table 8.

From the regression result in the Table 8 above, it is shown that the value of Multiple R -squared is 0.5941, which is close to 1. The value of adjusted R -squared of the sample after being adjusted by sample size and degree of freedom is 0.515, which means the reference value of correlation equation is high. The value of F -statistic is 3.318, showing

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.01524	1.10231	1.828	0.0763
X1	-1.04349	0.37162	-2.808	0.0082**
X2	1.06874	0.51787	2.064	0.04674.
X3	0.58302	0.40479	2.44	0.01189*
X4	-0.21024	0.40082	-2.525	0.0146.
X5	-1.27056	0.49299	-2.577	0.0447.
X6	1.90165	0.65962	2.883	0.00678**
X7	-0.544	0.4654	-0.169	0.24951
X8	1.62873	0.47995	3.394	0.00177**
X9	0.47167	0.35974	2.311	0.0816.
X10	-0.64745	1.32712	-2.488	0.01328*
X11	0.2436	0.3402	0.716	0.47827
X12	1.16292	0.51108	2.275	0.0113*
X13	-0.36445	0.71294	-2.511	0.01361*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1; Multiple R-squared: 0.5941, ; Adjusted R-squared: 0.515 ; F-statistic: 3.318 on 15 and 34 DF; p-value: 0.001843

Table 8 – Regression analysis results

that the possibility of existence of null hypothesis is true and $p\text{-value} < 0.01$. Generally, the index system is significant. According to the regression results, this paper comes to the following conclusions: (i) From the significance of the index, the regression result shows that 11 indexes are significant including response hierarchy, affair guidance, Information disclosure, press conference, etc. It shows that the effect of government's response is mainly affected by these factors. While the effects of actions by regulation and emergency plan on government's response capability are not significant, thus these two indexes, actions by regulation and emergency plan (X7, X11) are deleted. Meanwhile, these two second level indexes, actions by regulation and emergency plan belong to two dimensions, trust and standardization respectively. Therefore after general regression, the number of dimensions of index system of the ability to response to network opinion on public emergencies decrease from 7 to 5. The number of second level index decrease from 13 to 11 (as shown in Table 9). (ii) According to the results of regression, the significant indexes which have more impact on the effect of government's response are press conference, speed of response, response hierarchy, information sharing, affair guidance. It shows that if we want to improve the effect of government's response to network opinion on important incidents, the most important thing is to release information in time and to strengthen the guidance of the situation through sector linkage.

According to Table 9, the five dimensions of government's response capability to network opinion are timeliness, diaphaneity, authority, exactitude and coordination. Among these, timeliness is measured by the speed of response, response attitude and response frequency. Diaphaneity is measured by information disclosure and press conference, which means that after public emergencies, government should release related information to public,

Target Layer	First level index	Second level index
Index System	Authority (I1)	Response hierarchy I11
		Affair guidance I12
	Exactitude (I2)	Professional level I21
		Media literacy I22
	Diaphaneity (I3)	Information disclosure I31
		Press conference I32
	Timeliness (I5)	Speed of response I51
		Response attitude I52
		Response frequency I53
	Coordination (I7)	Information sharing I71
		Department linkage I72

Table 9 – Index system of government's capability to response to network opinion on public emergencies (final)

meanwhile it should decide whether or not to answer the public's concern by holding a press conference according to the order of priority. Authority is measured by response hierarchy and affair guidance, which means that relevant departments of government should respond and give positive guidance from the form of agenda after public emergency happens. Exactitude is measured by Professional level and Media literacy, which means that response personnel from government should be on the professional level and can give a keen judge on the development of the situation. Coordination is measured by information sharing and department linkage, which means every departments in government should keep the information exchange, be united in concert and respond jointly in order to avoid the phenomenon of different lines and buck-passing.

6. Conclusions

Facing the high rocketing network opinion, the government's response still have some problems at present like negative attitude, inappropriate measures, low efficiency and so on. Domestic and foreign scholars only analyze the characteristic and patterns of government's response to network opinion from theoretical level, practical level and macro level, which lack structural analysis and quantitative analysis and are inefficient in operation.

Considering the above drawbacks, we summarize key elements of government's response capability to network opinion and constructs an index system of ability to response including 7 first level indexes and 21 second level indexes. In order to improve the computational efficiency of evaluation index, based on attribute reduction algorithm of rough set theory, an index decision table is built, which discretizes index data, simplifies the original index system and simplifies the number of second level indexes from 21 to 13. Finally, based on data from questionnaires of 50 typical cases from 2011 to 2012, an empirical analysis is carried out by the regression model constructed. Finally this research establishes an index system of government's response capability to Network

opinion on public emergencies which is made up of 5 first level indexes including authority, exactitude, diaphaneity, timeliness and coordination and 11 second level indexes including response hierarchy, affair guidance, professional level and media literacy etc. The empirical result shows that the index system is feasible and effective. In the future the research should delve deeper into how to combine the index system with the evolution process of public emergencies so as to analyze government's response capability to network opinion dynamically, which will be of practical guiding significance.

Acknowledgments

The authors would like to thank the anonymous reviewers. The research supported by Key projects of the National Natural Social Science Foundation of China (Grant No. 14AZD045), the Ministry of education of Humanities and Social Science (Grant No. 13YJA630089).

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A Novel Bayesian Algorithm for Evaluation Lifetime Performance of Exponential Model

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Pages: 263–272

Abstract: The aim of this paper is to propose a novel Bayesian algorithm to product a quality test of exponential model. The presented test procedure is developed on the basis of Bayesian technique under LINEX loss function. Firstly, Bayes estimation of life performance index is derived by using the conjugate gamma distribution. Then an algorithm for posteriori probability ratio test is developed based on the posterior probability distribution. Finally, a practical example is discussed to prove the effectiveness and feasibility of the proposed algorithm.

Keywords: life performance index, Bayes estimation, LINEX loss function, posterior probability ratio, Bayes test.

1. Introduction

With the progress of science and technology as well as more sophisticated and complex products, people want to be able to guarantee the life of the products to enhance the competitiveness of the product and stimulate consumer's purchasing desire. Then manufacturers need to work more than ever to improve the product quality and the reliability of the evaluation. Process capability index is an effective and convenient tool for quality assessment (He et al, 2008; Lino et al., 2016), which has become the most widely used statistical process control tool in enterprise for promoting quality assurance, reducing costs and improving customer's satisfaction. Many process capability indices, such as C_p , C_{pk} , C_{pm} and C_{pmk} have been put forward (Juran, 1974; Kane, 1986; Chan and Cheng, 1988; Pearn et al, 1992). The statistical inferences of these process capability indices have drawn great attention. For example, Shiau, Chiang and Hung (1999) discussed the Bayesian estimation of C_{pm} and C_{pmk} under the restriction, which the process meaning is equal to the midpoint of the two specification limits. Pearn and Wu (2005) discussed the Bayes test of C_{pk} for a general situation without restriction on the process mean. Chen and Hsu (2016) proposed a likelihood ratio test to C_{pk} . Baral and Anis (2015) developed a generalized confidence interval method to measure the process capability index C_{pm} in presence of measurement errors. Macintyre (2015) studied the Bayesian estimation of the process capability indices for the inverse Rayleigh lifetime model.

In recent years process capability index has been widely used in process numerical strength and life of the product performance test, whose purpose lies in understanding process to meet specifications and quality requirements, and improve the manufacturing process as well.

Customers cherish the life of the product, and the longer the life of the product means the better quality, thus the quality of the product belongs to the larger-the-better type of the quality characteristics. With these regards, Montgomery (1985) proposed the use of a special unilateral specification process capability index, named as lifetime performance index C_L , to measure the product lifetime performance, where L is the lower bound of the specifications.

Most of the literature about the process ability index of statistical inference research assumes that the quality characteristics of the product obey a normal distribution. However, the life of the product often obeys the non-normal distribution, and even such distributions as exponential distribution, Pareto distribution and Weibull distribution. The process of competence evaluation is full of quality characteristics by following normal distribution under the assumption of the index. However, some quality characteristics don't obey normal distribution, but takes up the exponential distribution, Pareto distribution and Weibull distribution, in particular for the lifetime of the product, including electronic components, cameras, engine, and electrical appliances. Tong, Chen and Chen (2012) investigated the minimum variance unbiased estimator of the electronic component life under exponential distribution. Wu, Lee and Hou (2007) explored the maximum likelihood estimation of life performance under Rayleigh distribution, and developed a test procedure for evaluating the performance of the product. The studies mentioned above are all about the statistical inference problem of product process capability index under complete sample. However, when the reliability of the application of the products are being analyzed and improved, there is a need to do product sampling life experiment, because life test is usually destructive experiment, and such experiment is usually time-consuming and costly. Therefore, how fast and effectively can life test achieve, and how to save time and cost has become an important issue. In real life, due to the time constraints, manpower and cost considerations, the samples obtained are often referred to censored samples as they are incomplete. The progressively type II censored samples are expanding ones, which have attracted extensive attention from scholars in recent years (Ahmed, 2014). Yan and Liu (2012) proposed the product life obey index distribution of the fixed number of censored data under the lifetime performance index of P value test program, and take the example to illustrate the feasibility and effectiveness of the method. Wu, Chen and Chen (2013) under progressively type II censored life test and discussed the Rayleigh distribution product lifetime performance index of the maximum likelihood estimation, minimum variance without offset estimation and to further develop the corresponding product lifetime performance inspection procedures. Laumen and Cramer (2015) discussed the special index distribution of product family life performance of maximum likelihood estimation and testing procedure based on progressively II censored lifetime data. Lee, Hong and Wu (2015) discussed maximum likelihood estimation and hypothesis testing problem of lifetime performance index based on censored samples, which the lifetime of product from the normal distribution but sample data modeled by fuzzy numbers. All of the above are the statistical inference problem of product life performance under the classical statistical framework. However

along with the progress of the manufacturing technology, the reliability of the products becomes increasing high, while the censoring of data is very small. At this time Bayesian method can better deal with the statistical inference problem with small sample case model. However, there are few studies on Bayesian statistical inference about life performance index, and it is necessary to conduct in-depth research. Recently, Lee et al. (2011) studied the Bayesian estimation and testing procedures of lifetime performance index under squared error loss for Rayleigh distribution product. Liu and Ren (2013) obtained Bayesian estimation of lifetime performance index for exponential product under progressively type II censored samples and analyzed the practical example to demonstrate the product quality performance of the proposed Bayesian test program.

In this paper, we study the estimation of C_L in Bayesian approach, and the test procedure of C_L will also be constructed based on Bayesian approach. In Section 2, some properties of the lifetime of product with the exponential distribution are introduced. Moreover, the relationship between the lifetime performance index and conforming rate is also discussed. Furthermore, the Bayesian estimator of C_L on the basis of the conjugate Gamma prior distribution is also obtained under squared error loss and LINEX loss functions. A new Bayes hypothesis testing procedure is developed in Section 3, and a practical example and discussion is given in Section 4. Finally, a conclusion is given in Section 5.

2. Methods

2.1. Lifetime performance index

Let X be the lifetime of such a product whose lifetime distribution is exponential distribution with the following probability density function:

$$f(x|\theta) = \theta \exp(-\theta x) \quad , x > 0 \quad (1)$$

where $\theta > 0$ is the unknown scale parameter.

Obviously, a longer lifetime often implies a better product quality. In this case, the lifetime of components owns the character of the-larger-the-better quality. The lifetime is generally required to exceed some unit times, for example, we use L expressing the lower specification limit to both be economically profitable and satisfy customers. Montgomery (1985) proposed a capability index C_L to measure the larger-the-better quality character. The index C_L is defined as follows

$$C_L = \frac{\mu - L}{\sigma} \quad (2)$$

Here μ is the process mean, σ is the process standard deviation, and L is the lower specification limit. The capability index C_L is often called the lifetime performance index. Under the assumption of exponential distribution with pdf (1), we can easily derive the process mean $\mu = EX = 1/\theta$ and the process standard deviation $\sigma = \sqrt{\text{Var}(X)} = 1/\theta$. Then the lifetime performance index C_L can be rewritten as follows

$$C_L = \frac{\mu - L}{\sigma} = \frac{1/\theta - L}{1/\theta} = 1 - \theta L \quad (3)$$

The failure rate function $r(x)$ is defined by

$$r(x) = \frac{f(x|\theta)}{1 - F(x|\theta)} = \frac{\theta \exp(-\theta x)}{\exp(-\theta x)} = \theta \quad (4)$$

From the equations (3) and (4), we can see that the larger the mean $1/\theta$, the smaller the failure rate and larger the lifetime performance index C_L . Therefore, the lifetime performance index C_L reasonably and accurately represents the product performance of new products.

Moreover, if the lifetime of a product X exceeds the lower specification limit L , then conforming rate of the product can be defined as

$$P_r = P(X \geq L) = \int_L^\infty \theta \exp(-\theta x) dx = e^{-\theta L} = e^{C_L - 1}, -\infty < C_L < 1 \quad (5)$$

Obviously, conforming rate P_r and lifetime performance index C_L have a strictly increasing relationship. The relationships of P_r and C_L are shown in Table 1 by a list of various values. For the C_L values which are not listed in Table 1, the conforming rate P_r can be obtained through interpolation. The conforming rate P_r can be calculated

C_L	P_r	C_L	P_r	C_L	P_r
$-\infty$	0.00000	0.125	0.41686	0.575	0.65377
-2.25	0.03877	0.225	0.46070	0.625	0.72253
-2.00	0.04979	0.250	0.47237	0.700	0.74082
-1.75	0.06393	0.275	0.48432	0.725	0.75957
-1.50	0.08209	0.300	0.49659	0.750	0.77880
-1.25	0.10540	0.325	0.50916	0.775	0.79852
-1.00	0.13534	0.350	0.52205	0.800	0.81873
-0.75	0.17377	0.375	0.53526	0.825	0.83946
-0.50	0.22313	0.400	0.54881	0.850	0.86071
-0.25	0.28650	0.425	0.56270	0.875	0.88250
0.000	0.36788	0.450	0.57695	0.900	0.90484
0.025	0.37719	0.475	0.59156	0.925	0.92774
0.050	0.38674	0.500	0.60653	0.950	0.95123
0.075	0.39657	0.525	0.62189	0.975	0.97531
0.100	0.40657	0.550	0.63763	1.000	1.00000

Table 1 – The lifetime performance index C_L versus the conforming rate P_r

by dividing the number of conforming products by total number of products sampled (Tong and Chen, 2012). To accurately estimation, Montgomery in 1985 suggested that the sample size must be large. However, a large sample size is usually not practical from the perspective of cost, since collecting the lifetime data of new products need much money. In addition, a complete sample is also not practical due to time limitation and/or other restrictions (such as material resources, mechanical or experimental difficulties, etc.) on data collection. Since a one-to-one mathematical relationship exists between the conforming rate P_r and the lifetime performance index C_L . Therefore, utilizing the one-to-one relationship between P_r and C_L , lifetime performance index can be a flexible and effective tool, not only evaluating products performance, but also for estimating the conforming rate P_r .

2.2. Bayes estimation of lifetime performance index

As the population mean and standard deviation of the lifetime of production components are generally unknown, we need estimate them by some estimating methods. Let $X_1, X_2, \dots, X_n$ represent the lifetime of sample from the exponential distribution with pdf (1), which the likelihood function corresponding to pdf (1) is given by

$$l(x; \theta) = \prod_{i=1}^n f(x_i | \theta) = \prod_{i=1}^n \theta \exp(-\theta x_i) = \theta^n e^{-\theta t} \quad (6)$$

Here $x = (x_1, x_2, \dots, x_n)$ is the observation of $X = (X_1, X_2, \dots, X_n)$ and $t = \sum_{i=1}^n x_i$. Then we can easily show that the probability density function of T is

$$f_T(t) = \frac{\theta^n}{\Gamma(n)} t^{n-1} e^{-\theta t}, \quad t > 0 \quad (7)$$

which is called Gamma distribution, noted by $\Gamma(n, \theta)$. Assume that the conjugate prior distribution of θ is the Gamma prior distribution $\Gamma(\alpha, \beta)$, with pdf

$$\pi(\theta; \alpha, \beta) = \frac{\beta^\alpha}{\Gamma(\alpha)} \theta^{\alpha-1} e^{-\beta\theta}, \quad \alpha, \beta > 0, \theta > 0 \quad (8)$$

In Bayesian statistical inference, the loss function plays an important role, and symmetric loss function, such as the squared error loss $L(\hat{\theta}, \theta) = (\hat{\theta} - \theta)^2$ is widely used, which assigns equal losses to overestimation and underestimation. However, in many practical situations, overestimation and underestimation will make different consequents. Thus under such conditions, symmetric loss functions are inappropriate, Zellner (1986) proposed an asymmetric loss function known as the LINEX loss function and expressed it as

$$L(\Delta) = e^{a\Delta} - a\Delta - 1, \quad a \neq 0 \quad (9)$$

where $\Delta = \hat{\theta} - \theta$, and $\hat{\theta}$ is an estimator of θ , and a is a constant, which represents the direction and degree of symmetry respectively. When $a > 0$, the overestimation is more

serious than underestimation, and vice-versa. More details about Bayes estimation and loss functions can be found in paper of Zakerzadeh and Zahraie (2015), Ali S, Aslam Mand Kazmi S M A (2013), Galván, J. B., Recarte, L. and Pérez-Ilzarbe, M. J. (2014).

The posterior expectation of the LINEX loss function (5) is

$$E[L(\hat{\theta} - \theta) | X] = e^{a\hat{\theta}} E(e^{-a\theta} | X) - a(\hat{\theta} - E(\theta | X)) - 1 \quad (10)$$

The Bayes estimator of θ under the LINEX loss function can be solved by minimizing (10) and that is the Bayes estimator $\hat{\theta}_{BL}$ can be solved with the following form:

$$\hat{\theta}_{BL} = -\frac{1}{a} \ln[E(e^{-a\theta} | X)] \quad (11)$$

Assume that the expectation $E(e^{-a\theta} | X)$ exists and is finite.

Combining the prior distribution (8) with the likelihood function (6), the posterior density of θ can be derived as follows by using Bayes' theorem,

$$\pi(\theta | x) \propto \theta^n e^{-\theta t} \cdot \frac{\beta^\alpha}{\Gamma(\alpha)} \theta^{\alpha-1} e^{-\beta\theta} \propto \theta^{n+\alpha-1} e^{-(\beta+t)\theta} \quad (12)$$

Obviously, the posterior distribution of θ is Gamma distribution, i.e. $\theta | X \sim \Gamma(n + \alpha, \beta + t)$.

Then, (i) under the squared error loss function, the Bayes estimator of C_L is its posterior mean

$$\hat{C}_L = E(C_L | X) = E(1 - \theta L | X) = 1 - L \cdot E(\theta | X) = 1 - L \cdot \frac{n + \alpha}{\beta + T} \quad (13)$$

(ii) Under the LINEX loss function, the Bayes estimator of C_L is

$$\begin{aligned} \hat{C}_{BL} &= -\frac{1}{a} \ln E(e^{-aC_L} | X) \\ &= -\frac{1}{a} \ln \left[\int_0^\infty e^{-a(1-\theta L)} \pi(\theta | X) d\theta \right] \\ &= 1 - \frac{n + \alpha}{a} \ln \frac{T + \beta}{T + \beta - aL} \end{aligned} \quad (14)$$

3. Results

This section will construct a testing procedure by Bayesian approach to assess whether the lifetime performance index adheres to the required level. Assume that the required

index value of lifetime performance is larger than c , where c is the target value. First, we establish the null hypothesis $H_0 : C_L \leq c$ and the alternative hypothesis $H_0 : C_L > c$. Then the new proposed testing procedure using Bayesian approach about C_L is as follows:

- (i) Determine the lower lifetime limit L for the components and sample size are n .
- (ii) Calculate the Bayesian estimation

$$\hat{C}_{BL} = 1 - \frac{n + \alpha}{a} \ln \frac{T + \beta}{T + \beta - aL},$$

$$\text{Where } T = \sum_{i=1}^n X_i.$$

- (iii) Calculate the posterior odds ratio

$$BF = \frac{P(H_0 | X)}{P(H_1 | X)} = \frac{P(H_0 | X)}{1 - P(H_0 | X)},$$

$$\text{where } P(H_0 | X) = \int_{\frac{1-c}{L}}^{\infty} \pi(\theta | X) d\theta \text{ and } \pi(\theta | x) = \frac{\beta^{n+\alpha}}{\Gamma(n+\alpha)} \theta^{n+\alpha-1} e^{-(\beta+t)\theta}.$$

- (iv) The decision rules are provided as follows:

If $\hat{C}_{BL} > c$ and $BF < 1$, we reject to the null hypothesis $H_0 : C_L \leq c$, then it is concluded that the lifetime performance index or conforming rate of the products meets the required level;

If $\hat{C}_{BL} < c$ and $BF > 1$, we accept the null hypothesis $H_0 : C_L \leq c$, then it is concluded that the lifetime performance index or conforming rate of the products does not meet the required level.

4. Discussion

To illustrate the practicability and feasibility of the proposed testing method, a practical data set on the mileages at which $n=19$ military personnel carriers failed in service is analyzed, which is studied by many references (Grubbs,1971; Lawless, 2003). Table 2 will give the data set.

162	200	271	320	393	508	539	629	706	777
884	1008	1101	1182	1463	1603	1984	2355	2880	

Table 2 –The Data Set

Gail and Gastwirth (1978) have proved the data set can be modeled by exponential model based on Gini statistics. Next, we will give the steps of the proposed testing procedure about C_L as follows:

(i) From Table 2, we can get $t = \sum_{i=1}^n x_i = 18963$ and here we assume the lower lifetime limit $L = 171.0144$. To deal with the military's concerns regarding operational performances, the conforming rate P_r is required to exceed 0.80. Referring to Table 1, the value of C_L is required to exceed 0.80. Thus, the target value of performance index is set at $c = 0.80$, the testing hypothesis $H_0 : C_L \leq 0.80 \leftrightarrow H_0 : C_L > 0.80$ is constructed.

(ii) Under LINEX loss function, we get the Bayesian estimate $\hat{C}_{BL} = 0.8098$;

(iii) Suppose that the prior parameter values $\alpha = 2.0$ and $\beta = 3.0$, then

$$P(H_0 | X) = \int_{1-c}^{\infty} \pi(\theta | X) d\theta = \int_{0.0012}^{\infty} \frac{\beta^{21}}{\Gamma(21)} \theta^{20} e^{-(3+18963)\theta} d\theta = 0.3724.$$

So, posterior odds ratio is $BF = \frac{P(H_0 | X)}{1 - P(H_0 | X)} = 0.5934$.

(V) Obviously, $\hat{C}_{BL} = 0.8098 > c = 0.80$ and $BF = 0.5934 < 1$, then we can reject the null hypothesis $H_0 : C_L \leq c$. That is, we conclude that the lifetime performance index meets the required level.

5. Conclusions

Process capability indices are widely employed by manufactures to assess the performance and potentiality of their process. Lifetime performance index is one of the most important indices of all the proposed process capability indices. In this paper, Bayesian estimation and Bayesian test method of life performance index are presented. The new proposed testing method is easier than other classical approaches. This method can be similar to other life distribution, such as Rayleigh distribution, Lomax distribution. In practice, the method proposed in this paper is easy to use such programming software as Matlab to carry on the programming operation, and it can provide the enterprise with the simple and clear form. It can also provide reference for the enterprise engineers to evaluate whether the true performance of products meets the requirements.

Acknowledgments

This project is supported by JK Project of Special Project of Fujian Provincial Colleges and Universities Foundation in China (No. JK2015026), National Social Science Foundation of China (No. 14AGL003), National Science Foundation of China (No. 71661012), Soft Science Project of Fujian Natural Science Foundation of China (No. 2016R0074), Young Doctoral Project of Social Science Foundation of Fujian Province of China (No. FJ2016C188), and the General Project of Young and Middle-aged Teachers Education Scientific Research Projects of Fujian Province of China (No. JAS160294).

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A Research on Working Status Model and Failure Mode of Automotive Hydraulic Brake System

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Pages: 273–280

Abstract: Over the past years, high-quality productions and high-level service strategy have already become the important factors for the auto industry competition. With the development of the computer technology and information technology, especially the launch of the National Information Infrastructure, ITS becomes the important research and development direction of the auto industry. Vehicle Condition Remote Monitoring and Fault Prediction System as the important elements contains practical and profound meaning of the researches. This paper takes the automotive hydraulic brake system as example, first it analyzes the dynamic working process of automotive hydraulic brake system and establishes the whole motor model; then, it improves the model and analyzes the possible factors which influence the model; finally, it analyzes the common fault mode and reasons of automotive hydraulic brake system. On that basis, it ensures the monitoring parameters and methods, laying a good foundation for Vehicle Condition Monitoring and fault prediction.

Keywords: king Status Model, Failure Mode, Automotive Hydraulic Brake System

1. Introduction

Vehicles condition remote monitoring system utilizes the mobile communication system and computers networks to monitor the running state, predict faults and diagnosis so that we could timely online measure vehicles' running state and quickly and accurately diagnose and analyze the vehicles' fault or the potential faults. The vehicles could get the technological service as soon as possible, nipping in the bud and ensure the running in a good condition. This way not only improves the reliability of the vehicles' overhaul and maintenance and eliminates the unnecessary wastes but also plays an important role in decreasing the traffic accidents and keeping the road fluency (Kwak and Choi, 2009). At the same time, the accumulated fault data as the first-hand reference materials improve vehicle development and design units and manufacturing units design, manufacture, assembly, and other departments. It is a tendency for the future to utilize and develop the system (Ma et al, 2014).

Vehicles' condition remote monitoring system suits to the complexity and variety of the vehicles' fault diagnosis. It plays the drive role in prolonging the common operating cycle, improving the maintenance quality, shortening the maintenance time (Han et al,

2015), reinforcing the feasibility and security of the vehicles 'running and decreasing and preventing the faults. Meanwhile, it also realizes the exchange, collection, copy, transition and long-term preservation of the expertized knowledge and experience (Liu et al, 2015). The massive original information recorded provided reliable reliance and back-office support in order to accumulate the experience on the vehicles' rational running and quick diagnosis. It also provides the information and resource about vehicle maintenance to improve the service quality (Tretsiak et al, 2008).

2. The brief introduction about automobile brake system

2.1. Definition of automobile brake system

The Brake System is means that a series of special devices to force braking to some extent by the outside making some force to the vehicles in order to make the drivers understand the road and transportation. It could decelerate or stop the running vehicles which could keep the downhill vehicles being stable and keep still of the paused vehicles. Vehicles' braking is one of the major function of the vehicles. One of the fine and feasible braking vehicles could give a full play of its dynamic performance.

2.2. Composition of the automobile brake system

Any brake system includes the four basic parts, as the figure 1 shown:

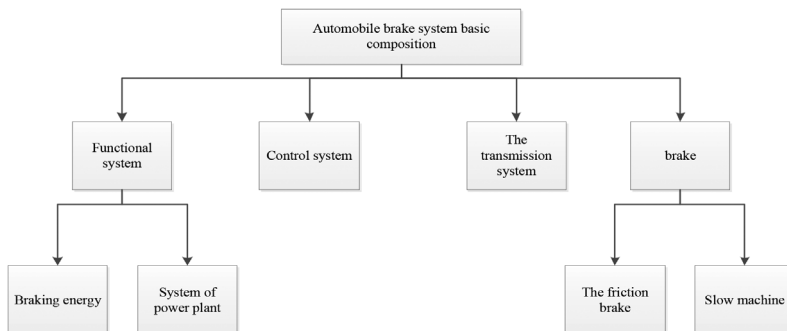


Figure 1 – Elements of braking system

1. Energy supplying device - including energy supply, the required energy for adjusting brake and every component for improving the energy Transfer control state.
2. Control device - including every components of generating braking action and braking effective.
3. Gearing device - including every components transmitting the energy to the brake.
4. Brake -the components which hinder the vehicles motion and movement tendency.

More perfect braking system also has an additional means braking force adjusting means and alarm devices, pressure protection devices.

3. Establishing the dynamic work model of the automotive hydraulic brake system

3.1. Establishing mentality of the dynamic work model of the automotive hydraulic brake system

In order to make the effective monitor of the Dynamic Work Model of the Automotive Hydraulic Brake System (Yu et al, 2015), it needs to create a working model of the dynamic automotive hydraulic brake system, in order to better analyze the status of the car is running.

Hydraulic braking system model input parameters and output parameters of the relationship shown in Figure 2. Each intermediate variables of braking system model are not easily measured, it could only measure as an intermediate variable, but not as a condition monitoring parameters. Therefore, the introduction of vehicle model and the tire model (Neelakantan et al, 2008), according to the established brake torque equation, the hydraulic brake system dynamic working model parameters and vehicle operating parameters closely together. As can be seen from the figure, the entire model input and output parameters are: wheel speed, vehicle speed, the slip ratio, the wheel angular deceleration, the brake pedal stroke.

Vetches' condition remote monitoring system suits to the complexity and variety of the vehicles' fault diagnosis. It plays the drive role in prolonging the common operating cycle, improving the maintenance quality, shortening the maintenance time, reinforcing the feasibility and security of the vehicles 'running and decreasing and preventing the faults. Meanwhile, it also realizes the exchange, collection, copy, transition and long-term preservation of the expertized knowledge and experience (Tretsiak et al, 2008). The massive original information recorded provided reliable reliance and back-office support in order to accumulate the experience on the vehicles' rational running and quick diagnosis. It also provides the information and resource about vehicle maintenance to improve the service quality (Patil et al, 2016).

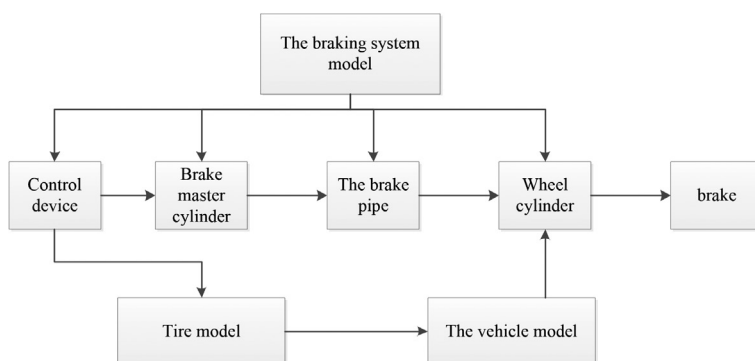


Figure 2 – Schematic about relationship of models

3.2. Establishing the running model of the Conventional braking process of the automotive hydraulic brake system

When establish a conventional braking system braking process modeling, we should be in line with the braking force and displacement of the transfer process, and then analyze. Firstly, we should establish the hydraulic brake system control device working model, and two parameters including the brake pedal and the brake pedal force displacement. After passing through the vacuum booster, the relationship between the brake master cylinder after cylinder (first) force and displacement at the input piston. Then, creating a dynamic model of the flow of brake fluid in the brake pipe. Finally, building a brake model. The calculation model is as follows:

- a. The relationship between brake pedal force and the vacuum booster input force:

$$F = \frac{F'}{i\eta \cos \alpha} \quad (1)$$

Equation: i -Brake pedal mechanism transmission ratio; h -Transmission efficiency of the brake pedal mechanism; $\cos \alpha$ -Brake pedal force and the horizontal angle (rad)

- b. The relational expression of first master cylinder piston F_m :

$$\begin{cases} F_m = 0 \\ F_m = F_o \\ F_m = (F \cdot i \cdot \eta \cdot \cos \alpha - f_c) \cdot \left(1 + \frac{D_x^2 + D_c^2}{D_c^2} \right) \end{cases} \quad (2)$$

- c. Brake pedal stroke calculation

The relationship between Vacuum booster input and output displacement:

$$\begin{cases} x_1 = 0 \\ x_1 = X' - F' \cdot \phi \\ x_1 = X' - \Delta S \end{cases} \quad (3)$$

Equation:

x_1 -Vacuum booster input displacement (m);

X' -First brake master cylinder piston displacement amount (m);

F' -Control valve plunger and the rubber reaction disk space (m);

f -Rubber reaction disk maximum deformation (m);

ΔS -the amount of deformation Unit reaction force of a rubber rod (m/N).

Substituting equation 1 into equation 2 to make simultaneous equation 3, then eliminating X' , then we could get the relation expression of X between the brake pedal stroke of the brake master cylinder piston displacement of the first X_1 .

$$x_1 = f(X) = \begin{cases} x_1 = 0 \\ x_1 = \frac{X}{i} - \delta - F' \cdot \phi \\ x_1 = \frac{X}{i} - \delta - \Delta S \end{cases} \quad (4)$$

4. Fault mode and parameter analysis of the automotive hydraulic brake system

4.1. Fault analysis of hydraulic brake system

Analysis	Not functional braking	Failed braking	Delayed braking	Deviated braking
Brake pedal	Excessive play		No free trip	Cup damage
Braking line	1. Piston oil spill 2. Compensation hole clogging 3. Valve damage	1. Badly worn piston 2. Compensation hole clogging	1. Return oil clogging 2. Return spring is too soft	Cup damage
Bake master cylinder	1. Piston oil spill 2. Aeration 3. Blocking 4. Aging hose swollen	Serious oil spill	Blocking	Blocking
brake cylinder	1. Oil spilling 2. Valve clampingstagnation 3. Apron aging 4. not drained air	Serious oil spill	1. Piston failure 2. Cup failure	Cup damage
Brake fluid	1. Brake fluid deterioration 2. Insufficient brake fluid	Serious oil spill	Excessive viscosity	
ABS system	ABS Fault indicator light			
vacuum booster	1. Vacuum valve leak 2. Insufficient degree of vacuum 3. Vacuum tube blocking			

Table 1 – Hydraulic brake system failure

Common faults of hydraulic brake system is not working brake, brake failure, brake dragging, Brake Steer and brake noise. In order to further the cause of the fault analysis and system fault monitoring can determine the required acquisition parameters. Here, the causes of the failure are classified in accordance with its members (as shown in Table 1).

4.2. Analysis on the fault predication parameters of hydraulic brake system

According the common fault mode of the hydraulic brake system, we analysed the fault predication plan and parameters aiming at the possible fault types and positions. This way is the precondition to achieve the fault predication and provides the reference to the experts for establishing the fault predication regulations. As the Table 5.1 shown, the reason of the hydraulic brake system is more complex and the reasons are intersected. During the fault predication process, first, from the point of economics, if we monitor all these fault predicated parameters, it needs a large number of sensors, so it is not proper. Second, from the point of the existing monitoring technology, some fault real time data are difficult to acquire and some data do not need acquire. So as to avoid to waste the manpower, material and financial resources.

4.2.1. Parameter analysis on Brake master cylinder failure prediction

As can be seen from Table 5.1, the brake master cylinder failure was mainly due to the brake master cylinder piston and the valve failure fault with the brake master cylinder connected components. When the piston rear brake master cylinder failure, the cylinder pressure cannot be established brake master cylinder, two brake lines of the first circuit are no brake pressure or lack brake pressure. The back brake master cylinder piston front directly is put on top of the piston, and then building up in the second loop by pushing the front cylinder piston pressure.

4.2.2. Parameter analysis on Braking lines failure prediction

As the Table 5.1 shown, the common failures of the baking lines are leakage and blocking. When a line leaks, the corresponded the other lines connected by brake master cylinder cavity cannot build up the pressure or lack pressure. When a line is blocked, it will only influence the establishment of itself pressure. Thus, when the monitor the failure of the baking lines, this work is finished by lines' pressure and master cylinder fluid level sensors.

4.2.3. Parameter analysis on Braking lines failure prediction

As the Table 5.1 shown, the common failures of the baking cylinders include mixed with air, the piston and cup failures. Generally speaking, when the baking cylinders mixed with air, the condensation of the air will prolong the baking systems operation time. If the piston failures, the single baking cylinder cannot establish pressure or lack pressure. If the cup failure, the single baking cylinder building pressure will be delayed. The baking cylinders failures always have a direct relation with cylinders' pressure. Hence, when monitoring the cylinders' working, cylinder is an important monitoring parameter.

5. Conclusion

This paper takes the automotive hydraulic brake system as example. After analyzing the dynamic working process of automotive hydraulic brake system, it established the whole motor model; analyzed the possible factors which influence the model; finally, it analyzes the common faults mode and reasons of automotive hydraulic brake system.

1. Through the establishing baking tire model we can get the tire adhesion coefficient variation on slip rate; through establishing the whole dynamical model, we could get the Brake torque on adhesion coefficient, wheel angular acceleration equation when baking.
2. On the basis of the analysis of the working process of the automotive hydraulic brake system, we could apply the Hydrodynamics and Hydraulic Drive related theories to establish the mathematical model of dynamic hydraulic braking system of the working process which regard brake pedal stroke as an input and the brake torque as output.
3. On the basis of the analysis of On the basis of the analysis of the working process of the automotive hydraulic brake system, we should explicit the faults reasons. According to the working process of the automotive hydraulic brake system, we could achieve the fault predication of the On the basis of the analysis of the working process of the automotive hydraulic brake system, combining the related monitoring of the parameters varied situation.

Acknowledgements

This paper was supported by a project titled “Research on the combination of virtual classroom and practical teaching of hydraulic transmission. Project Number is NJZY381.

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Research on the Application of Computer Multimedia Technology in Chinese Situational Dialogue Teaching

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Abstract: this paper starts from analyzing the principle of applying multimedia to primary oral Chinese teaching, designs multimedia teaching program by taking oral textbook “Holiday, Party” as blueprint, investigates the teaching effects of using media courseware, discusses the advantages and shortages of multimedia teaching and finally summarizes the precautions of multimedia teaching. This paper mainly discusses the application of multimedia in primary oral Chinese teaching as a foreign language and makes oral Chinese teaching as a foreign language more targeted, meets the learning features and requirements of learners in a better way and then improves the quality of oral Chinese teaching as a foreign language.

Keywords: computer multimedia, Chinese situational dialogue, Chinese teaching – oral Chinese.

1. Introduction

Oral teaching plays an important role in Chinese teaching as a foreign language. As a basic course, oral class is a bridge with which learners apply the learnt knowledge to realistic communication and is of great practical significance for students. Learners at primary stage hope to master the basic language knowledge and satisfy the need of daily life communication through study (Yuan and Zuo, 2013; Abreu et al., 2015). The oral learning is with strong purpose, so primary oral Chinese teaching as a foreign language is of great significance for the overseas students.

Learners at primary stage have language communication barriers and their sensitivity and flexibility for language is weak. In the teaching, it needs to set up a lot of communication scenes to create teaching atmosphere good for student understanding, while traditional teaching method is deficient in this aspect (Yang et al, 2013). In recent years, multimedia technology has been widely applied to Chinese teaching as a foreign language, which provides new ideas for solving above problems. Multimedia integrates functions of text, sound, image, animation and others together, which can create a lot of communication scenes requested by teaching and meet the teaching demands. Chinese teaching assisted with multimedia can motivate and inspire the enthusiasm, initiative and creativity of students and promote the improvement oral level of students.

2. Principle of multimedia applied to primary oral Chinese teaching

2.1. Principle of communication

Principle of communication is mainly presented in following two aspects in applying multimedia in primary oral teaching: First, oral teaching under multimedia condition needs to be contextual. The language teaching can't be separated from certain context, because the discourse separated from context does not have practical communication function and does not have discourse function. Second, primary oral teaching process under multimedia condition needs to be communicative (Wang et al, 2006). It means that the whole language teaching process is the process of making students to make language exercising in the language communication environment with adoption of multimedia creation simulation, which is to say language classroom teaching should create vivid language communication scenes, organize teaching activities based on scenes, exclude mechanical drilling and enable learners to drill in real communication (Selwyn, 2007).

2.2. Principle of intuitive

For Chinese learners at preliminary stage, they do not have a lot of perceptual knowledge for Chinese and lack conceptual understanding of pronunciation, vocabulary and grammar of Chinese; therefore, oral Chinese teaching at primary stage should take intuitive and vivid as teaching principle. The Chinese level of Chinese learner at primary stage is limited, barriers exist in communication between teacher and student, the more intuitive of teaching content and teaching method, the more useful to help them to establish direct relationship between language and objects and cultivate their ability of Chinese thinking. What intuitive teaching presented to learners is specific knowledge concept, which can avoid abstract knowledge concept bring about difficulties for their understanding effectively, help them to cultivate their learning interest and improve the learning enthusiasm.

2.3. Principle of interest

Multimedia is with interaction and great feedback function, whose application in oral teaching makes learners not listen and memorize passively, but participate in study with combination of eyes, hands and mind (Ma et al, 2005). Therefore, the students will not play the passive accepting roles and it breaks the situation which focuses on teacher activities and restricts the creative thought of students. For example, when explaining the nouns related to career, the teachers let students master all the new worlds (such as lawyer, doctor, entrepreneur) easily and happily through multimedia (as shown in Figure 1) to create interesting and vivid communication context and question based on the scenes displayed by multimedia (such as what does the mother want the son to do, what does the father want the son to do and what does the son finally say etc.), in this way, it can exercise the expression ability of students and let students to describe the content of the Figure in way of telling story.

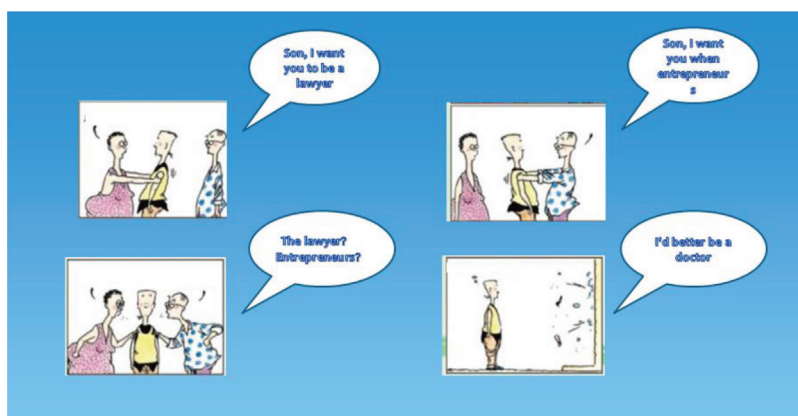


Figure 1 – Situational dialogue

2.4. Principle of science

Multimedia teaching method is with intuitive, diversified, real time, easy operation and other features, which provides practical auxiliary function for classroom teaching. However, the adopting of multimedia teaching method in teaching is not as much as possible; when available should be used properly based on teaching demand and classroom time. For example, in the process of oral teaching, when it needs to explain some animal nouns, such as panda, lion, tiger and giraffe etc, the teacher can use multimedia images to explain vividly and intuitively and make everything clear to students. For example, in primary oral teaching, it needs to set some communication scenes to provide topic context to students for their language communication, such as the scene of party. The teacher can also play a video related to this, which can inspire the interest of learners for language expression in a vivid and lively way. Therefore, in teaching design, it needs to plan when to display the requested content in class.

3. Case design for multimedia applied to primary oral Chinese teaching

3.1. Specific design for “Holiday, Party” multimedia teaching cases

1. Organization teaching

Greeting between teacher and students, the teacher transfers class information to students, attract their attentions and make preparation for the new class in way of questioning.

2. Introduction of new class

Teacher presents multimedia courseware and guides the student to enter the study of new lesson in way of questioning. Teacher displays target language (arrow pointing to the target language of students) with the answers of students step by step. The specific teaching steps are as following:

1. Display PPT (as shown in Figure 1) and ask what are these festivals?→They are Christmas and Spring Festival.
2. Display PPT (as shown in Figure 2) and ask what are they doing?→They are sending gifts and playing firecrackers.
3. Display PPT (as shown in Figure3) and add new words?→Sending gifts and playing firecrackers

The students may not be able to express the behavior of people in the Figure accurately, so it needs to add the new words that the test does not have.



Figure 2 – Look at the Figure speaking



Figure 3 – Make a sentence to practice

3.2. Learning and extension of new words and phrases (15 minutes)

This lesson has 44 new words. As the class time is limited, the teacher can't explain all new words in details, so the students need to study the new lesson in advance, which can not only cultivate the self-learning ability of students, but also make effective guidance for the problems appeared in the preview process in a targeted way.

When studying new words or phrases, the teacher uses PPT to present new words and phrases firstly (as shown in Figure 4), lead the students to read by one time and then the students follow by one time, correct the new words which have been pronounced wrong by students and make students understand the pronunciation of the new words in a deeper way (Igbaria et al, 1995); and then the teacher explains new words and phrases with combination of courseware and make the students understand the new words with combination of courseware and explanation of teacher. The teaching of new words and phrases mainly combines multimedia courseware display and teaching and questioning way of teacher together to inspire the students to speak out the words related to text, and then makes detailed explanation for the new words that students do not understand and offers examples or ask students to create new sentences independently (Vigdoret et al, 2014). Finally, ask students to read new words and phrases together and deepen the impression (Becker, 2000). Following is the detailed steps of new words teaching. Because they are new words and phrases, it needs to correct the pronunciation and exercise repeatedly.

1. Guide language of teacher: we just talked about spring festival and Christmas and we will learn some words related to festivals. Which word can express spending or celebrating festivals?-Festivity

Teacher asks question while displaying Figure with PPT.

Use PPT (as show in Figure4) to display Figures and ask do you like festivals?→All people like festivals.

Use PPT (as show in Figure4) to display Figures and ask what are they doing during holiday?→They are having dinner together.

Use PPT (as show in Figure4) to display Figures and ask what are they doing during holiday? →They are holding party.

What do we call the first day of the year?→New year

Teacher asks that party held during New Year holiday is called New Year's Party, what other parties do you know and display with PPT (as shown in Figure5).

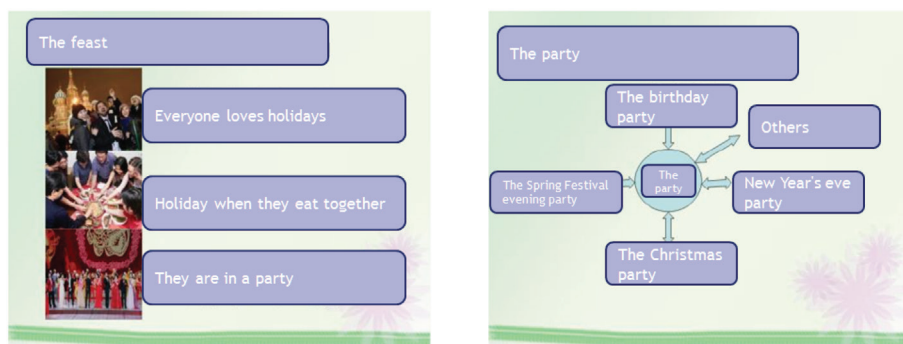


Figure 4 – Make a sentence to practice

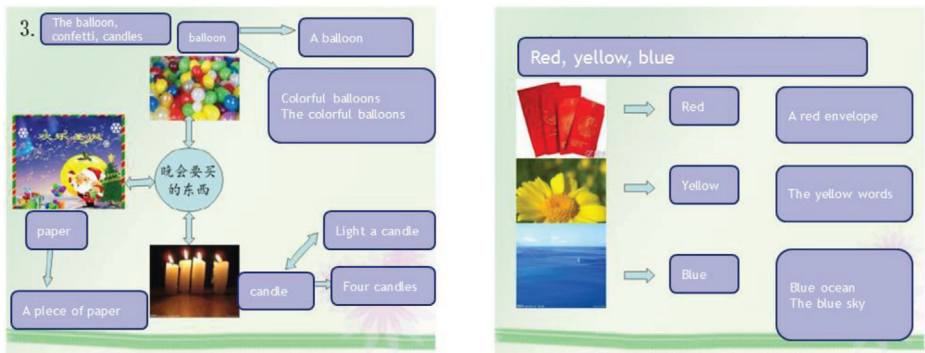


Figure 5 – Make a sentence to practice

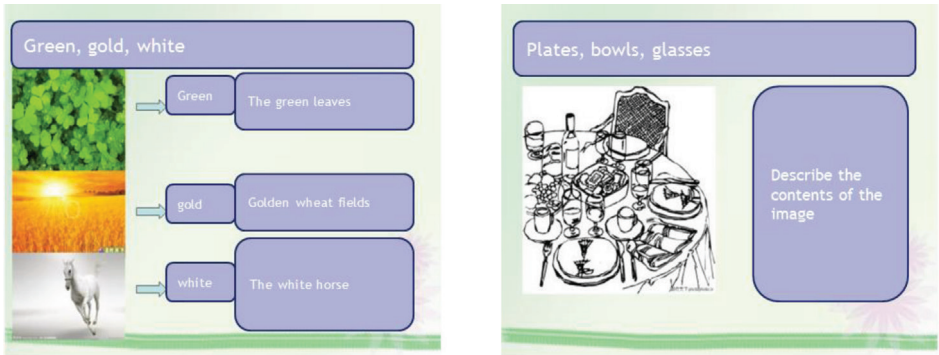


Figure 6 – Make a sentence to practice



Figure 7 – Situational dialogue

2. Guide language of teacher: what shall we buy for the evening party?

Teacher uses PPT (as shown in Figure5) Figure to lead the target language. Display target language one by one with the answers of students.

3. Guide language of teacher: what will be on table during meal?

Teacher uses PPT (as shown in Figure 6) Figures to lead target language and display target language one by one with PPT with the answers of students.

4. Guide language of teacher: let at this Figure, what are they doing?

Teacher uses PPT (as shown in Figure 7) Figure to lead target language, display target language one by one with the answers of students and then make extension.

3.3. Learning and extension of key sentences

Teacher displays multimedia courseware, offers scenes one by one and then guides the student to exercise the given sentence.

1. Do you want to buy...../or not?

This sentence is used to ask whether the people want to buy something. Such as: do we need to buy balloons? Do we need to buy candles?

1. Use PPT (as shown in Figure8) to display scene: my shoes are broken→My shoes are broken, do I need to buy a new pair of shoes/or not?
2. Use PPT (as shown in Figure 8) to display scene: my bike is lost ...→ My bike is lost, do I need to buy a new bike/or not?
3. Use PPT (as shown in Figure 9) to display scene: tomorrow is the birthday of my girlfriend ...→Tomorrow is the birthday of my girlfriend, do I need to buy a bunch of flowers/or not?
4. Use PPT (as shown in Figure 10) to display scene: Today is raining ...→Today is raining, do I need to buy an umbrella/or not?



Figure 8 – Situational dialogue



Figure 9 – Situational dialogue



Figure 10 – Situational dialogue

4. Several precautions of multimedia applied to primary oral Chinese teaching

4.1. Deal with the relationship between teacher and multimedia correctly

Multimedia has advantages in primary oral Chinese teaching, but the important role of teaching in teaching can't be ignored. As a teaching tool in primary oral Chinese teaching, multimedia plays an auxiliary role in teaching and can't replace the guidance role of teacher in teaching (Eteokleous, 2008). The teaching of any subject can't be separated from mutual cooperation and mutual communication between teacher and students and there is no exception for oral Chinese teaching. Primary oral Chinese teaching is with special features, on one hand, Chinese level of learners at primary level is limited and it needs specific guidance of teacher; on the other hand, oral teaching needs to follow the principle of communication, which also needs the communication between teacher

and students in class. Excessive use of multimedia will increase the gap between teacher and students, decrease dialogues between teacher and students on one hand, which is not good for students to contact real language environment to make communicative language training and impede the improvement of oral English level of students (Hasselbring and Glaser, 2000); on the other hand, students will become the objects of knowledge infusion and in a passive position, so that they can't participate in class actively. In the primary oral Chinese teaching, the teacher should play the guidance role, use multimedia to display vivid language material related to teaching content, inspire students to make active and initiative thinking and cultivate the interest of students in learning Chinese. Students can not only attain deep perceptual knowledge through study, but also feel fresh and interesting and realize that pronunciation is not as difficult as imagined and they can express their opinions in class actively (Eley, 2009). In this teaching process, multimedia plays a very important role, but the guidance of teacher is also indispensable. Teacher uses multimedia to assist oral teaching, at the same time, observes the pronunciation situation of each student and corrects properly, which are the functions not possessed by multimedia.

4.2. Deal with the relationship between student and multimedia in a correct way

One of the biggest features of multimedia is virtual character, which the communication scene created by multimedia can't replace the real language communication environment. For the overseas students, they can always communicate with others in class, but can't understand others in daily life and can't express themselves with own language, which causes that the communication activity can't be made smoothly. There are also some situations, where the teacher can understand what the overseas students want to express but the other people can't understanding (Eley et al, 2008). The reason for this situation is that the communication scene in classroom teaching is virtual and fixed, while the communication in real life is changing and students can't adapt the changing communication environment in reality. In certain perspective, the teacher should make full use of each scene and resources and build up real communication scene for students. For example, when setting the scene buying clothes in shop, to make the selected multimedia material closer to real scene, the teacher can shoot a video of one person shopping for clothes in advance, covering the plots of selecting clothes patterns, sizes, colors as well as payment. In this way, it is close to daily life scene setting for students and good for arousing the resonance of students.

5. Conclusions

With the development of science technology as well as people's continuous demand for education, establishing a new teaching mode meeting the cognitive law of students with combination of traditional teaching method as well as the introduced advanced education technology has become one of the important aspects of improving the quality of Chinese teaching as a foreign language. Applying multimedia technology to oral Chinese teaching as a foreign language can not only create good language learning environment for learners and inspire their learning interest, but also expand the information input amount, break the limitations of traditional teaching and then improve the efficiency of

class teaching and improve the oral level of learners. Compared with traditional teaching methods, multimedia teaching will continue to play its advantages, but we can't ignore its shortages. In multimedia class teaching, it needs to adopt multimedia teaching method in a timely and proper way, well deal with the relationship between multimedia and teacher, student and traditional teaching method and ensure the multimedia class carried out orderly.

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Research on Collaboration in Innovative Methods of Manufacturing Innovation Chain

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Abstract: For enterprises, independent innovation is the direction of sustainable development, while scientific innovation is the foundation and security of promotion in independent innovation ability. Based on the concept of traditional manufacturing chain, the work put forward the manufacturing innovation chain. Besides, it systematically introduced and discriminated different innovative methods corresponding to each stage of manufacturing innovation chain, such as demand analysis stage, creative scheme generation stage, technology R&D stage, knowledge materialization stage, product development stage, product manufacturing stage, market realization stage and their relative independence. What's more, based on innovation in the three dimensions of technology, management and market, we proposed a solution to deal with collaboration between different innovative methods. In the end, we propose enterprise's decision model for innovative methods application. The solution and decision model will provide enterprise with innovative methods, scientific basis and all-round support. With scientific use of the methods, innovation ability and performance of enterprise will be elevated comprehensively.

Keywords: Manufacturing chain, Manufacturing Innovative chain, Innovative methods, Collaborative effect.

1. Introduction

Manufacturing chain regards product realization as the goal. From the beginning of technology acquisition, technical results will be materialized into product design, through product manufacturing processes, to finally achieve the ultimate goal. The manufacturing chain, formed on the product life cycle, is a relatively mature concept, including product design and manufacturing. Because technological innovation plays an important role in manufacturing chain, scholars put forward the concept of innovation chain (Liu, 2009) and technology innovation chain (Cheng and Zhao, 2011; Peng, 2012). Besides, in order to realize the sharing and optimal allocation of manufacturing resources under the network environment, scholars propose the concept of collaborative manufacturing chain (Hu et al., 2003; Tian and Ji, 2009; Luo et al., 2011). Therefore, in the atmosphere of current knowledge-based economy, for enterprises, the ability of independent innovation has become the key to success. There are few researches on solutions to infiltrate innovation to all aspects of manufacturing chain. What's more,

it is still a problem to highlight the core role of innovation, R&D and knowledge of product in pre-manufacturing stage, and pulling effect of on the creativeness in post-manufacturing stage. Last but not least, it remains for us to all-round remodel old-fashioned manufacturing chain and build manufacturing innovation chain.

For enterprises, the implementation of independent innovation strategy is the direction of sustainable development, while scientific innovation is the foundation and security of promotion in independent innovation ability. Recently, scholars have undergone plenty of researches around the innovative methods from different perspectives. Firstly, Huang Qing et al. introduced the characteristics of various evolution theories in TRIZ technology, summarizing the limitations of existing researches (Huang Qing et al., 2009). Secondly, Shao Yunfei found that the Six Sigma (6σ) management model can complement TRIZ (Shao, 2010). Through analyzing the basis of integration between TRIZ and Six Sigma (6σ), he constructed the framework of the integration. Thirdly, Tian Qing discovered that the Osborn checklist method can significantly promote the creative thinking output (Tian, 2012). Lastly, Tang Yanqiu and Zhao Yaping proposed that knowledge map can effectively collect and organize the dominant and recessive knowledge resources in enterprise, so that the staff can more easily find required resources and experts of related fields through the map (Tang and Zhao, 2011). Besides, some scholars considered that innovative design, based on patent evasion, is an effective way to improve the independent innovation ability (Li et al., 2011; Jiang et al., 2012). Indeed, existing researches have positive effect on introducing the innovative methods and promoting the independent innovation ability, but with the defects of disorder. These innovative methods remain to be integrated into manufacturing chain, in order to play role in products and services. At the same time, it is still a problem to make use of their independent advantages while realizing their collaboration. According to the above analysis, the work built a kind of manufacturing innovation chain based on traditional manufacturing chain. On the basis of systematic analysis and comparison of various innovative methods, we put forward the collaboration method of three-dimensional innovation including technology, management and market, aiming at elevating technological innovation in capability and performance of the enterprise.

2. From “manufacturing chain” to “manufacturing innovation chain”

Manufacturing chain is a series of process. In the process, from the beginning of the technology acquisition, technical achievements will be materialized into product design. Finally, through manufacturing process, product will be produced. In a word, the chain represents the indivisible entire process from technology to product. Among the whole process, we can regard technology acquisition as the premise, product realization as the goal, and achievement materialization as the means. These three steps are organically interlocked with each other. A successful manufacturing chain gives birth to competitive products. With less stock and short production cycle, production cost will be reduced, whereas product quality will be improved. In that way, demands will be quickly responded, with promotion in competitiveness, at the same time. Therefore, effective operation of manufacturing chain plays a decisive role in the success of enterprise.

Manufacturing innovation chain refers to a functional chain structure model. Around an innovative core, the model is market-oriented, through knowledge-related activities to link the related participants. Its ultimate goal is to optimize intellectual economic process and innovation system. The chain is usually an innovative route throughout the entire product line, namely scientific discovery (professional basic research), R&D (Professional Applied Research), patented technology (innovation), new products or technology (application of experimental research and incubation of the results), large-scale production leading to the formation of goods (achievement industrialization) and product sales. The whole process is a chain structure involved in a scientific research, with each link participated by several subjects, starting from innovative ideas and ending with new product sales. To conclude, it reflects the promotion and transformation of knowledge in innovation activities.

For enterprise, the key to independent innovation is to transform traditional manufacturing chain into manufacturing innovation chain. The core concept is to emphasize the role of creativity, R&D and knowledge, and protrude the feature of high efficiency and low consumption in manufacturing system, as well as the pulling effect of the market.

3. Innovative methods of manufacturing innovation chain

Within the enterprise, manufacturing chain is not automatically transformed into manufacturing innovation chain. Applying innovative methods is an important way to realize the transformation. Specifically, manufacturing innovation chain includes

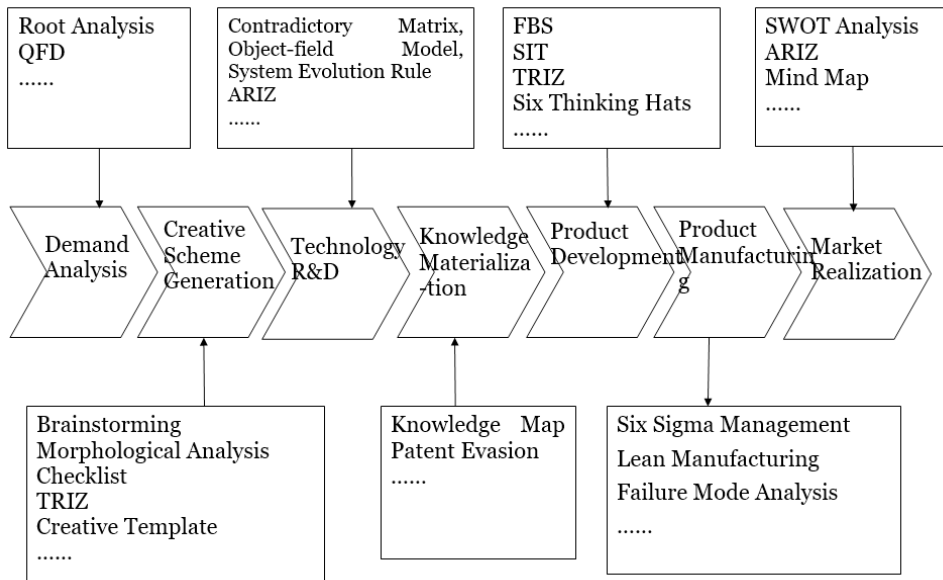


Figure 1 – Different innovative methods in manufacturing innovation chain

demand analysis stage, creative scheme generation stage, technology R&D stage, knowledge materialization stage, product development stage, product manufacturing stage and market realization stage. In different manufacturing innovation chain, there are different innovative methods (See Figure 1). These innovative methods provide innovative thinking and solutions for product design, manufacturing and sales from different perspectives, with relative independence between each method.

Demand analysis stage mainly includes root analysis and quality function deployment (QFD). According to customer's demand, two methods both provide support for follow-up product design, R&D and manufacturing stages. Although with the same purpose, the two methods are relatively independent. Specifically, root analysis focuses on problems of existing customer's demand, through decomposition to find the root causes and provide effective solutions. As for QFD, from the perspective of quality, the steps of product development, design and manufacturing should be driven by customer's requirements. Through improving quality awareness among staff in departments, final products will meet their requirements.

In creative scheme generation stage, conceptual design methods include brainstorming method, morphological analysis method, checklist method, TRIZ method, creative template and other creative generation methods. This stage is the core of the whole innovation analysis process, which can generate new knowledge. Indeed, these methods are conducive to the generation of creative schemes, but different from each other, because of their relative independence. Specifically, TRIZ focuses on solving the problem-oriented innovative designs (Huang et al., 2009); creative template method put emphasis on the vital of processing product-oriented innovative designs (Zhang et al., 2007); the checklist method deals with the problem in carrier-oriented innovative designs (Tian, 2012). Among those methods, brainstorming method is the most mature and comprehensive in existing studies. At the beginning, brainstorming method was just designed for inspiring creation in advertisement. Afterwards, this method has been widely used in management innovation, technology innovation, social issues processing, etc., requiring the user equipped with high level of experience. In order to cover all possible space of the entire solution, brainstorming requests that participant must be expert in the corresponding field. On contrary, TRIZ believes that the experience of participant is not the most important, but different levels of experience will give birth to different innovative products. Both TRIZ and brainstorming methods are based on empirical thinking. Compared with the traditional methods, TRIZ is a method that has solved similar problems in analogy applications, with its solving process mainly relied on logical thinking. To conclude, TRIZ is a systematic theory and methodology in solving the problem of innovation, while brainstorming and other methods only focus on one aspect of creative thinking without a complete theory. In comparison with other innovative methods such as TRIZ and brainstorming, the creative template method is characterized by strong target, easy operation, simplicity and high efficiency.

Product R&D refers to a series of research activities carried out by enterprises on new technologies and materials which is to be applied to new products and ideas. General speaking, the main innovative methods in the stage include contradictory matrix, object-field model, system evolution rule, ARIZ. Among these innovative methods, contradictory matrix and object-field model are used to solve the technical conflict in

the process of product innovation. The system evolution rule focuses on finding out the potential direction of product innovation by studying the law of product development, while ARIZ put emphasis on searching for solutions of product innovation by means of algorithms (Zhang, 2004).

Knowledge materialization stage is a process, which develop product ideas into real products. Through knowledge materialization to improve the function and knowledge content in the products, the ability to compete in market will be enhanced at the same time. Specifically, commonly adopted innovative methods include knowledge map and patent evasion, etc, which provide support for knowledge materialization from different levels. On the one hand, the knowledge map mainly provides intelligent support such as dominant and recessive knowledge from the resource perspective (Tang and Zhao, 2011). On the other hand, patent evasion provides patent protection from the technical level for already formed advantages, which is helpful in forming sustainable competitiveness. In a word, by use of navigation and nurturing function in knowledge map, plenty of new knowledge can be derived from recent situation (Li et al., 2011). To conclude, through rational use of patent evasion, enterprises can provide reliable protection for maximized functions and high-precised knowledge content of the products.

Product development stage means that through integration of a series of activities, brand-new concept will be actively introduced into existing market. Generally, commonly used innovative methods contain FBS, SIT, TRIZ and six thinking hats, etc. These methods evaluate the product from different perspectives, in order to improve the shortcomings of existing products or to deal with existing defects. Different from FBS, SIT, and TRIZ, six thinking hats provide a logical way of all-round thinking. On contrary, FBS, SIT and TRIZ aims at generating specific solutions to specific innovation. Besides, since SIT is an improved version of TRIZ, the two methods, defined by the basic criteria of product innovative design behavior, both regard creative behavior as a kind of accurate science. What's more, they belong to a series of comprehensive theoretical system, which consists of methods and algorithms in support of innovative design processes. However, FBS is a brand-new product, designed by function decomposition. It takes function decomposition as a solving process, in which we keep asking "HOW". That is to say, the lower function is the mean to achieve upper function, while the bottom level of function decomposition is the working principle (Fan et al., 2012). In the FBS method, function is an abstract description of behavior, the result of which is state changes. This method accords with human thinking character, in the way of transferring decomposition subject from function into behavior description.

Product manufacturing refers to a series of production activities, including technology analysis, production management and quality control, etc., which are conducted on new products. Commonly used innovations include six sigma management, lean manufacturing and failure mode analysis, etc., which are designed to improve product quality in manufacturing process, with the ultimate goal to enhance product competitiveness. However, these three methods are still different from each other, with their relative independence. When comparing six sigma management and lean manufacturing, In terms of the emphasis of solving problem, the former one focuses on eliminating variation in the process, to make it stable and reliable, whereas, the latter is based on pull-typed Just in Time production, to eliminate the waste at work and stock

during production activity. As for the process of solving problem, they have different driven factors when solving problem. While six sigma management is driven by data, lean manufacturing is motivated by observation. When it comes to the degree of systematic, lean manufacturing mostly relies on experts' experience. As a result, experts in lean manufacturing must firstly become experts in production site. What's more, lean tools are short of rigorous usage processes, as well as lacking the feature of systematic (Xu et al., 2008). On contrary, six sigma management advocates all available tool technology, in accordance with strict logic, forming a complete set of systematic problem-solving method. In that way, even if the operator is not an expert in some field, he/she can still quickly approach the solution. Failure mode analysis is to predict the failures, bad types or problems that may occur in product or service design procedure, and through evaluating their risk priority, to play a role in ex ante prevention. Different from six sigma management and lean manufacturing which only apply in product manufacturing stage, failure mode analysis can be used in any stage of product or process development. Specifically, the type of failure mode includes defects in design, manufacturing, quality management, usage and equipment maintenance.

Market realization stage refers to a process, in a changing market environment in order to satisfy the consumers and realize enterprises' targets through series of business activities closely related to the market, such as channel selection, promotions and sales, ultimately realizing products' economic value. The stage mainly includes SWOT analysis, ARIZ, mind map and other innovative method. SWOT analysis is the summary of enterprise's various aspects in internal and external conditions, so as to analyze the pros and cons, opportunities and threats of the organization. ARIZ is to solve various kinds of contradiction in procedure of market realization. As for mind map, it is used to guide and motivate marketing staff to develop brand-new sales scheme. When comparing the two methods of SWOT analysis and mind map, the former focuses on providing scientific analyzing tools for enterprises in formulating strategy and determining market position, whereas, the latter aims at simulating new sales scheme through inborn radioactive thinking. In a word, these two methods are all designed for promoting product market realization.

4. Collaboration of innovative methods in manufacturing innovation chain

For enterprises, there are different innovative methods in different manufacturing innovation chains. These methods refer to an evolutionary process developing from junior to senior stage, with problems to be solved more and more specific. Meanwhile, the obstacles faced by enterprises are multidimensional, involved in market, technology, management, etc. Although these innovative methods with relative independence, problems to be solved are organically linked with each other. Specifically, innovation in the manufacturing chain is a kind of three-dimensional innovation, in the aspect of market, technology and management. In the corresponding innovative methods, market innovation includes root analysis and QFD in demand analysis stage; brainstorming method, morphological analysis method, checklist method, TRIZ method and creative template in creative scheme generation stage. When it comes to technology innovation, it contains contradictory matrix, object-field model, system evolution rule and ARIZ in

technology R&D stage; knowledge map and patent evasion in knowledge materialization stage; FBS, SIT, TRIZ, and six thinking hats in product development stage. For management innovation, it refers to six sigma management, lean manufacturing and failure mode analysis in product manufacturing stage, as well as SWOT analysis and mind map in market realization stage.

From the perspective of system properties, innovation can be interpreted as collaboration between the above methods and innovative factors. According to the original Schumpeter's point of view, enterprise innovation should be with comprehensiveness, which includes new products, production methods with new technique, expanding virgin market, controlling new source of raw materials and new organization to realize industrialization. More specifically, that is the collaboration between each factor. In other words, the effect of " $1+1>2$ " (or $1+1=3$, $2+2=5$) which is difficult to be realized alone can be realized by the collaboration between the entities. With regard to enterprise management, effect of collaboration in different innovation of market, technology and management can not only increase but also create value. Whether it is innovation in technology or management, innovation should be tested and recognized by the market. In short, enterprises should provide the market with competitive products. Enterprise innovation is an integration of systematic factors, so that any single innovation cannot lead to success. In reality, a large number of facts prove that enterprises with strong innovation ability in an individual aspect may not have sustainable competitive advantage or rapid promotion. It is necessary to joint innovation in three dimensions of technology, management and market.

As mentioned above, manufacturing innovation chain has steps of demand analysis, creative scheme generation, technology R&D, knowledge materialization, product development, product manufacturing, market realization, etc. Each step in the chain has some relatively independent methods, which provide enterprises with creative thinking in different perspectives. After obtaining product demand information by market research, designers through demand analysis techniques further extract useful factors, like design parameters, technical requirements and product constraints. In the process of conceptual design, conceptual product is formed based on these useful factors. Afterwards, in the stage of structural and detail design, its technical parameters will be more specific, with confirmation on production requirements, machining accuracy and technical process. After processing and manufacturing with appropriate material, these products will be promoted to market through marketing or other approaches, where products will obtain their value. The above stages are independent, but with connection and support between one and another.

When it comes to the innovative methods in different stage of the manufacturing innovation chain, after analyzing the market information, enterprises can rely on root analysis and QFD to search for new innovation point, so as to provide new ideas in product innovation and value realization. By taking advantage of brainstorming method, morphological analysis method, checklist method, TRIZ method and creative template, we can figure out more creative plan and give birth to new knowledge. With the help of contradictory matrix, object-field model, system evolution rule and ARIZ, enterprises may conduct a series of research activities on new technology and materials which will be applied on new product or creative conception. These research activities determine

whether the new products will be successfully developed and put into production; What's more, if enterprises plan to further develop their ideas into products, they can utilize knowledge maps and patent evasion. Through knowledge materialization to provide new functions, more knowledge content and reliable guarantee for high-precision, hence the competitiveness of products will have synchronous growth. With the aid of methods like FBS, SIT, TRIZ and six thinking hats, defects in existing products can be found and eliminated, which is the way to improve product quality and satisfaction among guests. Besides, in order to decrease time and cost of products in manufacturing, enterprises can undergo process analysis, production management and quality control by innovative methods, such as six sigma management, lean manufacturing and failure mode analysis. The practice also lay competitive market base for products. By means of SWOT analysis and mind map, conflicts in the process of market realization will be overcome. Under guidance and motivation, marketing staffs will give birth to brand-new sale scheme, so as to realize market value.

To conclude, market dimensional innovative methods, corresponding with demand analysis stage, creative scheme generation stage, is propitious to discover new market, entering into the market directly or with an improvement in products and service, so as to expanding target market. New market can be a new region, or a new market segment. Besides, enterprises also can dig out new function in existing products, which also belongs to the concept of new market. Different from technology innovation, discovering new market does not change the performance or quality of the products. Instead, it is to develop potential demands, so as to put the value of products into reality. Compared with management innovation focusing on internal resource integration, market innovation prefers to lay emphasis on external resource. As for technology dimension, innovation methods in R&D stage, knowledge materialization stage and product development stage, creates opportunities for business growth. In an environment of fierce competition, most of products are faced with shortening market cycle and great number of market followers. Some of products are just imported to the market, and then quickly experience rapid growth and recession period. As a result, enterprises have to keep learning technology, so as to improve their ability in technical and creation. Only in this way can enterprises maintain their competitive advantage and grow steadily. Last but not least, in the category of management, methods in product manufacturing and market realization stage can integrate internal and external resources with new concept, method and mode, which is a favorable guarantee for innovation in both technology and market.

5. Decision model of enterprise innovation method application

Based on the above conclusions, we propose that from the perspective of enterprise's decision, the decision-making and application of innovative methods is a nonlinear programming model. The objective of enterprise's promoting innovative methods is to achieve the optimum matching between enterprise innovation capability and innovative objective through coordination among technological innovation, management innovative and market innovation. So we put forward the multiplicative model of the application of innovative methods, that is, enterprise's innovative capability is the coordination of three dimensional innovation capability.

We use zc standing for enterprise's innovation capability, js standing for enterprise's technological innovation capability, gl standing for enterprise's management innovation capability, and sc standing for enterprise's market innovation capability. Then $zc = js \times gl \times sc$. Enterprise's innovation capability depends on its specific innovation target. It's meaningless to talk about innovation capability without innovation target. From the perspective of enterprise's strategy, the relationship between innovation target and innovation capability is closer, the more likely innovation succeeds. We propose that each enterprise is seeking to maximize its innovation ability, then enterprise's decision target can be set as following:

$$MAXzc = js \times gl \times sc$$

From a static point of view, the innovation ability of the enterprise is the integration of its technological innovation ability, management innovation ability and market innovation ability, and it is a certain value. We assume that enterprise innovative talents, capital input and technological conditions are all constant, then enterprise's three-dimensional innovation ability is the function of innovative methods. We use θ standing for innovative methods, and assume that there are n_1 kinds of technological innovation methods, n_2 kinds of management innovation methods, and n_3 kinds of market innovation methods. Then enterprise's technological innovation capability can be depicted as $js = \Psi(\theta_1, \theta_2, \dots, \theta_{n_1})$; management innovation capability can be depicted as $gl = \Gamma(\theta_1, \theta_2, \dots, \theta_{n_2})$; market innovation capability can be depicted as $sc = K(\theta_1, \theta_2, \dots, \theta_{n_3})$.

Enterprise's three-dimensional innovation capability can be transformed into each other, and this transformation is nonlinear. That is, the improvement of one certain innovation capability can improve other innovation capability, and may impair other innovation capability as while. Because three-dimensional innovation capability can be transformed into each other, enterprise's innovation capability is dynamic. Thus, enterprise should decide whether transform and how to transform its own three-dimensional innovation capability, according to its specific innovation target. We use functions to depict the transformation relationship of three-dimensional innovation capability. It should be noted that the transformation is not fixed, but contingent according to enterprise specific innovation target. We assume: (1) the transformation relationship between technological innovation capability and management innovation capability is $f(js, gl) = o$. (2) the transformation relationship between technological innovation capability and market innovation capability is $g(js, sc) = o$. (3) the transformation relationship between management innovation capability and market innovation capability is $x(gl, sc) = o$.

The mutual transformation of three-dimensional innovation capability is a long-term and continuous process and work for enterprise's strategy. Applying the multiplication model, we propose that to fulfill enterprise's innovation target, three-dimensional innovation capability is all necessary, none of them should be ignored. Even though one certain innovation capability is in shortage, it should reach a minimum amount. As for a certain innovation target, we use js_{min} , gl_{min} , and sc_{min} standing for the minimum amount for technological innovation capability, management innovation capability and market innovation capability respectively.

Then enterprise's decision model for innovative methods application can be expressed as follows:

$$MAXzc=js \times gl \times sc$$

$$\left\{ \begin{array}{l} js = \Psi(\theta_1, \theta_2, \dots, \theta_n) \\ gl = \Gamma(\theta_1, \theta_2, \dots, \theta_{n2}) \\ sc = K(\theta_1, \theta_2, \dots, \theta_{n2}) \\ f(js, gl) = 0 \\ g(js, sc) = 0 \\ x(gl, sc) = 0 \\ js \geq js_{min} \\ gl \geq gl_{min} \\ sc \geq sc_{min} \\ fc, gl, sc \geq 0 \end{array} \right.$$

6. Conclusions

To realize independent innovation, proper methods will lead the way. Innovative method is the origin of technical innovation, while promoting innovative methods in daily work is the key to improve independent innovation ability and occupy a commanding height. Based on the concept of traditional manufacturing chain, the work put forward the manufacturing innovation chain. Besides, it systematically introduced and discriminated different innovative methods corresponding to each stage of manufacturing innovation chain, such as demand analysis stage, creative scheme generation stage, technology R&D stage, knowledge materialization stage, product development stage, product manufacturing stage, market realization stage and their relative independence. What's more, based on innovation in the three dimensions of technology, management and market, we proposed a solution to deal with collaboration between different innovative methods. We hope to provide enterprise with innovative methods, scientific basis and all-round support. With scientific use of these methods, innovation ability and performance of enterprises will be elevated comprehensively.

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The Generation and Recognition of False News in the Network Environment and a Fuzzy Classification Model of their Harmfulness

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Pages: 304–312

Abstract: There are a lot of false news in the network environment. Without an effective recognition and discrimination of false news, individuals may suffer from both spiritual and physical harms, or even be exposed to graver threats socially. Therefore, it is of great significance to analyze the cause to and identification mode of false news in the network environment, as well as to quantify their harmfulness. To this end, we first analyzed the factors and background that allow the generation of false news in the network environment; then, on this basis, we considered the characteristics and features of false news to study on the methods and strategies to recognize false news; afterwards, by discussing the harmfulness of false news and its measurement indicators and referring to fuzzy mathematical theories, we established a fuzzy classification model of the hazard of false news which realized a preliminary quantification of false news harmfulness. Finally, discussion and outlook were included of the propagation of false news in the network environment.

Keywords: false news, network environment, harmfulness, measurement analysis, generation and recognition – model

1. Introduction

Together with its increasing harmfulness and expansion of affected scope, the mounting number of false news has become a recent phenomenon that draws the attention of leaders, experts and scholars at all levels, and sparks targeted discussion and analysis (Gao, 2013; Chen, 2010; Gao, 2013). News are propagated more informative and influential at wider scopes especially against the backdrop of rapidly developing network technologies featured by the nonstop improvement of means and channels for news to spread online (Wan et al, 2008; Dong, 2011; Zhao and Qi, 2016). This provides online news with more active space. However, as a double-edged sword, the humming dissemination of network news, on the one hand, positively strengthens the advantage side of online news media and promotes social advance and publicity service; and on the other hand, can be faked in reasonable amount which will generate a series of harms (Wang, 2014; Zhou, 2014; Wang, 2013). Therefore, it is of great importance to systematically analyze the causes to and harmfulness of false news in the network environment as well as the tactics and ways to identify them. Quantitative partition of the hazard of false online news is the very necessity and urgency.

In view of such popular issues and key contents, numerous studies were conducted from different research perspectives and achieved fruitful results (Wu, 2015; Wang, 2011; Ju, 2011; Wang et al, 2016; Fu, 2016). In this paper, referring to existing research findings, we further analyzed the causes to and the harmfulness of false online news as well as their identification methods. What is more, backed with fuzzy mathematic theories (Taylan et al, 2012; Mesiar and Stupňanová, 2015), a preliminary quantitative discussion was done on the hazard of false online news. A triangular fuzzy number (Taylan et al, 2012; Wang et al, 2016; Stupňanová, 2015) based fuzzy classification model was built up as an effective support of false news identification in the network environment.

2. Analysis of causes to false online news

The generation of false news, no matter in the print version or the online version, is subject to multiple factors. Nevertheless, due to the swiftly developing network technologies, network media has its own inherent characteristics compared with the paper media. To our understanding, there are several contributors to the generation of false online news, i.e.

1. Along with the rapid development of network technology, network news are spread faster, wider and more diversified in terms of channels. As a result, they convey a large information volume and a strong capacity of dissemination.
2. Interest-driven factor. The online propagation cost is relatively low.
3. Politics-driven factor. Some of false online news are spread for implicit political purposes.
4. Weak censorship and supervision in the imperfect network supervision system and mechanism.
5. The mere pursuit of commercial interest renders network media unscrupulous to carry out false information propagation.
6. The employed in the media industry lacks professional qualities and qualifications.
7. Changed by social morals, the media industry regards false news as an eye-catching tool to gain an increase in the click-through rate and the exposure rate towards enhanced competitiveness.
8. Indiscrimination of online news source and gullibility of information conveyed in online news.

3. Types of fake online news and the corresponding recognition

By summarizing, sorting and classifying the contents of various types of false online news, we divided them into the following parts as listed in Table 1.

4. Analysis and measurement of the harmfulness of false online news

4.1. Harmfulness analysis for false online news

With multiple representation forms, wide channels of dissemination, fast propagation and considerable information volume conveyed by them, false online news exert serious

No.	Type	Content
1	Imagined news	Mostly hearsay and/or tip-offs from journalists
2	False news	Ungrounded, fabricated, garbled or overgeneralized
3	Distorted news	Embellished or overstated
4	Irrelevant news	Headlines or pictures are mismatched with contents.
5	Unverified news	Cite news sources from elsewhere without detecting the authenticity
6	Advertising news	Mainly aimed towards advertising or long-term promotion
7	Bribery news	Lure the targeted audiences by modest or exaggerated profits
8	Predatory news	Cater to the audiences' curiosity and beauty-hunting impulse; mostly social news, cultural and entertainment news and sports news
9	Inflammatory news	Containing misleading political speeches; mostly current news, political news and religious news
10	News for value	Gain higher CTR or more attention by cheating
11	Exclusive news	Deliberately produce news to enhance competitiveness
12	Inference news	Out of speculation or unreliable deduction due to lack of knowledge

Table 1 – Contents of various types of false online news

influence on many aspects. Among them, political hazard, law and security hazard, and social hazard are deemed by us as the major three ones, which are listed in details in Table 2 as follows.

No.	Tier one	Tier two
1	political hazards	Detrimental to the interest of the country, nations and the people
		Damage to religious and cultural policies
		Encroaching folkcustoms and ethos
		Threatening social morality
		Harming cultural traditions
		Infringing national unity and sovereign integrity
2	law and security hazard	Destroying national security and stability
		Harmful to social security and public order
		Damaging social stability and development
		Infringing the basic principles of the constitution
		Undermining laws, regulations and policies
		Divulging national secrets
3	social hazard	Subverting state regime and destroying national unity
		Undermining social credibility
		Destroying news value
		Harmful to social morality and virtue
		Undermining authority
		Threatening creditworthiness
		Infringing legal interest
		Misleading social opinion
		Affecting the images of media and society

Table 2 – Downsides of false online news

4.2. Implementation of the fuzzy classification model

Fuzzy information can be effectively described by using triangular fuzzy numbers, which enjoy widespread application prospect with simple calculation process, reliable output and explicit physical meanings (Lino et al., 2016). The general form of the fuzzy membership function $u_G(x)$ of triangular fuzzy numbers $G = (g^L, g^M, g^U)$ is

$$u_G(x) = \begin{cases} 0 & x \leq g^L \vee x \geq g^U \\ \frac{x - g^L}{g^M - g^L} & g^L \leq x < g^M \\ \frac{g^U - x}{g^U - g^M} & g^M < x \leq g^U \\ 1 & x = g^M \end{cases} \quad (1)$$

A real number K , a triangular fuzzy number $G = (g^L, g^M, g^U)$ and another triangular fuzzy number $H = (h^L, h^M, h^U)$, if exist, satisfy the following properties:

Multiplex operation

$$G \otimes H = (g^L * h^L, g^M * h^M, g^U * h^U) \quad (2)$$

Scalar operation

$$\begin{cases} K * G = K * (g^L, g^M, g^U) = (K * g^L, K * g^M, K * g^U) \\ \frac{1}{K} * H = \frac{1}{K} * (h^L, h^M, h^U) = \left(\frac{1}{K} * h^L, \frac{1}{K} * h^M, \frac{1}{K} * h^U \right) \end{cases} \quad (3)$$

The similarity $Sim(G, H)$ between $G = (g^L, g^M, g^U)$ and $H = (h^L, h^M, h^U)$ can be expressed as

$$Sim(G, H) = \frac{g^L * h^L + g^M * h^M + g^U * h^U}{\max \left[(g^L)^2 + (g^M)^2 + (g^U)^2, (h^L)^2 + (h^M)^2 + (h^U)^2 \right]} \quad (4)$$

Or as

$$Sim(G, H) = \frac{\min \left[(g^L)^2 + (g^M)^2 + (g^U)^2, (h^L)^2 + (h^M)^2 + (h^U)^2 \right]}{g^L * h^L + g^M * h^M + g^U * h^U} \quad (5)$$

Sharing the same trend of measurement effect, the above two expressions can displace each other according to actual application needs. Triangular fuzzy numbers are adopted

in this paper to serve the fuzzy measurement of the harmfulness of false online news. The corresponding specific steps are:

1. Construction of clustering-oriented indices

The paper chooses the content in Table 2 as the measurement indices of the hazard of false network news according to the principles of scientificity, objectivity, comprehensiveness, analyticity and independence. Assuming that the number of clusters selected for cluster analysis is n , the indicator set S can be expressed as:

$$S = \{s_1, \dots, s_j, \dots, s_n\}, 1 \leq j \leq n \quad (6)$$

2. Standardization of indicators

Indicators are generally measured according to different standards. In order to unify the measurement standards towards the obtainment of precise and reliable measurement results, indicators selected in this paper should undergo normalization processing. There are commonly two types of indicators: performance-driven and cost-driven.

If we let the j th indicator be performance-driven and the corresponding index magnitude be $G_j = (g_j^L, g_j^M, g_j^U)$, then the standardized magnitude H_j is

$$H_j = (h_j^L, h_j^M, h_j^U) = \frac{1}{g_j^{\max}} (g_j^L, g_j^M, g_j^U) \quad (7)$$

Where $g_j^{\max}$ is the maximum value of the j th indicator's threshold.

If we let the j th indicator be cost-driven and the corresponding index magnitude be $G_j = (g_j^L, g_j^M, g_j^U)$, then the standardized magnitude H_j is

$$H_j = (h_j^L, h_j^M, h_j^U) = \left(\frac{g_j^{\min}}{g_j^U}, \frac{g_j^{\min}}{g_j^M}, \frac{g_j^{\min}}{g_j^L} \right) \quad (8)$$

In which $g_j^{\min}$ is the minimum value of the j th indicator's threshold.

3. Assignment of indicator weight

Indicator weight is expressed in the form of triangular fuzzy numbers. Supposing that there are Q experts grading these indicators. The scores of the basic weight, the maximal weight and minimal weight of the j th indicator assigned by the i th expert are $w_j^M(i)$, $w_j^U(i)$, and $w_j^L(i)$, respectively. Thus, the weight w_j of the triangular fuzzy number of the j th indicator is:

$$w_j = (w_j^L, w_j^M, w_j^U) = \frac{1}{Q} \left(\sum_{i=1}^Q w_j^L(i), \sum_{i=1}^Q w_j^M(i), \sum_{i=1}^Q w_j^U(i) \right) \quad (9)$$

We convert the weight w_j into a precise magnitude

$$w_j = \frac{w_j^L + 4 \times w_j^M + w_j^U}{6} \quad (10)$$

Accordingly, the weight sequence W is obtained as

$$W = \{w_1, \dots, w_j, \dots, w_n\}, 1 \leq j \leq n \quad (11)$$

4. Construction of classical domain and joint domain

In the process of cluster analysis, in order for an effective analysis of the harmfulness of false network news, it is a common practice to conduct threshold analysis on different indicators, i.e. setting or calculating the default threshold range. Assuming that the maximal value and the minimal value of the j th indicator's threshold are respective $g_j^{\max}$ and $g_j^{\min}$, then the joint domain of the j th indicator g_j^O is given as

$$g_j^O = [g_j^{\min}, g_j^{\max}] \quad (12)$$

We suppose that there are m levels of state, and then the classical domain of the i th state level g_{ij} is expressed as:

$$g_{ij} = (g_{ij}^L, g_{ij}^M, g_{ij}^U) \quad (13)$$

It can be seen that $g_j^{\min} \leq g_{ij}^L \leq g_{ij}^M \leq g_{ij}^U \leq g_j^{\max}$.

In particular, there exist

$$\begin{cases} g_{1j} = (g_j^{\min}, g_{1j}^M, g_{1j}^U) \\ g_{mj} = (g_{mj}^L, g_{mj}^M, g_j^{\max}) \end{cases} \quad (14)$$

In consideration of the actual situation of damage caused by false online news, we divide their harmfulness into four grades: extremely grave, grave, moderate, and unnoticeable. This means that there are 4 levels of state.

5. The triangular fuzzy number similarity model targeted at clustering analysis

If the magnitude of the j th index of a piece of false online news is $V_j = (v_j^L, v_j^M, v_j^U)$, we can refer to the given triangular fuzzy number similarity model and accordingly calculated the triangular fuzzy number similarity $Sim(g_{ij}, V_j)_j$ of the j th indicator between the false online news and the i th state level as:

$$Sim(g_{ij}, V_j)_j = \frac{g_{ij}^L * v_j^L + g_{ij}^M * v_j^M + g_{ij}^U * v_j^U}{\max[(g_{ij}^L)^2 + (g_{ij}^M)^2 + (g_{ij}^U)^2, (v_j^L)^2 + (v_j^M)^2 + (v_j^U)^2]} \quad (15)$$

Or as

$$Sim(g_{ij}, V_j)_j = \frac{\min \left[(g_{ij}^L)^2 + (g_{ij}^M)^2 + (g_{ij}^U)^2, (v_j^L)^2 + (v_j^M)^2 + (v_j^U)^2 \right]}{g_{ij}^L * v_j^L + g_{ij}^M * v_j^M + g_{ij}^U * v_j^U} \quad (16)$$

In consideration of indicator weight, the comprehensive similarity $Sim(g_i)$ is expressed as:

$$Sim(g_i) = \sum_{j=1}^n \left(w_j \times Sim(g_{ij}, V_j)_j \right) \quad (17)$$

We determine the membership category of false online news according to the size of their comprehensive similarity. The membership principle is: the higher the comprehensive similarity between the false online news and the state level, the more it approaches the state level.

4.3. Analysis of preventive measures

As it exists, the variety of harmfulness of false online news should be diminished in numbers or weakened in degrees by adopting several preventive measures, which are

1. To improve related laws and regulations, and to render punishments strict by stepping up punishments and defining corresponding standards.
2. To strengthen network supervision mechanism; to guide network media and especially mainstream media with policies so that allowing full play the guidance effect of mainstream media in terms of network culture.
3. To improve network security mechanism and enhance the ability to manage the means and channels of network news and information to spread.
4. To enhance the comprehensive quality of media staff, not only in terms of professional qualities, but also in the political, ideological, moral and civism aspects.
5. To perfect the censorship mechanism of network news, and to establish the social exposure system correspondingly.
6. To bind online news with the credit of individuals, institutions and units, with efforts to improve their ideological and political levels as well as the credibility.
7. To adhere to correct guidance of public opinion; to be able for online news to be controlled by proper political interference and by the timely and rational remedial system so as to reduce harm.

5. Discussion and prospect

This paper analyzes the causes to and the recognition methods of false news in the network environment as well as its harmfulness. A preliminary discussion is undertaken on the quantitative analysis of false news harmfulness, accompanied by the provision of a triangular fuzzy number based fuzzy classification model. In this way, we realize an effective support to discern false online news. However, the increasing influential power of false online news is also a noticeable phenomenon resulting from more channels,

wider spread scopes, faster propagation and mounting sources. Therefore, not only should there be effective and targeted measures to reduce the harm according to the varying forms of false online news, but we also need to be more discerning.

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The Prediction of the Sport Performance based on the IGSA

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Pages: 313–321

Abstract: The sport is one of the main methods to enhance the physical fitness of the college students. The college students are making the physical exercise by using their own spare time. Many colleges and universities have set up a sports team in order to participate in a variety of the competitions. It is necessary to predict the results of the athletes by using the scientific means in order to improve the performance of the athletes. In this paper, in order to improve the performance of the GSA algorithm, we propose an improved algorithm IGSA and apply this algorithm to predict the performance of the athletes. In the numerical experiment, we apply this algorithm to predict the performance of the aerobic gymnastics. The experimental results show that the prediction method is and effective and feasible.

Keywords: IGSA, GSA algorithm, Sport Performance

1. Introduction

In the campus of the colleges and universities, we can see many college students do the physical exercise. The physical exercise can not only enhance the physical fitness, but also can enhance the team spirit and enrich the cultural life. Because the sports have a strong popularity and competitive, many colleges and universities begin to set up a sports team expert the physical exercise. In order to improve the performance of the athletes, it is necessary to predict performance by using the modern technology (Lino et al., 2016).

Some scholars studied the sports from the point of the view of the sport middle market. The author studied the development trend of the sports intermediary market and the possible problems from the aspects of the intermediary organizations, the main body of the market supply, the main body of the consumer market, the market subject and the market management system (Zhang et al, 2004). Some scholars studied the sports from the point of the view of the sports talent demand. The author found the existing problems by analysing the present situation of the sports talents. Finally, the author put forward the two steps of the development of sports talent strategy (Zhao and Chen, 2006). Some scholars studied the sports from the point of the view of sports industry development. The research thought that the development of the sports industry in China was very fast. The scale has expanded and the industry field also had expanded. It showed the feature

of the sunrise industry. However, the economic contribution is relatively low and it belonged to the more typical hard industry (Jiang and Xia, 2015). Some scholars studied the sports from the point of the view of sports performance prediction (Chen, 2007). The gravitational search algorithm (GSA) was proposed in 2009 by Iran Kerman university professor Esmat Rashedi et al (Rashedi et al, 2009). The basic principle of GSA algorithm was based on Newton's law of the gravitation. It had the strong advantages of in solving all kinds of the nonlinear functions (Behrang et al, 2011). At present, some domestic and foreign scholars had studied aiming at the improvement and the application of the algorithm. For example, some scholars had combined the GSA algorithm with the particle swarm (Khadanga and Satapathy, 2015). In addition, they combined the GSA algorithm with the support vector machine (Soroor and Hossein, 2013). The gravitational search algorithm has been applied in the fields of the power system optimization (Khadanga and Satapathy, 2015), the numerical optimization (Sarafrazi et al, 2015) and the genetic engineering (Ferradini et al, 2011).

2. The GSA algorithm

The universal gravitation is one of the 4 basic forces in the nature. The particles are constantly close to each other under the action of gravitation. In nature, each particle and all other particles are attracted to each other. The effect of gravity is everywhere and is shown in figure 1.

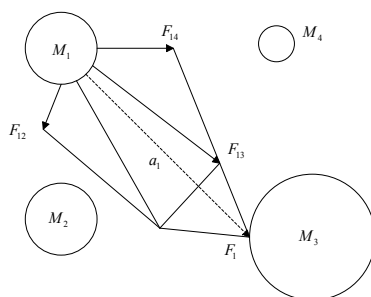


Figure 1 – The figure of the gravity

For the two separated particles, the gravitational force between them is not the interval and the delayed. According to the Newton formula, its size is proportional to the mass of the two particles, and is inversely proportional to the square of the Euclidean distance between the two particles.

$$F = G \frac{M_1 M_2}{R^2} \quad (1)$$

Where, F is the size of the universal gravitation. G are the inertia masses of the two particles M_1 and M_2 . R is the Euclidean distance between the two particles. The magnitude of the acceleration depends on the mass of the object and the magnitude of the force.

$$a = \frac{F}{M} \quad (2)$$

a is the acceleration under the force F . M is the inertial mass of an object.

In a space of D dimension, we assume that there are N particles. We define the position of the i particle is,

$$i = 1, 2, \dots, N \quad X_i = (x_i^1, x_i^2, \dots, x_i^d, \dots, x_i^n) \quad (3)$$

Where, x_i^d represents the position of the i particle in the space of D dimension.

At t time, the size of the gravitation of the i particle that the j particle forces is,

$$F_{ij}^d(t) = G(t) \frac{M_{pi}(t) \cdot M_{qj}(t)}{R_{ij}(t)} (x_j^d(t) - x_i^d(t)) \quad (4)$$

$M_{pi}(t)$ is the inertia mass that forced on the j particle and $M_{qj}(t)$ is the inertia mass that forced on the i particle. ε is a very small constant. $G(t)$ is a gravitational constant at t time.

$$G(t) = G_0 e^{-\frac{t}{T}} \quad (5)$$

$R_{ij}(t)$ is the Euclidean distance between the i particle and the j particle.

$$R_{ij}(t) = \|X_i(t) - X_j(t)\|_2 \quad (6)$$

In the gravitational search algorithm, in order to increase the random characteristic, we assume that the total force of the gravitation in the space of D dimension is the sum of all of the particles. The definition is as follows.

$$F_i^d(t) = \sum_{j=1, j \neq i}^N rand_j F_{ij}^d(t) \quad (7)$$

$rand_j$ is a random number in the range of $[0, 1]$. $F_{ij}^d(t)$ is the gravitation of the i particle that the j particle forces in the space of D dimension.

According to Newton second theorem, the acceleration of the i particle in the space of D dimension at t time is,

$$a_i^d(t) = \frac{F_i^d(t)}{M_i(t)} \quad (8)$$

Where, $M_i(t)$ is the inertia mass of the i particle.

In the GSA algorithm, for each iteration process, the particle will update its speed and position according to the following formula.

$$v_i^d(t+1) = rand_i \cdot v_i^d(t) + a_i^d(t) \quad (9)$$

$$x_i^d(t+1) = x_i^d(t) + v_i^d(t+1) \quad (10)$$

Inertial mass is calculated according to the size of the adapted value. The bigger the inertial mass of the particle is, it means that it is close to the optimal value and the particles have a greater attraction. The moved speed is slower. In the GSA algorithm, we use the following formula to update the inertia mass of the particle.

$$M_{ai} = M_{pi} = M_{ii} = M_i, i = 1, 2, \dots, N$$

$$m_i(t) = \frac{fit_i(t) - worse(t)}{best(t) - worse(t)} \quad (11)$$

$$M_i(t) = \frac{m_i(t)}{\sum_{j=1}^N m_j(t)} \quad (12)$$

Where, $fit_i(t)$ is the fitness degree of the i particle at t time.

3. IGSA

Gravitational coefficient $G(t)$ is an important parameter of the gravitational search algorithm. In the initial search, GSA needs the larger $G(t)$ to lead the population to explore the optimal solution area quickly. In the later period of the seeking optimal, it needs the smaller $G(t)$ to make the local research in the explored optimal solution region. However, in the standard GSA, $G(t)$ adopts the form of the exponential function. The speed of the decline is very fast. Therefore, it leads to the global exploration ability of GSA is rapidly weakened and reduces the global convergence rate. In order to make GSA explore quickly the more accurate optimal solution area, this paper uses the linear function to improve the gravitational coefficient $G(t)$. The calculation formula is as follows.

$$G(t) = G_o \left(1 - \frac{t}{T}\right) \quad (13)$$

Where, t is the current iteration number. T is the maximum iteration number. It is difficult to find out the appropriate constant G_o . According to the individual position in the population, this paper adjusts dynamically G_o . The calculation formula is as follows.

$$G_o = \gamma \max_{d \in \{1,2,\dots,n\}} (|x_{\max}^d - x_{\min}^d|) \quad (14)$$

Where, γ is a constant. $x_{\max}^d$ is the value of the maximum position in the space and $x_{\min}^d$ is the value of the minimum position in the space.

At the same time, in order to improve the convergence rate of the algorithm, we propose an improved strategy to improve the overall performance of the algorithm by using the individual's own evolution rate. With the iteration, when the individual obtain the better solution than the original population, in order to get the evolutionary trend of the more optimal solution, it can get the better individual. Firstly, we need to judgment whether the generation of the evolution get the better solution or not. For the particle that meets the determination condition, we calculate the change rate before and after one iteration. According to the change rate, we continue to implement the corresponding operation until it does not meet the decision condition.

Firstly, we determine whether the particle adopts the individual self-evolution rate strategy. The judgment condition is as follows.

$$|f_i(t-1)| \cdot \eta^{\frac{t}{T-1}} < |f_i(t)| \quad (15)$$

Where, $|f_i(t-1)|$ is the fitness value of the particle i before the evolution. $|f_i(t)|$ is the fitness value of the particle i after the evolution. η is a value between 0 and 1. $\eta^{\frac{t}{T-1}}$ is a function that the base is less than 1 and the index decreases with the time.

For the value of η , The initial distribution of population is relatively sparse. At the initial period, with the iteration, it is easy to find out the more optimal value than the previous generation, Therefore, the $\eta^{\frac{t}{T-1}}$ need to be bigger and its changes need to be quick. At the after period, the population converges gradually. It is difficult to find out the more outstanding individual than the previous generation. Therefore, the $\eta^{\frac{t}{T-1}}$ needs to be changed slowly. If the η is too bigger or too smaller, it cannot make the search performance of the optimal solution achieve the best. Through experimental comparison, when η selects 0.1, the most test functions will get better results.

When it satisfies the discrimination condition, we calculate the current evolution rate of the particle. It is the ratio of the position information of the current particle and the position information of the previous particle.

$$l_i^k = X_i^k(t) / X_i^k(t-1) \quad (16)$$

$X_i^k(t-1)$ is the position information of the particle i before the evolution. $X_i^k(t)$ is the position information of the particle i after the evolution. We calculate the evolution rate and adopt the following function to obtain the new individual.

$$\widehat{X_i^k(t)} = l_i^k \cdot X_i^k(t) + p \quad (17)$$

Where, $\widehat{X_i^k(t)}$ is the predicted value that obtains by the change rate. p is an adjustment parameter. Then, we calculate the fitness value. Next, we compare it with the fitness value that corresponding to $X_i^k(t)$ and reserve optimal value.

However, with the evolution, the diversity of the population will gradually decrease with time. Once it falls into the local optimum and it does have other mechanism to help, it will lead to the algorithm to stop the process of the research. In order to maintain the diversity of population, the early variation should be removed. We should adopt the way that exerts the variation for the optimal individual to disturb the population particles. For the evolution particle, if it cannot get the more optimal solution, we make it variation. The specific variation formula is as follows.

$$x_i^k(t+1) = \eta^{\frac{t}{T}-1} \cdot x_i^k(t) + \frac{1}{\eta^{\frac{t}{T}-1}} \cdot x_{best}^k(t) + \frac{r_2 x_{best}^k(t) - x_i^k(t)}{r_1} \quad (18)$$

r_1 and r_2 are the random numbers that obeys $U(0, 1)$ distribution. With the increase in the number of iterations, the center of the disturbance is gradually transferred from the current individual to the optimal individual. We continue to exert the disturbance for the particle. It can avoid the population to fall into the local optimum and lead to the search stagnation. It enhances the local mining capacity of the algorithm.

4. Experiment

In order to verify the validity and reliability of the algorithm, we predict the sports performance in Colleges and universities. Because the aerobics has the strong ornamental, it is very popular among the college students. Therefore, we study on the prediction of aerobics performance. We selected 25 students to perform aerobics. Then, the experts score from the body shop, the overall strength, the coordination ability, the endurance and the flexibility.

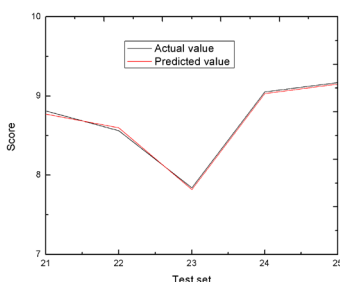


Figure 2 – The compare of the actual value and the predicted value

NO	body shop	overall strength	coordination	endurance	flexibility	average value
1	8.2	8.5	9.0	8.1	9.4	8.64
2	7.7	9.6	7.8	8.9	7.6	8.32
3	8.1	8.6	8.6	8.3	7.5	8.22
4	7.5	8.2	9.3	9.1	9.0	8.62
5	8.6	7.5	8.0	7.7	7.3	7.82
6	9.6	8.7	9.4	8.6	8.2	8.90
7	7.4	7.6	9.2	8.1	8.2	8.10
8	9.1	6.4	7.9	8.9	8.5	8.16
9	8.6	7.7	7.0	8.0	7.7	7.80
10	9.0	8.1	9.6	8.7	9.4	8.96
11	7.8	7.5	9.3	8.8	8.3	8.34
12	9.4	7.2	7.	9.0	7.5	8.14
13	8.3	7.7	8.0	7.8	9.1	8.18
14	9.1	8.8	8.2	7.7	8.8	8.52
15	8.8	7.4	7.8	8.1	8.8	8.18
16	7.6	7.7	8.6	9.1	8.5	8.30
17	8.1	7.8	8.4	8.0	8.9	8.24
18	9.6	9.0	7.9	7.7	9.3	8.70
19	8.8	8.9	8.5	8.1	7.8	8.42
20	8.9	8.4	8.5	8.3	7.6	8.34

Table 1 – The results of the scores for the samples

Finally, we calculate the average scores of each student. Among them, the performances of the first 20 students are as the text set. The performances of the later 5 students are the sample set. The performances of the 25 students are shown in the following table.

After that, we apply the improved GSA algorithm to predict the data and get the predictive value. We compare the predicted values with the performances of the other 5 students. We draw the actual values and the predicted values in one picture. The results are shown in figure 2 and table 2.

NO	Actual value	Predicted value
21	8.81	8.77
22	8.56	8.60
23	7.84	7.82
24	9.05	9.03
25	9.17	9.15

Table 2 – The actual value and the predicted value

From the table 2, we can see that the error of the actual values and the fitted values are smaller. It shows that the IGSA algorithm has higher accuracy. From the figure 2, we can see that the fitting of the actual values and predicted values is better. The two curves are basically coincident. The above experiments show that the IGSA algorithm has achieved the better results and it can predict the college aerobics effectively.

5. Conclusion

The physical exercise is full of the college students' leisure life. All kinds of sports are the characteristics of the simple entry and the high popularity. It is popular with the teachers and students. In order to enhance the competitive nature of the sports, many colleges and universities set up the sports teams in order to participate in the competition. In order to improve the performance of the college sports competitions, it is very necessary to predict college sports scores. In order to effectively predict the college sports scores, this paper improves GSA algorithm and predict the performance of the aerobics. This paper does the following works. Firstly, this introduces the related research background. Secondly, this paper briefly introduces the GSA. Thirdly, in order to improve the performance of the algorithm, this paper proposes the IGSA algorithm. Finally, through the numerical analysis, this paper predicts the performance of the aerobics and verifies the accuracy and feasibility of this method.

Acknowledgment

Yulin city technology bureau industry-university-institute cooperation projects, Project name: Sports resources of science and technology information sharing system of yulin city to build research; project number: 2015CXY-12

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The Physical Health Condition of Civil Servants Based On Analytic Hierarchy Process Research

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Abstract: In view of status quo of civil servant's physical health, the expert interview law, market survey method, analytic hierarchy process (AHP) and established the rule layer, four indexes of body function, quality, metabolism and morphology, and according to the author analyzed the four factors, established the comprehensive evaluation model of civil servants in good health, through hierarchical analysis method to determine the weight, and apply the migration algorithms, stratified according to various factors. Results: in the end of the proceeds of the positive deviation factor as a judgment of its evaluation, the model combined with the actual, proves the rationality and validity of the model.

Keywords: Physical health, Analytic hierarchy process, National civil servants.

1. Introduction

With the progress of society and rapidly development of medical science, people's demand on health is also constantly increasing, but in present society, a large proportion of people are in the sub-health status, as far as Chinese civil servant is concerned, sub-health status has become ubiquitous, so research on physical health status has great effects on disease prevention (Liang, 2013; Vázquez et al., 2016). Regarding health aspects research, formers have made many efforts, and obtained abundant achievements, such as: Wang applied analytic hierarchy process method in civil servant physical health conditions to define weights, after that combined fuzzy mathematical method to made comprehensive evaluation on it, and predicted its trend (Zhang et al., 2015); Li evaluated on students' physical health, established its evaluation system that included organizational benefits layer, behavior layer, learning layer, reaction layer and result layer these five layers, and combined with Shanghai city one school's practical situation to make quantization and verification, finally obtained result reflected evaluation grade and evaluation scores two methods (Seyed, 2016).

The paper just bases on above previous researches, it evaluates on Beijing civil servant physical health, applies experts interviewing method, market survey method, analytic hierarchy process and else to define guidelines layer four indicators, defines weights by analytic hierarchy process, and uses deviation algorithm, hierarchizes each factor, and finally gets its reasonable evaluation results, which let the model to obtain extensive testing and improving in the field (Zhang et al., 2016).

2. Apply analytic hierarchy process into evaluating civil servant physical health conditions

Analytic hierarchy process was earliest proposed by American operational research experts, the method can simplify complicated problems, AHP features are hierarchizing complicated problems, making clear about primary and secondary, possessing stronger logicity and hierarchical structure, the algorithm mainly is calculating indicators weights (Jiang et al., 2016). It is applicable to comprehensive assessment system, is a powerful mathematical method that converts problems into quantitative research (Zhang Bing, 2012). Nowadays analytic hierarchy process has already widely used in each field to solve practical problems (Eng et al., 2016).

2.1. Analytic hierarchy process calculates indicators weights

Expert No.	Name	Age	Gender	Job title	Education background	Unit
1	WWB	41	Female	Sub-senior	Doctor	Nanjing Sport Institute
2	WM	45	Female	Senior	Doctor	Shanghai Sport Institute
3	LHJ	51	Male	Senior	Master	National sports science institute
4	LDJ	52	Female	Sub-senior	Master	Shanghai Sport Institute
5	XWH	51	Female	Sub-senior	Master	Beijing Sport University
6	WRH	42	Male	Senior	Doctor	Beijing Sport University
7	ZJ	34	Male	Sub-senior	Doctor	Shenzhen University
8	XY	54	Male	Senior	Doctor	Shanghai Sport Institute
9	RH	70	Male	Sub-senior	Master	Beijing Sport University
10	SB	42	Male	Senior	Doctor	Beijing Sport University

Table 1 – Experts status table

Analytic hierarchy process is the key to solve physical health indicator system aspect weight issue, and selection of weights are mainly experts selection, due to every selected expert has profound researches on his field, emphasis and familiar degree on his field are deeper, so it will be inclined to higher weights, therefore it is inappropriate to select more experts, the paper selects ten experts to evaluate on the weights (Pu Sheng, 2013). During selection process, experts should follow with necessary and reasonable education background; they are of all ages as young and middle-aged as well as old; their affiliated job titles should be in senior title and above; they possess higher prestige in their fields (Song, 2013).

According to above principles, the paper selected experts are as following Table 1 shows.

2.2. Expert defined weight proper evaluation methods selection

After certain processing with multiple factors, it can get their individual indicator total evaluation system; the method is called comprehensive evaluation method. For the method, formers have put forward many ways, combines with the paper researched contents, it selects massive scholars common used one type weighted geometric mean method, arithmetic mean method (Zheng, 2015).

Regarding weighted geometric mean method, from which let number of evaluation indicators to be n ; let individual indicator evaluation value to be y_i ; let evaluation indicator weight to be w_i ; evaluated object comprehensive evaluation value to be y , so corresponding equation is:

$$y = \prod_{i=1}^n y_i^{w_i} \quad (i = 1, 2, \dots, n) \tag{1}$$

And corresponding weighted arithmetic mean method equation is:

$$y = \sum_{i=1}^n w_i y_i \quad (i = 1, 2, \dots, n) \tag{2}$$

Due to the method is relative simple, and it conforms to the paper.

3. Analytic hierarchy process theoretical models

Civil servant physical health conditions evaluation involves multiple reference indicators, the decision problems is just suitable to analytic hierarchy process.

3.1. Construct judgment matrix

For above guidelines layer's three kinds of indicators, it makes meticulous comparison of the two relative importances' to construct judgment matrix. Such as: Take T_i, T_j to make importance comparison, the structure is using b_{ij} to express, and then all factors after comparing can get judgment matrix U . Its expression is as following.

$$U = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1j} \\ b_{21} & b_{22} & \cdots & b_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ b_{i1} & b_{i2} & \cdots & b_{ij} \end{pmatrix} \tag{3}$$

In formula, b_{ij} the two compared importance uses quantized value to express, uses 1—9 number to describe, number representative meaning is as following Table 2 show:

Scale	Meaning
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is more important than the later by comparing two factors
7	Indicates the former is relatively more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
Even number	Represents importance is between two odd numbers
Reciprocal	Represents factors positive and negative comparison order

Table 2 – 1—9 scale meaning

3.2. Weight vector and maximum feature calculation

According to first grade indicator's judgment matrix vector, carry out normalization with it; solve the sum and then make normalization, then it can get weight vector. According to feature value and feature vector relations, it can solve feature value; its implementation method is as following:

Firstly, normalize judgment matrix every column, its result is:

$$b_{ij} = b_{ij} / \sum_{k=1}^n b_{kj} \quad (i, j = 1, 2, \dots, n) \quad (4)$$

Then solve the sum by lines on judgment matrix that makes normalization by column, it can get:

$$\overline{W}_i = \sum_{j=1}^n b_{ij} \quad (i = 1, 2, \dots, n) \quad (5)$$

Above vector $\overline{W} = [\overline{W}_1, \overline{W}_2, \dots, \overline{W}_n]^T$ proceeds with normalization processing:

$$\overline{W}_i = \frac{\overline{W}_i}{\sum_{j=1}^n \overline{W}_j} \quad (i = 1, 2, \dots, n) \quad (6)$$

Then: $W = [W_1, W_2, \dots, W_n]^T$ is solved feature vector.

In addition, calculate maximum feature root, the process is:

$$\lambda_{\max} = \sum_{i=1}^n \frac{(AW)_i}{nW_i} \quad (7)$$

In above formula $(AW)_i$ represents vector AW the i component.

According to above formula, we can respectively solve civil servant physical health status comprehensive assessment analysis first grade indicator, second grade indicator to first grade indicator weight and maximum feature value.

3.3. Consistency test

To matrix $U = (b_{ij})_{n \times n}$, if matrix element meets $b_{ij}b_{jk} = b_{ik}$, then matrix is consistent matrix. Among them, $b_{ij} > 0$, $b_{ij} = 1/b_{ji}$. In order to use it to calculate factor weight, it requires that matrix inconsistency only under acceptable conditions. When problems are relative complicated, we cannot take all factors into account, which causes paired comparison construct judgment matrix instant, judgment matrix cannot arrive at ideal state consistency.

Judgment matrix consistency indicator CI , and judgment matrix consistency ratio CR , its computational method is as following formula

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (8)$$

Among them, n represent order number of judgment matrix that is also the number of compared factors.

$$\lambda_{10} = \quad (9)$$

Among them, RI represents Random Consistency Index value, as following Table 3 shows.

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Table 3 – RI value table

When $CR \geq 0.1$, it is thought that judgment matrix occurs inconsistency that needs to make adjustment on judgment matrix again. When $CR < 0.1$, judgment matrix inconsistency is within acceptable range.

By calculating, it gets four judgment matrixes' consistency indicator CI , and consistency ratio CR , single hierarchy judgment matrix conforms to consistency requirements by consistency testing; it can be thought that calculated weight is reasonable. Next step is doing combination consistency testing. Assume that in one layer, m pieces of factors weight calculation result is α_m , corresponding consistency indicator value respectively is CI_m , combination consistency test consistency ratio is:

$$CR = \frac{\sum_{j=1}^m \alpha_j CI_j}{\sum_{j=1}^m \alpha_j RI_j} \quad (10)$$

By calculating, combination consistency ratio calculated value is: $CR < 0.1$

So hierarchical total arrangement's consistency testing meets consistency requirement. It can be thought that civil servant physical health conditions' each indicator weight calculation result is reasonable that can be applied into instructional evaluation.

3.4. Weight calculation arrangement

If in one layer, m pieces of factors weight calculation result is α_m , corresponding consistency indicator value respectively is CI_m , in next layer n pieces of factors to A

layer calculation weight is β_{nm} , then in T layer factors total arrangement weight is:

$$w_i = \sum_{j=1}^m \alpha_i \beta_{ij}$$

4. Apply analytic hierarchy process into civil servant evaluation

According to experts opinions and consult previous documents, the paper defines civil servant physical health hierarchical system table, from which it including body shape, function, metabolism and quality as well as other elements, specific status is as following Table 4 shows:

Target layer	Guidelines layer	Solution layer
Physical health (A)	Metabolism (B_1)	Bone metabolism (C_{11})
		Blood sugar (C_{12})
		Blood fat (C_{13})
	Body function (B_2)	Blood pressure (C_{21})
		Pulse (C_{22})
		Lung capacity (C_{23})
		Maximum oxygen uptake (C_{24})
	Physical quality (B_3)	One foot standing with eyes closed (C_{31})
		Reaction time (C_{32})
		Sit-up (C_{33})
		Lower limbs explosive power (C_{34})
		Grip (C_{35})
		Sit and reach (C_{36})
	Body shape (B_4)	Waist circumference (C_{41})
		Body fat rate (C_{42})
		RMI (C_{43})

Table 4 – Civil servant health evaluation system

According to above process, combining with analytic hierarchy process theoretical model, we get guidelines layer reflected target layer’s judgment matrix, their weights results are as following:

$$W_1 = \begin{matrix} 0.150894 \\ 0.390813 \\ 0.067481 \\ 0.390814 \end{matrix}$$

$$W_2 = \begin{matrix} 0.146545 \\ 0.49951 \\ 0.288398 \\ 0.065536 \end{matrix}$$

$$W_3 = \begin{matrix} 0.067481 \\ 0.390814 \\ 0.150892 \\ 0.390814 \end{matrix}$$

$$W_4 = \begin{matrix} 0.125 \\ 0.375 \\ 0.125 \\ 0.375 \end{matrix}$$

$$W_5 = \begin{matrix} 0.099602 \\ 0.293113 \\ 0.507684 \\ 0.099603 \end{matrix}$$

$$W_6 = \begin{matrix} 0.067481 \\ 0.390813 \\ 0.150892 \\ 0.390813 \end{matrix}$$

$$\begin{array}{cccc}
0.096325 & 0.428973 & 0.070327 & 0.25 \\
W_7 = \frac{0.249485}{0.096325} & W_8 = \frac{0.128294}{0.065194} & W_9 = \frac{0.160312}{0.160311} & W_{10} = \frac{0.25}{0.25} \\
0.557865 & 0.377544 & 0.609052 & 0.25
\end{array}$$

By above result and combining with previous theory, we can solve corresponding maximum features roots that are respectively:

$$\lambda_{\max} 1 = 4.04338; \lambda_{\max} 2 = 4.19747; \lambda_{\max} 3 = 4.043381; \lambda_{\max} 4 = 4; \lambda_{\max} 5 = 4.22134;$$

$$\lambda_{\max} 6 = 4.04338; \lambda_{\max} 7 = 4.04338; \lambda_{\max} 8 = 4.11468; \lambda_{\max} 9 = 4.1532; \lambda_{\max} 10 = 4;$$

Precede with consistency test with maximum features roots, we can get consistency test result as:

$$CI_1 = 0.0144; CI_2 = 0.06582; CI_3 = 0.0144; CI_4 = 0; CI_5 = 0.0737; CI_6 = 0.0144$$

$$CI_7 = 0.0144; CI_8 = 0.03822; CI_9 = 0.05108; CI_{10} = 0$$

For the ten experts, $RI = 0.90$, and then according to above theory, we can calculate and get:

$$CR_1 = 0.01606; CR_2 = 0.07313; CR_3 = 0.01606; CR_4 = 0; CR_5 = 0.08197; CR_6 = 0.01606;$$

$$CR_7 = 0.01606; CR_8 = 0.04247; CR_9 = 0.05676; CR_{10} = 0;$$

In above result, the ten experts' CR always is far smaller than 0.1, so every expert pass consistency test.

Assume that every expert mastered knowledge and experiences are the same, and then it is available that:

$$\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = \lambda_8 = \lambda_9 = \lambda_{10} = 1/10$$

By above weight comprehensive weight method that:

$$WI = \frac{\bar{W}_i}{\sum_{j=1}^n \bar{W}_j}, \bar{W}_i = \prod_{l=1}^m W_{il}^{\lambda_l}, i=1,2,\Lambda,n,m=10$$

Target layer	Guidelines layer	Solution layer	Comprehensive weight total arrangement	Deviation coefficient
(A)(1)	(B ₁) (0.34048)	C ₁₁ (0.453807)	0.058	258.0%
		C ₁₂ (0.425)	0.035	23.5%
		C ₁₃ (0.227)	0.052	-63.0%
	(B ₂) (0.33681)	C ₂₁ (0.110)	0.034	-24.0%
		C ₂₂ (0.5)	0.188	-70.0%
		C ₂₃ (0.101)	0.039	-45.0%
		C ₂₄ (0.559)	0.039	-64.0%
	(B ₃) (0.17783)	C ₃₁	0.029	4.0%
		C ₃₂	0.040	-33.0%
		C ₃₃	0.016	-59.0%
		C ₃₄	0.055	25.0%
		C ₃₅	0.019	5.0%
		C ₃₆	0.019	149.0%
	(B ₄) (0.14486)	C ₄₁ (0.399)	0.067	10.0%
		C ₄₂ (0.357)	0.131	-33.0%
		C ₄₃ (0.244)	0.055	-2.0%

Table 5 – Civil servant physical health indicator weight table

And combine with above values; we can get corresponding comprehensive weights that:

$$\bar{W}_1 = 0.124721; \bar{W}_2 = 0.289979; \bar{W}_3 = 0.153102; \bar{W}_4 = 0.293142$$

$$\sum_{j=1}^n \bar{W}_j = 0.124721 + 0.289979 + 0.153102 + 0.293142 = 0.86094$$

Carry out normalization process with the weight, we can get civil servant body metabolism, function, quality and form the four weights are:

$$\bar{W}'_1 = \bar{W}_1 / \sum_{j=1}^n \bar{W}_j = 0.14486$$

By above process we can get corresponding other three types that:

$$\bar{W}'_2 = 0.33681 \quad \bar{W}'_3 = 0.17783 \quad \bar{W}'_4 = 0.34048$$

According to above process, we can similarly solve solution layer every indicator weights, as following Table 5 shows.

By above deviation, we can get the relationships among guidelines layer's body shape, metabolism, function and quality, that is body metabolism and function present positive deviation status, and for solution layer, it presents more positive deviation, so it can regard them as a unified entirety to calculate its deviation again, finally it gets blood sugar and maximum oxygen uptake is the first layer, but in solution layer, community of positive deviation is smaller than indicator layer of negative deviation.

5. Conclusions

Due to Chinese civil servant present physique is in the state of poor efficiency, so the paper analyzes the condition, it applies analytic hierarchy process method, and invites experts to define relative fields' each indicator weight to make preparation for correctly evaluating civil servant physical health conditions, finally it gets that body metabolism, function, quality and form are in the order from heavy to light, secondly is that the paper introduces deviation, it provides theoretical basis for civil servant body shape changes according to the method.

Acknowledgments

The han nationality in our country elementary and middle schools body shape characteristics of the dynamic change rule and trend research - to 1995-2015 years students physique and health test report as the basis (14YBB027).

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Research on Construction of Multi-Major Employment Recommendation Platform for College Students under the Internet plus era

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Abstract: While enjoying the great convenience brought by Internet, the Internet has created the problem of information overload. In recent years, personalized recommendation system has become a powerful tool to solve the information overload problem. However, the standalone recommendation system still can't provide highly efficient and quick personalized service. Therefore, it is necessary to combining the Spark platform which can process large-scale data efficiently with the personalized recommendation system to provide satisfying personalized recommendation service in mass data environment. This paper uses Spark platform as the core, combines with other Apache open source software to build a distributed employment recommendation system, sorts out and analyzes the employment information that search on the third-party employment information service website, then according to college student's resume recommends the recruitment information that suit for their professional level and personal preferences, so as to offer help for college students to obtain high-quality employment.

Keywords: employment Recommendation Platform, internet plus era.

1. Introduction

With the rapid development of information technology and Internet technology, human access to the information society and the Internet age quickly. The various types of information showing an explosive growth, people gradually from the era of information-poor into the era of information overload (Morgan et al., 2006; Salvador and Rocha, 2014). The so-called information overload refers to the amount of information beyond the scope which the individual or system can bear and use, the consequences is effective utilization is reduced (Gialamas et al, 2013). To a certain extent, the traditional search engine can meet some of the information needs for now; but the majority of internet users more eager to have a more targeted access to the information they want. In order to solve the shortcomings of the traditional search engine, the recommendation system with special information filtering method came into being.

Compared with the traditional search engine, the recommendation system shows many advantages (Wilson, 2002). It not only focuses on the results but also studies on the user

model and user preferences, present content that the user is interested in, to meet the personalized information needs. Recommendation system focus on the user's interests, according to the user's preferences to do personal computing, find the potential needs of users, mining the content that the user most likely interested in and presented to the user (Moore et al., 2010). At present, the recommendation system is mainly used in the field of electronic commerce, electronic business companies based on user preferences, purchase history or merchandise browsing traces recommend goods which user may be interested in, or find potential goods which user may need, to increase sales.

The employment of college students is still the focus of the national and social in China currently, reducing the difficulty of employment for college students and improve the quality of employment has always been the problem of many departments to explore (Whiting and De Janasz, 2004). Third-party employment information service website can only recommend the work according to a simple keyword, it is not only time-consuming, but also the results are difficult to satisfactory (Johnson, 2010). If we can effectively "work to match people" to achieve personal information in line with the recommended employment information, then the employment problem of college students may be able to get a large degree of ease (Lebold et al, 1994).

Apache Software Foundation's open source Spark distributed computing platform is praised by the enterprise developers and scholars for its high reliability, high scalability, high fault tolerance and high efficiency, the platform mainly for large-scale data computing and storage, has achieved a good application effect. Spark consists of two core modules: HDFS and Map Reduce HDFS provides a large file storage system and mass data storage solution which with corresponding reliable backup management of high-tolerance, high-throughput (Lassnigg and Vogtenhuber, 2011). The Map Reduce programming model provides the parallel programming interface, uses Spark platform as the core, combines with other Apache open source software to build a distributed employment recommendation system, sort out and analyze the employment information that search on the third-party employment information service website, then according to college student's resume recommend the recruitment information that suit for their professional level and personal preferences, so as to offer help for college students to obtain high-quality which with significant social meanings (Bamert et al, 1994).

2. Personalized recommendation system and Spark platform

2.1. Personalized recommendation system overview

The personalized recommendation system refers through the analysis of the user's personal information、historical behavior and the user's personal preferences to predict the user preferences for certain resources and initiative recommend the resources to users that they may be interested in (Parkinson et al., 2005). A complete personalized recommendation system mainly consists of three parts:

The module for collection of user information and user-related history and user preferences, the module for the recommendation of the candidate resource object and personalized recommendation strategy (or personalized recommendation algorithm), the personalized recommendation strategy is the core of the three parts (Celada, 1989).

As shown in Figure 1 is a general personalized recommendation system model, the model matching feature information and information filtering through the user mode which built by user preferences, user history and other user information in accordance with the candidate recommendation object model according to the personalized recommendation strategy, in the way, the most likely interested resource object is recommended to the user (Johansson et al., 2005). Personalized recommendation system is a kind of special information filtering system which is different from the search engine. It can find out the most suitable resource from the massive information database or the resources that potentially needed to the user, so it can filter the information efficiently and improve the resource utilization rate.

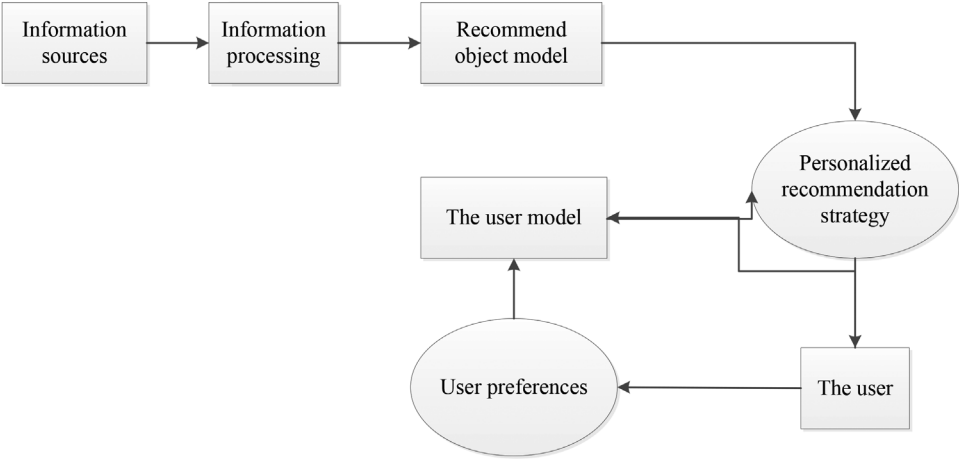


Figure 1 – The general model of personalized recommendation system

2.2. Collaborative filtering recommendation

The basic idea of collaborative filtering recommendation is that if the users have the same preferences in the past, they will also have similar preferences in the future, and use the evaluation to relative resources of neighbors who have higher similarity with current users to predict the specific resources Preferences. Collaborative filtering recommendation strategy is the most widely used recommended strategy currently, the biggest advantage of this strategy is that there is no special requirements on the recommendation object, whether it is structured text information, or text structured video can be used as recommend object (Pienkos et al., 2007). The input data is a rating matrix that with given user-item, and the output data is normally a Top-N list of recommended items or a predicted value of the user’s likeability for the item (Donna & Elizabeth, 2005).

Table I is the rating matrix of collaborative filtering recommendation, put $U = \{u_1, u_2, ...u_n\}$ as the users set, put $P = \{p_1, p_2, ...p_n\}$ as Item set, put R as rating

item $r_{i,j}$ of $n \times m$ rating matrix, $i \in 1, 2, 3, \dots, n$, $j \in 1, 2, 3, \dots, m$. The rating item from 1 to 5 represent very dislike to very like, if the user don't have rating for some item, the corresponding item $r_{i,j}$ is empty.

	items 1	items 2	items 3	items 4	items 5
User a	5	3	4	4	?
User b	4	2	2	3	3
User c	3	2	4	3	5
User d	3	3	1	5	4
User e	1	5	5	2	1

Table 1 – Rating matrix of collaborative filtering recommendation

Based on the user’s collaborative filtering and its main idea brief: First of all, the input data is given a rating matrix and the current user ID, identify other users has similar preferences with the current user, these users named the nearest neighbor, and then

	items A	items B	items C	items D
User A	5	4	4	Recommended
User B		5		
User C	4	4	5	5

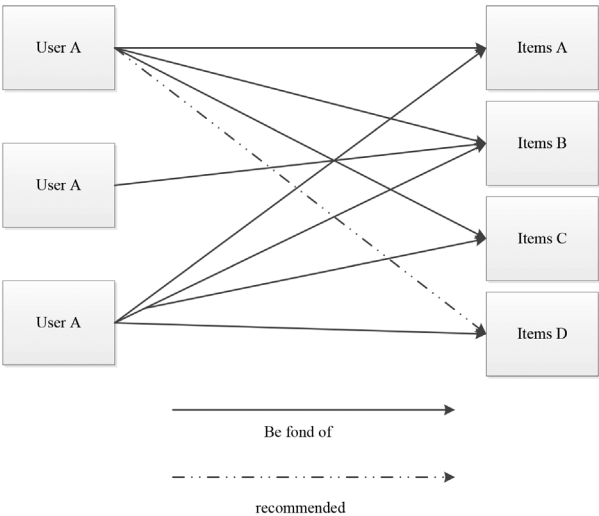


Figure 2 – Example of user-based collaborative filtering recommendation

for item p that the current user has not seen before, use the nearest neighbor rating to the item p to predict the current user's rating of the item p. The underlying assumptions of this approach are: firstly, users have the same preferences in the past, so they have a similar preference in the future; secondly, the user's preferences will not change over time. Figure 2 is an example of user-based collaborative filtering recommendation. For user A, user C is the nearest neighbor based on the user's history rating information, recommend item D which C likes to user A.

The specific process of User collaborative filtering recommendation is as follows:

Step 1: Find the nearest neighbor. Pearson correlation coefficient is commonly used in the recommendation system. Given the rating matrix R, the similarity $\text{sim}(a, b)$ between user A and user B can be expressed by the formula 1.

$$\text{sim}(a, b) = \frac{\sum_{p \in P} (r_{a,p} - r_a)(r_{b,p} - r_b)^2}{\sqrt{\sum_{p \in P} (r_{a,p} - r_a)^2} \sqrt{\sum_{p \in P} (r_{b,p} - r_b)^2}} \quad (1)$$

In the formula, r_a represent user A's average rating, $r_{b,p}$ represent rating that user X give to item Y.

The similarity of user A and B, computing as formula 2. ($r_a=4$, $r_b=2.8$)

$$\frac{(5-r_a)*(3-r_b) + (3-r_a)*(2-r_b) + \dots + (4-r_a)*(3-r_b)}{\sqrt{(5-r_a)^2 + (3-r_a)^2 + \dots} \sqrt{(4-r_a)^2 + (2-r_a)^2 + \dots}} = 0.61 \quad (2)$$

Pearson correlation coefficient range (-1, 1), -1 represent strong negative correlation, +1 represent strong positive correlation. The similarity of user A with user c, user d, and user e is 0.25, 0.00, and 0.79 respectively.

According to the results, the user A and the user B and C are similar, further analysis shows that, Pearson correlation coefficient take into account the fact that user's rating

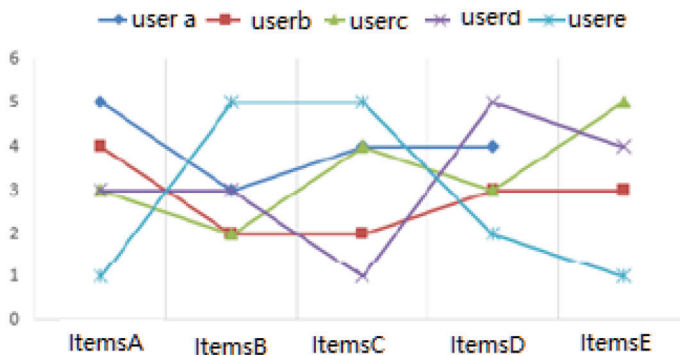


Figure 3 – The broken line graph of user ratings

criteria is different when calculating the similarity. Some users tend to give high scores, while others tend to give low scores. The PEARSON method ignore the difference of the average value in the calculation, so that the user can be compared, In other words, although the scores of user A and user B are different, the linear correlation between the scores still can be found, thus user A and user B is similar. The similarity between user A and user A, and the difference between user A and user E can also be seen from Figure 3 the broken line graph of user rating

Step 2: The selection of nearest neighbor. Select the first N users with the highest degree of similarity between current user and other users as the nearest neighbor. According to the results of the user similarity calculation in the first step, it is obvious that users B and C are the nearest neighbors of user A.

$$pred(a, p) = r_a + \frac{\sum_{n \in N} \sin(a, n) * (r_{n,p} - r_a)}{\sum_{n \in N} \sin(a, n)} \quad (3)$$

Step 3: Make a recommendation. Use the formula (2.3) to calculate the deviation r_a of average score between the nearest neighbor user and user a, the user a's preference for item P Predicted value is below:

In the formula, $\sin(a, n)$ represent the similarity of user a and the nth nearest neighbor user, r_a represent the average score of user a, $r_{n,p}$ represent the nth user's score for Item P.

In this example, the score of item 5 from user A is predicted based on the scores of the nearest user B and the user C:

$$4 + (1 / (0.61 * 0.25)) * (0.61 * (3 - 2.4) + 0.25 * (5 - 3.4)) = 4.89 \quad (4)$$

Finally, it is calculated that the predicted score of item 5 which user A never see is 4.89, so item 5 is the item that user A is most likely to be interested in, and it should be put into the recommended list of user A.

3. System analysis and design

The purpose of this system is to analyze the individual job information and feedback information of the college students, establish the user preference model, and then find out the employment information suitable for their employment intention in the millions of employment information, present employment information in line with their personal interests in the recommended interface. Therefore, the system consists of three parts: basic data part, personalized recommendation strategy part and system display interface part. The overall framework of the system is shown in Figure4.

3.1. The main components of the system

1. Data layer: The data is the basis of the entire personalized employment recommendation system, the final recommendation results of the recommendation system, to a certain extent depends on the quantity and quality

of data, the data stored in the data layer can be divided into four categories: employment information, user information (Mainly personal job information), the recommended results, and user's feedback. Use the distributed database HBase to store data, including user ID, name, gender, contact, professional name, graduation school, job intention, professional skills, personal introduction, internship or practical experience.

2. Logical layer: logical layer is personalized recommendation engine, is the core of the personalized recommendation system. A large number of data from data layer are analyzed, calculated or reasoning through the logic layer, regarding to each user's characteristics, generate personalized recommendation results.

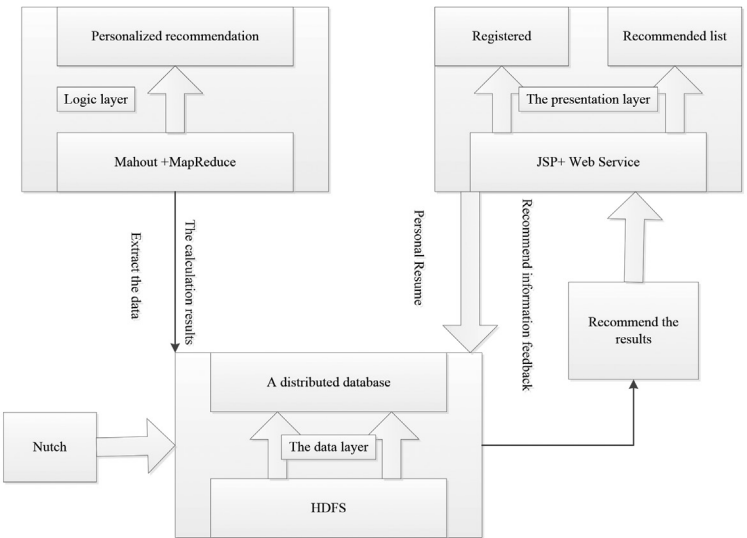


Figure 4 – System framework

3. Presentation layer: presentation layer is personalized recommendation system user interface, is part of that closest to the user, and is an important part of a complete personalized recommendation system. The functions implemented of

Display information	Display content	Show thereason
Theuserinformation	Job information	Basic data source
Recommendedlist	Thetitleand time	Telltheusertherecommendedcontent
Information feedback	OpinionsandSuggestions	Collectuserinformation to improve thesystem
Interest in thelist	Score highrecommendationinformation	To improve theuserexperience

Table 2 – The contents of display interface

the presentation layer include user registration and login, the user's personal information interface, the recommended information list, the portion of information feedback, and the list of information that has been scored. The content for each refer to Table 2.

3.2. System workflow

System workflow shown in Figure 5, the description of each step is as follows:

1. First of all, sort recruitment information from the third-party employment information service website by using Nutch distributed crawler system, then store the information in the HBase database, the system's registered users submit personal information to the HBase database, while the system collect the user's Interest score and feedback for recommended information.
2. After obtain the basic data, we can start personalized recommendation. Extract the relevant data from the HBase database for off-line analysis and calculation, store the user eigenvector through analysis, the filtered off-line recommendation results are stored to HBase for future use.
3. Completed of offline processing.
4. If the user modifies the key job information online, after saving the information, the system process online recommendation, combine the online analysis results and offline recommendation results as the final recommendation results then presented to the user; if not, the offline recommendation will be presented to the user.
5. After reviewing the recommendation information list, the user may express interest score and opinion for each recommendation information, and store the feedback information in the HBase database.
6. The end of the entire system workflow

3.3. System function modules

According to the overall system frame and workflow, the division of system function module shown in Figure 6. From the perspective of the system stability and the user experience, divide the system into three large functional modules: user-related module, personalized recommendation module and distributed system module.

4. System implementation

4.1. Function realization plan

The implementation of content-based recommended Map Reduce is divided into four stages

1. Extraction of employment information
2. Serialized of employment information and transformed into TF vector
3. User job information is mapped to topic vector
4. Similarity calculation, generate recommendation results

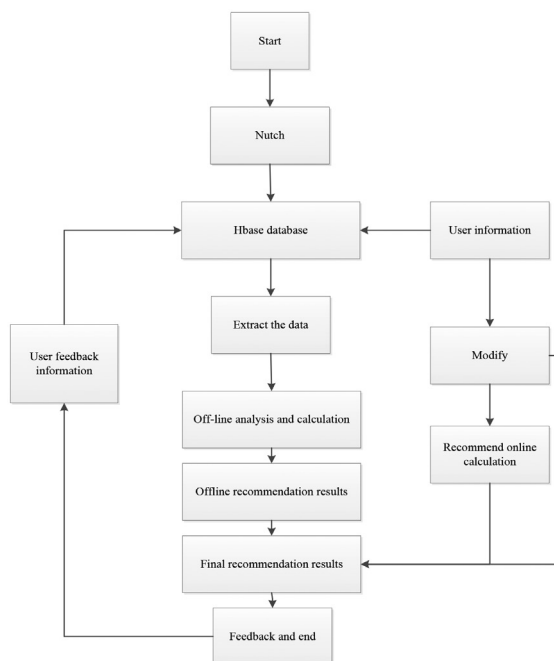


Figure 5 – System workflow

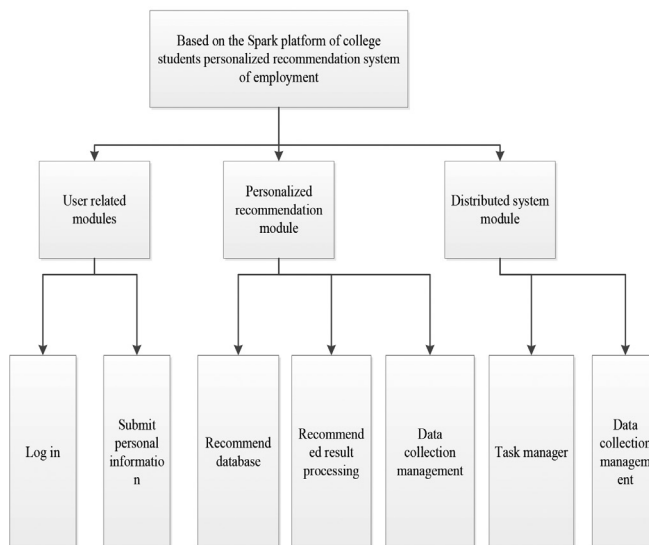


Figure 6 – The system functional module

Corresponding code is as follows:

```
Configuration conf = HBaseConfiguration.create();
Scan scan = new Scan();
Map:
    Foreach line in AllInfo
        context.write(URL,content);
Reduce:
    Foreach valInfo in values
        stringBuilder.append(valInfo+"\r\n");
    context.write(URL,valInfo)
```

4.2. System function display

When User Login in this system at the first time, user need to submit personal information, then view the list of recommended information, interest scoring the recommended employment information, the scored information can be reviewed in interested information list, as shown in Figure 7.

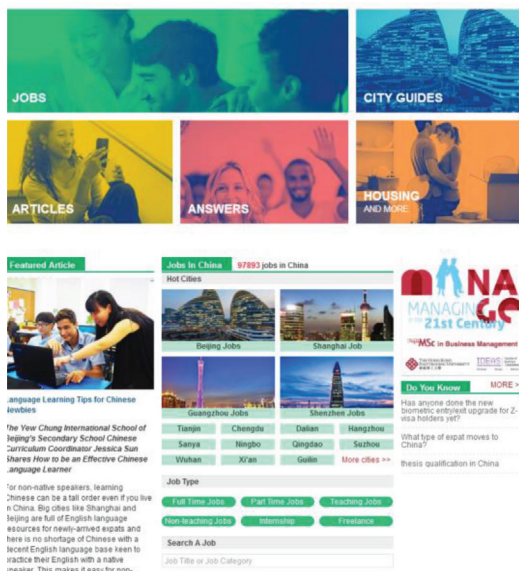


Figure 7 – System function display

5. Conclusions

Start from these practical problems, this paper constructs a personalized recommendation system for college students by using Spark and its related components, such as HBase, Nutch and Mahout. The specific achievements are as follows:

1. Personalized recommendation technology and cloud computing related technologies such as Spark are applied to college students' employment recommendation. In the information overload era, transfer the traditional pattern of "people looking for work" into "job matching person" pattern.
2. Through the research of personalized recommendation theory, considering the characteristics of Map Reduce and Mahout, combining the practical application environment, the content-based recommendation has been improved. In this way the content-based recommendation is not dependent on the user's history record, make it can overcome the cold start problem of recommendation system. Furthermore parallel mixture the improved content-based recommendation and the item-based collaborative filtering recommendation, make it can overcome the sparsity problem of the recommendation system.

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Empirical Study on Factors of Student Satisfaction in Higher Education

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Pages: 344–355

Abstract: Teaching quality is an important criterion to measure sustained and healthy development of colleges and universities. It is an important proposition to improve quality and level of higher education through effective evaluation of teaching effectiveness and efficiency. The research analyzed application and studies of Constructivism in higher education. Based on student-centered teaching philosophy of Constructivism, student satisfaction was adopted as a standard measuring teaching quality. Various factors of student satisfaction, including teacher quality, curricula construction and hardware facilities, were determined to construct an analysis model. Then, questionnaires and interviews were conducted on students in a Chinese university, using empirical study to explore effects of the factors on student satisfaction in higher education. By examining three main factors related with student satisfaction, the conclusion is that student satisfaction was effected by teachers' teaching attitude, teaching materials, teaching equipment in colleges and universities, so the specific recommendations were proposed to improve student satisfaction in higher education.

Keywords: higher education, student-centered, student satisfaction.

1. Introduction

Teaching quality of higher education is an important factor measuring comprehensive level of colleges and universities. Scholars have conducted theoretical and empirical studies on evaluation system of higher education (HE) from various perspectives based on research results and teaching experience. Obviously, it was an important proposition to effectively and efficiency evaluate teaching of higher education (Gan, 2010; Gonçalves et al., 2016).

In traditional college teaching system, “teaching” was the main body; “learning” a subordinate part; student the “product” of colleges. However, the initiative and importance of students was increasingly paid attention to in college teaching with continual theoretical research and empirical teaching practice (Eagle and Brennan, 2007; Alves and Raposo, 2009; Finney and Finney, 2010; Ahmad, 2015).

The “student-centered” concept represented by Constructivism has been gradually recognized. As a branch of cognitive psychology, Constructivism was firstly proposed

by the Swiss psychologist Piaget in the 1960s (Piaget and Gabain, 1932). According to Constructivism (Cobern, 1993), schema was the starting point and core of cognitive structure, or the foundation for understanding things. Thus, formation and variation of schema was the essence of cognitive development. Meanwhile, cognitive development was influenced by three processes: assimilation, accommodation and balance (Piaget and Gabain, 1932). Sternberg emphasized the crucial role of individual initiative in construction of cognitive structure, exploring methods to exert individual initiative in cognitive process (Sternberg, 1983, 2013; Slavinska-Holy, 1984); Vygotsky proposed “Culture-history development theory”, emphasizing the role of cultural and historical background of learners in cognitive processes, and he believed that learning was completed under certain historical, social and cultural background; the society played an key role in supporting and promoting development of individual learning. Vygotsky divided individual development into real level of development and potential level of development. Real level referred to that could be reached through independent activity of individual; potential level could be reached with the help of adults or older individuals. On the base of above theory, Culture-History School represented by Vygotsky deeply studied the important role of “activity” and “social interaction” in development of human higher mental functions (Vygotsky, 1979). These studies further enriched Constructivism with improvement, creating conditions for practical application in teaching process.

Rich contents were involved in Constructivism, while the core was student-centered concept. It emphasized students’ active exploration, discovery and construction of new knowledge (different from traditional teaching which transferred knowledge from teachers’ mind to students’ notebooks). Student-centered emphasized “learning” while teacher-centered emphasized “teaching” (Feng, 2006). This was the fundamental bifurcation point of the two teaching concepts, thus developing two opposing learning theories, teaching theories and instructional design theories. The required learning environment of Constructivism obtained sufficient supports from results of latest contemporary information technology. Therefore, Constructivism has been gradually integrated with teaching practice of teachers, becoming guiding ideology of teaching reform in higher education.

In teaching practice, “student-centered” teaching mode of Constructivism emphasizes initiative and participation of students to improve teaching effectiveness. Especially in teaching evaluation, the dominant position of students should be highlighted—student was the subject rather than the object of teaching evaluation (Xue, 2003).

In the present study, empirical studies were conducted on factors of satisfaction in higher education, based on “student-centered” concept of Constructivism; objective factors affecting university teaching quality were explored, with important theoretical and practical significances in improving teaching evaluation of university courses and student satisfaction in college teaching.

2. Definition of student satisfaction in higher education

Scholars studied student satisfaction and methods improving satisfaction in higher education from various perspectives, enriching the definition of student satisfaction from multiple aspects (Tsinidou et al., 2010; Tamim, 2013; Wilkins et al., 2015; Ahmad,

2015). Enache indicated the student satisfaction is becoming an important objective for universities and society as the role of the tertiary level institution is being questioned (Enache, 2011). Moreover, he concreted marketing approach to the student satisfaction problem. Hill et al. pointed out that the most important factors were quality of lecturer/classroom delivery, quality of feedback given to students during lessons and on assignments and lecturer-student relationships in the classroom. Student satisfaction is not determined solely by the students' teaching and learning experiences but rather by their overall experiences as a customer of a particular institution (Hill et al., 2003). Sojkin et al. identified social conditions and educational facilities among the key determinants of student satisfaction in higher education (Sojkin et al., 2012). Harvey and Green suggested that quality is used in five ways in the higher education debate: excellence, perfection, fitness for purpose, value for money and transformation in them seminal papers (Harvey and Green, 1993).

In summary, there were two implications in student satisfaction of higher education. The first was "student satisfaction" inspired by "customer satisfaction". In Marketing, "customer satisfaction" referred to happy or disappointed feeling of customers; this feeling was generated by customers' comparison between the purchased goods or service and psychological expectations (Voss et al., 2010; Wilkins and Epps, 2011). Colleges and universities are public institutions with responsibility providing educational services for students. Therefore, the research used "student satisfaction" in higher education for reference of "customer satisfaction". Student satisfaction was the happy or disappointed feeling generated by comparison between the accepted classroom teaching service and psychological expectations (Rowley, 1996; Suhre et al., 2007). The second was "degree of student satisfaction". "Student satisfaction" was naturally generated in the process receiving classroom teaching services, with subjectivity and invisibility. Thus, the way describing "student satisfaction" became the first problem in empirical studies, while "degree of student satisfaction" was the quantitative description of "student satisfaction" (Kotler and Fox, 1995; Arambewela and Hall, 2009).

3. Determination of student satisfaction factors in higher education

Student satisfaction factors were determined based on basic principles of ACSI (American Customer Satisfaction Index) and actual situation of higher education. Many studies on current satisfaction models of Chinese higher education adopted ACSI model, such as the Satisfaction Index Models of Chinese Higher Education (Li, 2011). Similarly, this research used the results of ACSI model to better analyze factors of student satisfaction. Meanwhile, the following two aspects were carried out to make up for shortcomings of theoretical research and better reflect actual teaching situation. Firstly, the research studied findings of classroom teaching satisfaction conducted by the school and college where the author researched. Great importance was attached to teaching quality, with surveys and analysis on classroom teaching satisfaction in each semester. By analyzing the survey results, factors of student satisfaction were determined based on ACSI model. Secondly, studies at home and abroad on factors affecting English teaching quality were collected with absorption and utilization. Learning from the research results, satisfaction factors were determined combined with actual situation of classroom teaching.

Based on above theoretical and practical researches, the research proposed factors of student satisfaction in higher education, consisting of teacher quality, curriculum construction and hardware facilities. The factors were interrelated with mutual influences (Table 1).

First-level factor	Second-level factor	
	No.	Content
Teacher quality	1	Appearance and manners
	2	Attitude
	3	Teaching concept
	4	Language competence
Curriculum construction	1	Curriculum system
	2	Materials selection
	3	Teaching method
	4	Teaching contents
Hardware facilities	1	Teaching facilities
	2	Teaching material
	3	Practice base
	4	Classroom arrangement
Student satisfaction	1	Absence rate
	2	Pass rate of exams

Table 1 – Factors of student satisfaction in higher education

4. Analysis of student satisfaction factors in higher education

4.1. Questionnaire design and survey

It is a combination of qualitative and quantitative research methods, based on the decided student satisfaction factors of higher education, the study designed a Likert Scale for questionnaire survey. Degree of student satisfaction was divided into five ratings- “very satisfied”, “satisfied”, “somewhat satisfied”, “dissatisfied” and “not satisfied at all”. The ratings were equipped with numerical values as “5, 4, 3, 2 and 1” (Juanandyang, 2012). Email and field interview were adopted in the survey for college students. There were 3600 questionnaires distributed to students. All samples of students came from 5 universities in China. The 3448 questionnaires were recovered, and 28 questionnaires were eliminated for unqualified. The effective rate was 88% with 3160 valid questionnaires, providing sufficient data basis for the study (Table 2).

4.2. Modeling of student satisfaction factors

Structural Equation Modeling was used to construct model of student satisfaction factors in college teaching. This modeling method could help users clarify the research

Grade	Gender		Discipline	
	Male	Female	Social Science	Natural Science
1	662	419	703	377
2	698	641	842	498
3	242	206	311	129
4	178	114	203	97

Table 2 – Sample distribution of the questionnaire

context; meanwhile, it was convenient for modeling and data processing. Currently, structural equation modeling was widely applied in social sciences, including sociology, psychology and management science (Genesee and Upshur, 2001; Wen et al., 2004).

There are various factors affecting student satisfaction in higher education. Therefore, research hypothesis should be determined before application of structural equation modeling. The hypotheses included following aspects:

Hypothesis 1: The level of teacher quality was positively correlated with student satisfaction in higher education.

Teacher quality, including appearance, manner, attitude, teaching philosophy and language skills, was a direct factor to improve student satisfaction. The study assumed that teachers' appearance, manner, attitude, teaching philosophy and language skills had positive effect on student satisfaction in teaching. In other words, student satisfaction increased when teachers had more elegant appearance, amiable attitude, advanced teaching philosophy and higher language ability.

Hypothesis 2: Curricula construction level was positively correlated with student satisfaction in higher education.

Curricula construction, including curriculum system, materials selection, teaching methods and contents, was the system safeguard to improve student satisfaction. It was assumed that curriculum system, materials selection, teaching methods and contents had positive effect on student satisfaction. In other words, student satisfaction increased with more perfect curriculum system, appropriate materials selection, proper teaching methods and more relevant teaching contents.

Hypothesis 3: Level of hardware facilities was positively correlated with student satisfaction in higher education.

Hardware facilities, including teaching equipment, teaching materials, practice base and classroom arrangement, provided basis for improvement of student satisfaction. It was assumed that teaching equipment, teaching materials, practice base and classroom arrangement had positive effect on student satisfaction. In other words, student satisfaction increased with the more advanced equipment, diverse teaching materials, formal practice base and comfortable classroom arrangement.

After proposing the hypotheses, the study determined path relationship among first-level factors of student satisfaction in higher education, and the path relationship

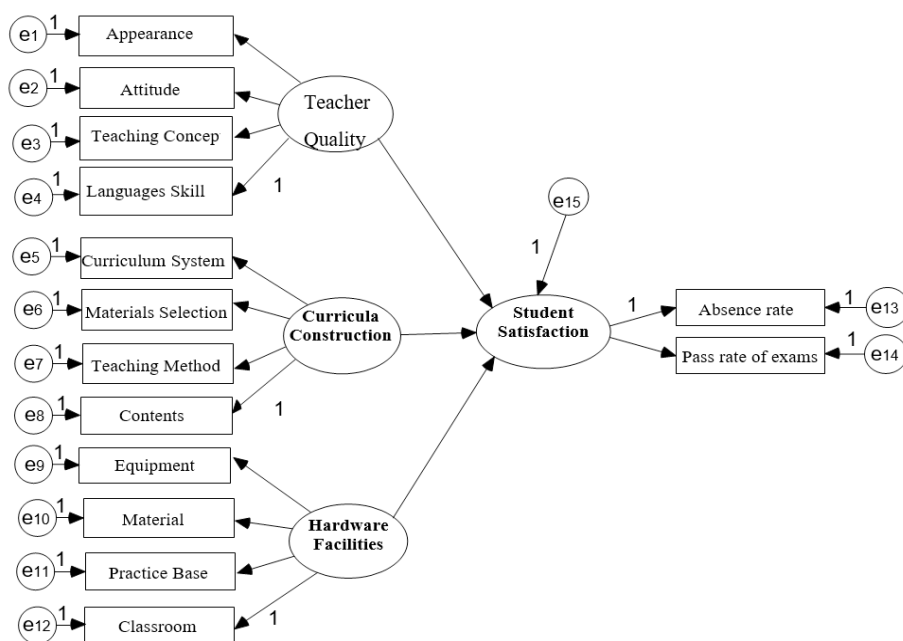


Figure 1 – Conceptual model of student satisfaction factors in higher education

between first-level factors and second-level factors. Figure 1 showed conceptual model of student satisfaction in higher education.

4.3. Fitting of student satisfaction factor model

The questionnaire data was processed and inputted into the structural equation model of student satisfaction factor for fitting. Figure 2 showed the fitting results, where the numerical values were standardized path coefficients, namely influence coefficients. The coefficients reflected the variation degree of a variable caused by another.

The fitting results of structural equation model were tested through subjective or objective testing methods. The so-called subjective test was to determine the reasonableness of hypotheses and the relationship among factors identified in the model; meanwhile, it also tested whether symbols, sizes and locations of path coefficients were proper. Objective test was to judge reasonableness of the model using various indicators.

The research adopted subjective test for student satisfaction factor model. Results indicated that the proposed hypotheses had real provability, in line with practice of classroom teaching; there was relationship among various factors with mutual influences; the path coefficients after fitting had proper sizes, locations and symbols. Then, the model was tested using objective testing method. Figure 2 showed common indicators, reference standards and actual values of model fitting.

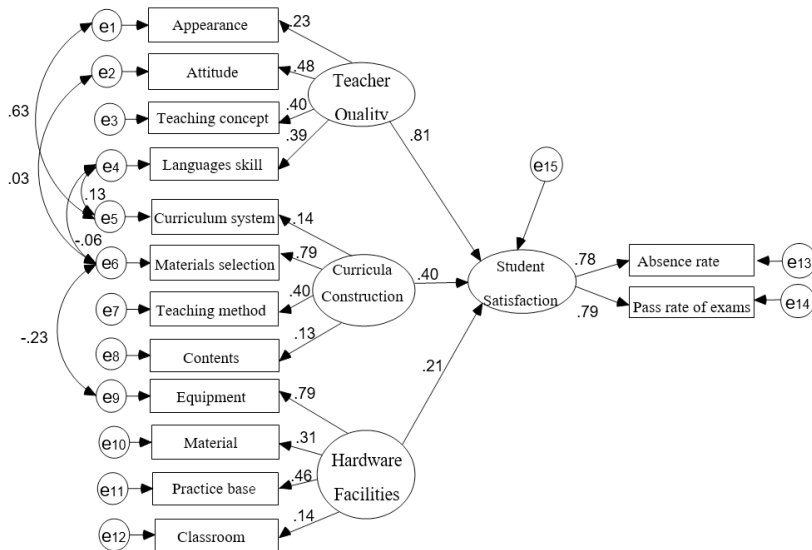


Figure 2 – Path coefficients of student satisfaction factor model

According to Table 3, only actual value of Relative fitting Index (RFI) was a smaller loss than standard value, while actual values of the other indexes reached or exceeded the standard values.

According to results of subjective test and objective test, the proposed hypotheses of student satisfaction factor model conformed to realistic situation; relationship and influences existed among factors; the symbols, sizes and locations of path coefficients were proper; the indexes conformed to evaluation criteria. Therefore, model for student satisfaction factor in higher education had good fitting effect and applicability.

Indicator categories	Index	Accepted standard value	actual value
Absolute fitting effect index	RMR	The smaller the better	0.071
	CMINDF	< 2.00	1.912
	GFI	> 0.90	0.903
	AGFI	> 0.80	0.914
	PGFI	> 0.50	0.589
Relative fitting effect index	NFI	> 0.90	0.919
	IFI	> 0.90	0.911
	PNFI	> 0.50	0.522
	RFI	> 0.90	0.889
	TLI	> 0.90	0.936
substitutive index	CFI	> 0.90	0.903
	PCFI	> 0.50	0.606

Table 3 – Accepted standard values and actual values of model fitting

4.4. Result analysis

Influence coefficients among factors were obtained after model fitting of student satisfaction factors. Table 4 showed the aggregated influence coefficients.

According to Table 4: Influence coefficient of teacher quality on student satisfaction was 0.81, indicating that student satisfaction with higher education increased by 0.81% when teacher quality increased by 1%. Therefore, teacher quality had positive effect on improvement of student satisfaction, verifying Hypothesis 1.

For second-level factors of teacher quality, the influence coefficients on student satisfaction were ranked in decreasing order as teaching attitude, teaching concept, language skill and teacher appearance. It indicated that teaching attitude had important influence on student satisfaction; meanwhile, psychological barriers of students for learning provided basis for correction of teachers' teaching attitude.

	Teacher quality	Curricula construction	Hardware facilities	Student satisfaction
Student satisfaction	0.81	0.40	0.21	0
Teacher appearance	0.23	0	0	0
Teacher attitude	0.48	0	0	0
Teaching concept	0.40	0	0	0
Language skill	0.39	0	0	0
Curriculum system	0	0.14	0	0
Materials selection	0	0.79	0	0
Teaching method	0	0.40	0	0
Teaching content	0	0.13	0	0
Equipment	0	0	0.79	0
Teaching material	0	0	0.31	0
Practice base	0	0	0.46	0
Classroom arrangement	0	0	0.14	0
Absent rate	0	0	0	0.78
Pass rate of exams	0	0	0	0.79

Table 4 – Influence coefficients of student satisfaction factor model

Table 4 showed that the influence coefficient of curricula construction on student satisfaction was 0.40, indicating student satisfaction increased by 0.40% when curricula construction improved by 1%. Therefore, curricula construction had positive effect on improvement of student satisfaction, verifying Hypothesis 2.

For second-level factors of curricula construction, the influence coefficients on student satisfaction were ranked in decreasing order as: materials selection, teaching method, curriculum system and teaching content. It indicated that materials selection had important influence on student satisfaction in teaching practice. Materials with

appropriate degree of difficulty could improve student satisfaction, providing direction for materials selection in college courses.

Influence coefficient of hardware facilities on student satisfaction was 0.21, indicating student satisfaction increased by 0.21% when hardware facilities improved by 1%. Therefore, hardware facilities had positive effect on improvement of student satisfaction, verifying Hypothesis 3.

For second-level factors of hardware facilities, the influence coefficient on student satisfaction was ranked in decreasing order as: teaching equipment, practice base, teaching material and classroom arrangement. It indicated that teaching equipment had greatest impact on student satisfaction. Thus, construction of learning equipment and facilities is an important future direction for improving student satisfaction.

5. Conclusion and discussion

During the sustainable development of universities and colleges, one of the problems is to improve student satisfaction in teaching process. Scholars have proposed many useful viewpoints from different perspectives. The “student-centered” view, based on constructivism theory, has gradually become the general teaching viewpoint in contemporary universities for its emphasis on students’ subjective initiative. To test “student-centered” view, student satisfaction could be an important evaluation index. Therefore, university and college should analyze and understand the main factors affecting student satisfaction for teaching and the major and minor relationship of factors. Then, it is possible to accurately master student satisfaction and the way to conduct student-centered teaching. In this study, three hypotheses were proposed by the way of questionnaire. Besides, Structural Equation Model was used to research an empirical case. Results showed that teachers’ teaching attitude has a significant influence on student satisfaction. In terms of course construction, the selection of teaching materials has a positive influence on student satisfaction too. As for hardware facilities in college teaching, teaching equipment also has a positive influence on student satisfaction.

Therefore, to improve student satisfaction, recommendations were proposed to improve student satisfaction in higher education. First of all, training and education for college teachers should be strengthened to improve their overall quality. Especially, teachers should have correct teaching attitude and proper understanding of responsibilities and job significance. Then, curricula construction should be improved to make curriculum system satisfy practical needs. It should focus on selection of appropriate materials to meet actual needs of students. Finally, colleges should strengthen construction of hardware facilities. Teaching equipment should be constantly updated, with sufficient practice base, creating favorable environment for learning of students.

Acknowledgements

This project was funded by the National Planning Office of Philosophy and Social Science in China (ID: CFA130153), and in providing financed support from the Major Normal Science Foundation of Henan Province, China (ID: 17A630016), Foundation of Henan provincial government (ID: 2016B071). The authors declare that there is no

conflict of interest with any financial organizations regarding the material reported in this manuscript.

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Influences of Leader-member Exchange on Employees' Service Innovation Behaviors

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Pages: 356–369

Abstract: Based on literature researches, a regulated conceptual model was built to explore relationship between leader-member exchange and employees' service innovation behaviors and regulation effects between economic exchange and social exchange. Based on existing maturity scale and proper adjustment to Chinese cultural factors, 11 measurement items were refined and used for measuring influences of leader-member exchange. Economic exchange and social exchange on employees' service innovation behaviors relatively. The research was conducted among employees in service companies in regions of Quanzhou, Xiamen and Fuzhou, Fujian Province. In total, 600 questionnaires were passed out and 407 responses were received. The empirical result basically supports theoretical expectation of the research. From the perspective of social exchange, the conclusion pointed out mechanisms of how leader-member exchange influences employee innovation behaviors. Specific performance is that leader-member exchange positively influences employees' innovation behaviors and economic exchange negatively influences the relationship between leader-member exchange and employees' service innovation behaviors. Positive regulation effect of the social exchange on the relationship between leader-member exchange and employees' service innovation behaviors has not been supported by empirical statistics.

Keywords: Leader-member Exchange, Economic Exchange, Social Exchange, Service Innovation Behavior.

1. Introduction

With the rapid development of global economy, global industrial structure has illustrated a general shift from “industrial economy” to “service economy”. Servitization of service sector and manufacturing sector plays an increasingly important role in real economy. Taking some developed countries in Europe and America as examples, the share of service sector in economic aggregate increases and ranks between 60% and 80% (Pieterse et al, 2010). Thus, under the trend of service sector's servitization, the level of development in service sector has become a significant determining factor of restricting economic growth. The continuous development and expansion of service sector requires general

innovation impulses of participants in service sector and undoubtedly, employees' service innovation behaviors are key to whether general innovation of service sector can be achieved.

In existing researches over influences on employee service innovation behaviors, influential factors are categorized into employee individual characteristics and external characteristics of employee workplaces (Chatman, 1989). External characteristics that influence employees' innovation behaviors include: innovation atmosphere, organization managers, leader-member exchange (LMX) and so on. Obviously, good organizational innovation atmosphere, excellent organization managers and high-quality LMX are beneficial for emergence of employees' service innovation behaviors. Among many observable variables that influence employees' service innovation behaviors, LMX is one of most often discussed variables in existing relevant research fields. LMX emphasizes that in an organization, due to limits of resource allocation, different kinds of member relationship in organizations are formed between leaders and members. Usually, building such kind of relationship between members centered by leader forms so-called "In-circle Organization" and "Out-circle Organization". Regardless of practical innovation behavior characteristics owned by employees themselves, once an employee belongs to existing "In-circle Organization" or "Out-circle Organization", his innovation behaviors are likely to be influenced by the innovation environment where the employees exist. Scott and Bruce (1994) pointed out that influences of LMX on employees' innovation behaviors are achieved through organizational innovation atmosphere as a complete intermediary. High-quality LMX relationship enables employees to feel stronger support of innovation management and in an organizational overall environment that supports innovative work to encourage innovation. Somech and Drach-Zahavy's research (2010) with LMX as an intermediary variable discusses employees' organizational relationship and certifies that quality of LMX relationship has certain regulation effect on social exchange relationship between employees and organization and organizational investment into employees' distribution depends on LMX. In addition, in researches over influences of social exchange and economic exchange on employee commitment and resignation intention, Chen et al. (2007) used LMX as an intermediary variable and pointed out regulation effects of LMX on two exchange relationships, emotional commitment and resignation intention. High-quality LMX relationship positively regulates the influence of social exchange on employees' emotional commitment and negatively regulates the influence of social exchange on their resignation intention. The research of Shipton et al. (2006) discusses the influence of employee-organization relationship on employees' innovation behaviors from the perspective of social exchange and pointed out that high-quality of employee-organization relationship can improve employees' self-efficacy, sense of belonging and responsibility to encourage innovation behaviors in actual work of employees. However, Avey (2009) focuses on relationship between realistic leaders and employees' innovation behaviors and his research pointed out that LMX has regulation effect between the two.

Traditionally, researches related to leader state that there are various leading styles and methods. For example, collaborative leader, problem-solving leader and transformational leader can encourage employee innovation effectively (Jung, 2001), but how LMX influences employee innovation behaviors, particularly service innovation

behaviors, is an issue worth more deep discussion. This paper attempts to explore the influence of LMX on employee service innovation behaviors using economic exchange and social exchange as variables. Different from previous related researches mostly with LMX as a regulation or intermediary variable, this research directly discusses influences of LMX on employee innovation behaviors and discusses direct and regulation effects of social exchange and economic exchange on employee innovation behaviors at the same time. The hypotheses of this paper about direct influences of LMX on employee innovation behaviors also matches with the basic judgment put forward by Tierney and Farmer (2002): the subjective high-quality exchange between employees and team has an impact on employee innovation behaviors through influence on the employees' self-judgment.

2. Literature review and hypotheses

2.1. Direct influences of leader-member exchange on employee service Innovation Behaviors

Innovation behavior is a multi-stage process including identifying problems, generation of ideas and solutions, and building practices of ideas. That innovation practices individual knowledge, skills and capability are main determining factors of whether innovation behaviors will emerge; at the same time, internal motives of organization also matter. Thus, Woodman et al. (1993) and Charbonnier-Voirin et al. (2010) put forward that considering individual characteristics (personality, accomplishment, etc.) as innovation metrics, organizational environment factors (atmosphere, job requirement etc.) are also variables that have mutual effect with individual characteristic indexes.

Since innovation behaviors belong to the consequence of mutual effects between employee individual motives and organizational environment, organizational innovation atmosphere related to employee-organization relationship is a determining factor influencing employee innovation behaviors. Anderson and West's research (1998) pointed out that in a team, mutual reaction and experience sharing between team members are significant prerequisites of innovation atmosphere. A leader in a team works as an organization agent as well as an organization spokesman. Due to limited time and energy of leaders, different forms of relationship form between organizational leaders and team members. Different organization-member relationship leads to difference of self-recognition that employees have in an organization and then difference of employees' performance in actual work (Hui et al. 2005).

Based on mutual benefit principle of social exchange, under high-quality leader-member relationship, members' efforts in resource exchange will make leaders have stress in rewards and as an organizational agent struggle for more benefits (Chiaburu, 2005). Similarly, under the prerequisite that leaders struggle for more benefits for organizational members, organizational members reward efforts of leaders with performance. Based on understanding above, this study makes hypothesis as following:

Hypothesis1: Leader-member exchange has a positive influence on employee service innovation behaviors.

2.2. Direct influence of economic exchange and social exchange on employee service innovation behaviors

In organization-member relationship, economic exchange and social exchange are two commonly existing and widely discussed relationship. Shore et al. (2009) pointed out social exchange and economic exchange are different elements in employee-organization relationship (EOR). Social exchange emphasizes long-term of relationship and emotional factor in maintained relationship; economic exchange is based on the exchange relationship formed by short-term perspective and generally, between leaders and members, no factors related to relationship investment exists (Janssen and van Yperen, 2004). EOR developed from social exchange theory drawn by Blau (1964) originally and under the assumption that exchange relationship exists, the exchange between members and the organization is based on equal exchange.

Considering that employee innovation in fact is an active behavior operated by individual minds, in actual work, only from the perspective of existing employee-organization relationships, whether employee innovation behaviors happen is influenced by two exchange relationships: social exchange and economic exchange (Amabile, 2004). Judging from experience, the positive incentive effects owned by economic exchange and social exchange should both encourage employee innovation behaviors. However, considering the difference between employee innovation behaviors and actual work responsibility, it is stated that whether employees innovate usually does not influence the performance of employees. That is to say, the emergence of employee innovation behaviors is based on other driving factors besides motivation of fair and equal exchange relationship. Based on innovation behavior mutual reaction model put forward by Woodman et al. (1993), individual emotional factor is an important variable deciding the appearance of innovation behaviors. In addition, researches of Shipton et al. (2006) illustrated that as an intermediary, psychological ownership influences connection between employee-organization relationship and innovation behaviors. Therefore, an assumption can be bravely made that emergence of innovation behavior operated by employee individual mind is influenced by psychological ownership formed by employee-organization exchange relationship. In other words, when organization-member relationship positively effects employee psychological ownership, that exchange relationship positively influences employee innovation behaviors. Conversely, when organization-member relationship negatively effects employee psychological ownership, that exchange relationship negatively influences employee innovation behaviors. Based on analysis above, Hypotheses are given as following:

Hypothesis2: Economic exchange has a negative influence on employee service innovation behaviors.

Hypothesis3: Social exchange has a positive influence on employee service innovation behaviors.

2.3. Regulation effects of economic exchange and social exchange

Further considering complexity of leader-member relationship in an organization, based on restriction of reality, different kinds of leader-member relationship forms between leaders and members. When leaders attempt to give more benefits and trust to the In-circle people, leader-member relationship naturally forms (Onne, 2005). Generally speaking,

high-quality LMX gives more cares to direct leaders and improve employees' comfortable feelings and sense of trust, which positively influences on the emergence of employee self-innovation (Krishnan, 2004; Krishnan, 2005). At the same time, under the influence of high-quality LMX, employees themselves will realize the significance to the success of the organization and their commitment to more willingly expand their responsibilities and perform incentives and have innovative performance (Carmeli, 2009; George, 2007). It is noticeable that with current knowledge economy development, employee value not only reflects in their knowledge but also their innovation behaviors in performance (Gerstner and Day, 1997). Employee innovation behaviors are bases of efficient organizations and play important roles in improving organizational competitive advantages and resource utilization maximization (Hooper and Martin, 2008; Lam et al., 2007).

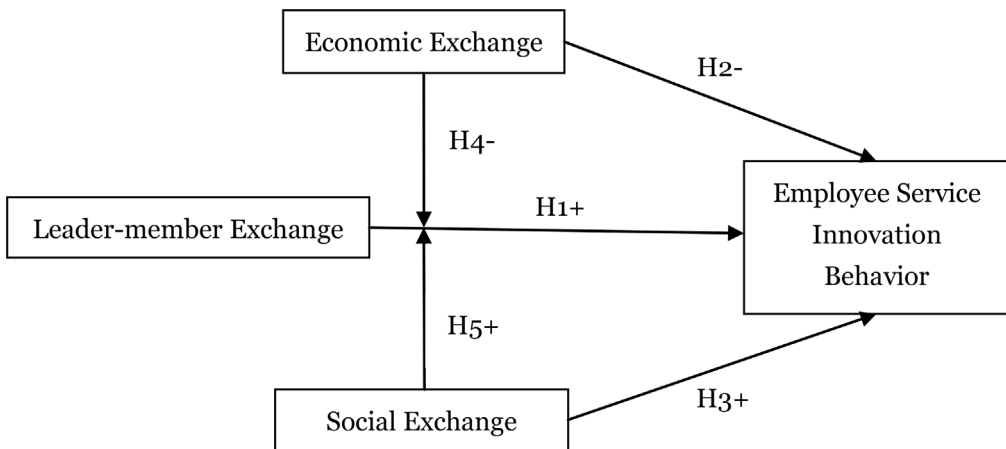


Figure 1 – A relationship model among leader-member exchange, economic exchange, social exchange and employee service innovation behaviors

As a result, this research further considers regulation effects of economic exchange and social exchange on relationship between LMX and employee innovation relationship. Known from previous analysis over LMX, in the framed of LMX relationship, “Out-circle” employees can get more advantages both materially and non-materially. Their self-consciousness in work is sparked to encourage innovative work. Thus, the next issue discussed is: if economic exchange and social exchange are added between LMX and employee innovation behaviors as regulation variables, how do regulation effects generated by those two influence the relationship between LMX and employee innovation behaviors? To expand issues of this paper, two hypotheses are further put forward as following:

Hypothesis 4: Economic exchange negatively regulates the relationship between LMX and employee innovation behaviors.

Hypothesis 5: Social exchange positively regulates the relationship between the relationship between LMX and employee service innovation behaviors.

Based on the theories and assumptions above, this study builds conceptual modal as Fig. 1.

3. Research design

3.1. Variable measurement

The measurement of economic exchange and social exchange uses measurement scales of Shore et al. (2006) which is adjusted properly according to Chinese cultural context and 11 measurement items were drafted. Six items were used for measuring economic exchange relationship between employees and the organization. For example, based on the question “compared with my contribution, I care more about what I can get from my workplace?”, Cronbach’s Alpha is 0.849; five items were used to measure social exchange relationship between employees and the organization. For example, based on “I contribute a lot to the workplace and I also benefit from it a lot”, Cronbach’s Alpha is 0.753. Base on measurement research results of Scandura and Graen (1984) and Wayne et al. (1997), six measurement items were used for leader-member exchange. For example, “I can use new ideas and methods to solve emerging problems in service”, Cronbach’s Alpha is 0.795. All measurement items used Likert scale. In addition, this research also chose learning experiences, age, working length and other employee characteristic variables as controlled variables and used dummy variables to measure.

3.2. Statistics collection and samples’ characteristics

This research used questionnaires to collect statistics and was conducted among employees in service companies in regions of Quanzhou, Xiamen and Fuzhou, Fujian Province. In total, 600 questionnaires were passed out and 407 responses were received. As many as 48 questionnaires that have more than 5 questions without answers, or have more than 8 constant questions with the same answer or the same reverse answers were extracted and final valid questionnaires were 359, so the valid rate of recovery is 59.8%. Frequency ratio method was used to analyze samples’ characteristics of applicants. From the perspective of gender, the share of males (46.5%) is a little lower than that of females (53.5%); from the perspective of age, employees in the service sector with the age of more than 23 account for the majority (89.4%); from the perspective of learning experience, employees in the service sector that have a degree above junior colleges account from more than a half (63.2%); from the perspective of the only child, employees in the service sector that are not the only child take up more than 70%. In addition, from the perspective of working length, the ages of applicants distribute relatively evenly; those with less than 1 year, between 1 and 3 years, between 3 and 6 years, and more than 6 years take up around a quarter relatively.

4. Conclusion and analysis

4.1. Descriptive statistical analysis and correlation analysis

Table 1 provides mean value and standard deviation of variables and Pearson correlation coefficients between variables. The mean value of social exchange relationship between employees and the organization ($M=5.446$) is higher than the mean value of economic exchange ($M=3.939$). It illustrates that the social exchange relationship between employees and the organization is stronger than economic exchange relationship. In addition, related analysis showed that correlation coefficients of social exchange, leader-

Variable	M	SD	1	2	3	4	5	6	7
1 age	22.19	1.215	-						
2 learning experience	.63	.483	.056	-					
3 working length	.52	.500	-.323***	-.176**	-				
4 economic exchange	3.939	1.485	.023	-.021	-.039	-			
5 social exchange	5.447	.935	-.002	-.033	.107*	-.010	-		
6 leader-member exchange	4.726	1.076	-.043	.142*	.142*	-.033	.441***	-	
7 service innovation behavior	5.309	.855	.013	-.081	.062	-.096	.315***	.373***	-

Table1 – Descriptive Statistics and Pearson Relation of Variables

Structure Name	Measurement Item	Rotated Factor Load			
Economic Exchange	Economic Exchange 1	.809	-.024	.037	.024
	Economic Exchange 4	.790	-.018	-.010	.064
	Economic Exchange 6	.783	.019	-.013	.137
	Economic Exchange 2	.780	.062	.002	-.037
	Economic Exchange 3	.714	-.066	-.055	-.008
	Economic Exchange 5	.613	-.014	-.058	-.211
Leader-member Exchange	Leader-member Exchange 6	-.162	.809	.020	.092
	Leader-member Exchange 5	-.061	.808	.071	.021
	Leader-member Exchange 4	-.112	.692	.093	.189
	Leader-member Exchange 3	.144	.676	.153	.173
	Leader-member Exchange 1	.087	.614	.157	.140
	Leader-member Exchange 2	.078	.569	.145	.274
Service Innovation Behavior	Service Innovation Behavior 6	-.097	-.094	.749	.087
	Service Innovation Behavior 4	.033	.205	.738	.131
	Service Innovation Behavior 5	.107	-.026	.726	.153
	Service Innovation Behavior 2	.107	.349	.680	.031
	Service Innovation Behavior 1	-.113	.191	.604	.089
	Service Innovation Behavior 3	-.348	.344	.542	.044
Social Exchange	Social Exchange 3	.105	.073	.136	.780
	Social Exchange 5	-.057	.152	.029	.779
	Social Exchange 2	-.224	.235	.089	.676
	Social Exchange 4	.195	.131	.168	.641
	Social Exchange 1	-.119	.352	.126	.502

Notes: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table 2 – Rotated Component Matrix and Factor Loading

member exchange and service innovation reach significant levels and are suitable for testing regression models.

4.2. Validity analysis

All measurement items used in this research come from maturity scales in authoritative journals and amended through experts' discussion and pre-tests, thus they have good content validity. At the same time, EFA method is used to test structural validity of questionnaires. The KMO value of 41 measurement items is 0.849. The Chi-Square value of Barlett spherical examination is 2773.16 (degree of freedom is 253) which is at a significant level. It illustrates that correlation matrixes contain general factors and factor analysis is suitable. Based on the characteristic root larger than 1 to decide the number of extracted factors, principal component analysis and varimax were used to extract factors and thus 4 factor structures are obtained (see Table 2): social exchange, leader-member exchange, service innovation behavior and social exchange. Cumulative explained variance is 55.67% and after varimax, all factors' loads after rotation are above 0.5. Therefore, that scale also has a good structure validity.

4.3. Hierarchical regression analysis

Based on hierarchical regression analysis, this research uses age, academic experience and working length as controlled variables and leader-member exchange, economic exchange and social exchange as independent variables. Service innovation behavior is used as a dependent variable and the result is showed in Table 3.

Model 1 and model 2 are used to examine the direct influence of leader-member exchange on employee service innovation behaviors. Model 1 considers the influence of three controlled variables including age, academic experience and working length on employee service innovation behavior. Leader-member exchange is added in model 2 as well. It is illustrated that leader-member exchange has a significantly positive influence on employee service innovation behavior ($\beta = .390$, $P < .001$) and hypothesis 1 is tested with the existence of controlled variables.

Based on model 2, model 3 further tests the direct influences of economic exchange and social exchange on employee service innovation behaviors. It is found that leader-member exchange positively influences service innovation behaviors ($\beta = .302$, $P < .001$). That is to say, in our models, the influence of leader-member exchange on service innovation behaviors has a quite good stability. In addition, observed from statistics in Table 3, economic exchange negatively influences service innovation behaviors ($\beta = -.087$, $P < .1$) and hypothesis 3 is certified. At the same time, hypothesis 2 is verified at a relatively less significant level. The probable reasons lie in that at the beginning stage of the economic exchange between employees and the organization, economic stimulus is effective for sparking employee's innovation passion. After the economic stimulus reaches or exceeds a certain point, economic stimulus reflects negative influence on employee innovation behaviors. That is to say, effectiveness of economic stimulus is limited. Thus, judging from current empirical evidence, the relatively lower level of negative influence of economic exchange on service innovation behaviors can be supported by subjective experiences and then hypothesis 2 is certified.

Variable	Service Innovation Behavior			
	Model 1	Model 2	Model 3	Model 4
Age of employees	.045	.043	.035	.007
Academic experience of employees	-.060	-.124*	-.110	-.069
Working length of employees	.078	.014	.000	-.001
Leader-member exchange		.390***	.302***	.296***
Economic exchange			-.087+	-.108*
Social exchange			.193**	.152*
Leader-member exchange * Economic exchange				-.168**
Leader-member exchange * Social exchange				-.053
R2	.011	.156	.193	.222
F	1.144	14.742***	12.682***	11.279***
ΔR^2		.145	.037	.029
ΔF		54.956***	7.387**	5.898**
DW			2.117	
VIF	.790 $\leq$ VIF $\leq$.997			

Notes: Model 2 to Model 1; Model 3 to Model 2; Model 4 to Model 2

*** represents $P < 0.001$; ** represents $P < 0.01$; * represents $P < 0.05$; + represents $P < 0.1$

Table 3 – Regression Analysis Results of the Effects of LMX on Employee Innovation Behavior

Under model 3, model 4 further introduces economic exchange and social exchange as regulation variables to examine the influence of leader-member exchange on employee service innovation behaviors. According to regression analysis result in Table 3, it is confirmed that both economic exchange and social exchange confirmed in model 3 have an impact on service innovation behaviors. Judged from the degrees and direction of influence in model 4, the influences of economic exchange ($\beta = -.108$, $P < .1$) and social exchange ($\beta = .152$, $P < .05$) on service innovation behaviors are consistent. That is to say, model still have a good stability. Following, observed from the regulation effects of economic exchange and social exchange on employee service innovation behaviors, economic exchange negatively regulates the relationship between leader-member exchange and employee innovation behaviors ($\beta = -.168$, $P < .01$) and hypothesis 4 is verified.

Social exchange positively regulates the relationship between leader-member exchange and employee innovation behaviors ($\beta = -.053$, $P > .1$) and hypothesis 5 cannot be certified. The possible reasons might be that social exchange emphasizes the non-material exchange relationship between the organization and members, but when limited resources decided by leader-member relationship are distributed in the “circle” of leaders and members, the distribution is also based on the non-material exchange relationship with leader-member relationship as a link. However, what needs to be pointed out that

non-material exchange relationship between leaders and members belongs to “In-circle” non-material exchange relationship and social exchange between employees and the organization belongs to “Out-circle” non-material exchange relationship. When “Out-circle” non-material exchange has an impact on the relationship between “In-circle” non-material exchange and employee innovation behaviors, existing “In-circle” member relationship will weaken the “Out-circle” organization-member relationship. As a result, the regulation effect of possible social exchange on the relationship between leader-member exchange and employee service innovation behaviors would not be significant or less negative as shown in Table 3.

5. Discussion and conclusion

This study using the modeling method of statistics and hierarchical regression certifies the direct influences of leader-member exchange, economic exchange and social exchange on employee innovation behaviors. It also uses economic exchange and social exchange as regulation variables to certify regulation effect on the relationship between leader-member exchange and employee innovation behaviors. Results of this research found that leader-member exchange and social exchange positively influence employee innovation behaviors and economic exchange negatively influences employee innovation behaviors; economic exchange positively regulates the relationship between leader-member exchange and employee innovation behaviors. This series of conclusions matches with hypotheses of the research. However, the regulation effect of social exchange on the relationship between leader-member exchange and employee innovation behavior is not significant and the direction is not consistent with the hypothesis of the research. In the past related literatures, Scott and Bruce (1994) pointed out the influence of leader-member relationship on employee innovation behaviors is achieved through organizational innovation atmosphere as an intermediary. Somech and Drach-Zahavy (2010) indicated that the quality of leader-member relationship has certain regulation effect on social exchange relationship between employee and organization. Study of Chen et al. (2007) discussed the influence of employee-organization relationship on employee innovation behaviors from the perspective of social relationship. Therefore, known from analysis above, leader-member relationship is the key factor which influences employee-organization relationship and employee innovation behavior. However, this research directly discusses the relationship between leader-member relationship and employee innovation behaviors, particularly with social exchange and economic exchange as regulation variables, to further explore their regulation effects on the relationship between leader-member exchange and employee innovation behaviors. The study in this direction have not appeared. In this paper, a conclusion about the positive influence of leader-member exchange on employee innovation behaviors is drawn using employees in the service sector as samples. But judged from generality of leader-member relationship in organizations, the conclusion has certain degree of expansion. Thus, the research result further deepens our understanding of leader-member exchange and points out research rooms in related fields like organization-member relationship, employee innovation behaviors and organization innovation atmosphere. In addition, based on the hypothesis about economic exchange and social exchange as regulation variables in this study, the results of the study support the hypothesis that economic exchange negatively regulate the

relationship between leader-member exchange and employee innovation behaviors, but do not support the hypothesis that social exchange positively regulate those relationships. The negative regulation effect of economic exchange illustrates that performance of economic stimulus is limited or excessive and even leads to reverse response in the aspects of shaping team innovation atmosphere and encouraging employee innovation behaviors. The insignificant social exchange shows that among existing leader-member relationships, social exchange influence based on employee-organization relationship is limited, at least under the research context setting of this paper.

Furthermore, empirical results of this study has quite strong practical meaning. The study confirms that for employees in the service sectors, leader-member exchange encourages employee innovation behaviors. At the same time, study for regulation effect using economic exchange and social exchange as variables point out that considering the influence of leader-member exchange on employee innovation behaviors, the negative regulation effect of economic exchange is certified, but positive regulation effect of social exchange has not. Based on understanding of this study over economic exchange and social exchange, regulation effects of exchange relationships above on the relationship between leader-member exchange and employee innovation behaviors can get proper explanations. Under the servitization shift trend of current global economic development, service sectors or sectors' servitization can be important factors of enhancing economic development. In the course of practical service sector and sector servitization, employee participation, particularly employee service practices of innovation, is the key to the degree of service sector development and sector servitization. Therefore, leaders of organization or service innovation should pay more attention to employee innovation behaviors in innovation practice. This research particularly for the relationship between leader-member exchange and employee innovation behaviors confirms positive influence of high-quality leader-member relationship on employee innovation behaviors in different dimensions. Thus, from the perspective of leaders in organizations, considering encouraging employee innovation, maintaining high-quality leader-member relationship is one of keys to promising the appearance of employee innovation behaviors. In addition, researches particular for regulation effects of economic exchange and social exchange point out when leaders encourage employee innovation passion, non-material exchange is better than material exchange relationship. So leaders in organization should focus on motivation performance of economic exchange and strengthen positive performance of social exchange in encouraging employee innovation.

Finally, this study provides one kind of effective mechanism between leader-member exchange, economic exchange, social exchange and employee innovation behaviors within organizations based on theoretical framework and empirical evidence. At the same time, this study also gives related executives with effective decision evidence and empirical reference based on the built valid management mechanism and combination strategy of encouraging employee innovation. Certainly, it is noticeable that particular for researches over the relationship between leader-member exchange and employee innovation behaviors, empirical researches in this essay reach some initial conclusion. Then more research expansion could be conducted over related research topics. Taking the regulation effect of social exchange on the relationship between leader-member relationship and employee innovation behaviors as

an example, empirical evidences in this essay fail to support assumptions in the conceptual models. What are the reasons in fact? Further researches would be conducted over similar issues.

Acknowledgement

The authors thank the anonymous referees for their constructive suggestions. This study was supported in part by the Education and Research Projects of Young and Middle-aged Teachers in Fujian Province (JAS150104) and NSFC (71571074).

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Study of Impact of Social Distance on Strategic Consuming Intentions

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Pages: 370–379

Abstract: Strategic consumer behaviors result in overstocking of products and reduce the overall economic efficiency and social welfare. The purpose of this study was to discuss the impact of social distance on strategic consumer behaviors from the cognitive perspective of psychological distance based on the Construal Level Theory. Experimental method was adopted in this study and mobile phones were used as the experimental product. Based on the data analysis of 230 questionnaires, this study found that far social distance would result in relatively stronger strategic consuming intention. Moreover, emphasis on far social distance would enhance strategic consuming intention, and emphasis on close social distance would weaken strategic consuming intention.

Keywords: psychological distance, social distance, temporal distance, strategic consumption, short-sighted consumption.

1. Introduction

Strategic consumer behavior is also known as “strategic customer behavior”, which was first proposed by John F. Muth (1961) from the perspective of economics and was introduced into the analysis of newsvendor model. In fact, when it comes to the balance of short-term benefits and long-term benefits, inter-temporal decision-making behaviors of the consumers can be divided into short-sighted behavior and strategic behavior. Short-sighted consumer behaviors are those of purchasing decisions that are made with short-term considerations and focus on the current price/value only. Short-sighted consumer behaviors occur when “the preference for personal short-term benefits is greater than that for long-term benefits” (Hoch and Loewenstein, 1991). On the contrary, strategic consumer behaviors are those of purchasing decisions that are made with considerations of future price/value, i.e., customers adjust the purchasing time based on the expected future price of the product, waiting for further price reduction (Phillips, 2005). Strategic consumer behaviors will cause decline in product and service quality, overstocking of products, and imbalance between supply and demand etc., and reduce overall economic efficiency and social welfare (Swinney, 2009).

Current studies on strategic consumer behaviors mainly involve the field of operational management, focusing on how to eliminate the adverse impact of strategic consumer behaviors. Current studies mainly present the following characteristics: (1) Based on the perspective of operational management. Most studies consider how to reduce the adverse impact of strategic consumer behaviors from the operational management perspective, such as enterprise pricing, inventory management, and supply chain management. (2) Based on entirely rational hypotheses. Namely consumers decide whether to buy the products now or later based on the current product price, the expected price, the expected inventory, etc., in accordance with the principle of utility maximization. (3) Mostly by quantitative research methods. In current studies, relevant mathematical models are mainly based on the game theory, the equilibrium solutions of which are obtained by theoretical analysis, and the feasibility of the model solutions is verified by numerical simulation. There are few empirical studies.

However, consumers are not entirely rational. According to Construal Level Theory (CLT), there are different levels of abstraction, i.e., construal level for people's psychological characterization of cognitive objects, and construal level depends on the psychological distance between the perceived object and the cognitive object, thereby affecting people's judgment and decision making (Kim, 2008). In the field of social psychology, Liberman first related the concept of psychological distance and Construal Level Theory in 1998, and formed relatively mature theory of psychological distance, the core idea of which is based on the social cognition perspective that people's reactions to a social event depend on people's the psychological characterization of the event. There is automatic and bidirectional link between psychological distance and construal level. People tend to use high levels of construal to characterize things of far psychological distance, and low levels of construal to characterize things of close psychological distance (Liberman, 2007).

Psychological distance is a subjective experience arising when something is close to or far away from the reference point (self, now and here) (Trope and Liberman, 2010). Psychological distance is thus egocentric: Its reference point is the self, here or now. Liberman (2002) defined that psychological distance contained four dimensions: temporal distance, spatial distance, social distance and hypotheticality (Baranan et al., 2006; Baranan et al., 2007; Trope et al., 2007; Trope and Liberman, 2010), which together constituted the basic framework of psychological distance. Thereafter, Liberman et al. (2007) thought that besides the four dimensions above, psychological distance shall also contain other dimensions. However, the other dimensions of psychological distance have been controversial all the time, and there is no more extensive study support. Commonality of various dimensions of psychological distance allows exchange of information perception between different dimensions. More and more studies have found that such dimensions as temporal distance, spatial distance and social distance extend towards different directions from the origin of the individual's own direct current experience (Baranan et al., 2006; Baranan et al., 2007; Liberman et al., 2006; Trope et al., 2007; Shani et al, 2009). The longer the temporal distance, the farther the spatial position, and the more unfamiliar the relationship, the psychological distance received by people will be farther.

Short-sighted consumption and strategic consumption have different psychological distances: Strategic consumption itself is associated with longer temporal distance, and short-sighted consumption itself is associated with shorter temporal distance. Therefore,

temporal distance will certainly affect these two types of consumer behaviors. Meanwhile, according to CLT theory, all kinds of psychological distances can systematically affect people's construal way of future events, thus affecting the preferences and choices (Fujita, 2008). Therefore, strategic consumer behavior and short-sighted consumer behavior will inevitably be affected by other dimensions of psychological distance - such as the impact of social distance between consumers and businesses. Moreover, different psychological distances have similar mechanism of action (Bar-Anan, Liberman, Trope, 2006; Liberman, Trope, McCrea, 2007). It can thus be seen, far social distance has stronger impact on strategic consuming intentions, and close social distance has stronger impact on short-sighted consuming intentions. Accordingly, this study assumed that:

H1: Different social distances had significant impact on strategic consuming intentions, and compared with close social distance, the strategic consuming intentions in far social distance are stronger.

H2: Different social distances had significant impact on short-sighted consuming intentions, and compared with far social distance, the short-sighted consuming intentions in close social distance are stronger.

There are also interactions between various dimensions of psychological distance. According to CLT, the mechanism of action to individual reaction is very similar for different dimensions of psychological distance. Increase of psychological distance on one dimension will affect the individual's perception of other distance dimensions. For example, according to the study on temporal distance, increase of temporal distance will make the subjects feel farther social distance (Stephan, 2010). In the studies on spatial distance, Boroditsky (2000) confirmed the similarity between temporal distance and spatial distance, namely the activation of space concept will affect the judgment of time dimension. In the studies on social distance, Stephan (2010) used politeness to characterize social distance, and proved by experiments that there was interaction between social distance, temporal distance, and spatial distance, and that increase of temporal distance (far future) would make the subjects feel farther social distance. Baranan (2007) verified the cognitive relationship between the four psychological distance dimensions, and the results supported the interrelations and inter-access between different dimensions of psychological distance. They also found that the subjects showed quicker reactions to consistent distance stimuli than inconsistent distance stimuli. Therefore, for strategic consumers of longer temporal distance, when the social distance is consistent with temporal distance, namely when the emphasis is on the impact of far social distance, strategic consuming intentions may be enhanced. Similarly, for short-sighted consumers with preference for shorter temporal distance, when the emphasis is on the impact of close social distance, short-sighted consuming intentions may be enhanced. Accordingly, this study proposed the following hypotheses:

H3: Emphasis on far social distance would enhance consumers' strategic consuming intentions;

H4: Emphasis on close social distance would enhance consumers' short-sighted consuming intentions.

On the other hand, since different psychological distances have the same mechanism of action, this study presumed that when different psychological distances are inconsistent, the interaction may be partially offset. For example, close social distance may partially offset the impact of long temporal distance, thus weakening the strategic consuming intentions, and even reversing the preference; likewise, far social distance may partially offset the impact of short temporal distance, thus weakening the short-sighted consuming intentions. Accordingly, this study proposed the following hypotheses:

H5: Emphasis on far social distance would weaken consumers' short-sighted consuming intentions;

H6: Emphasis on close social distance would weaken consumers' strategic consuming intentions.

2. Research methods

2.1. Procedure

Experimental method was adopted in this study and mobile phones were used as the experimental product. Firstly, this is because most scholars use 3C products as the experimental product of their studies. Secondly, 3C products are frequently used in the daily life of consumers, and consumers can blend themselves well into the experimental scenario. Thirdly, 3C products usually have a relatively fixed price reduction cycle. In China's mobile phone market, for example, the price is reduced by about 15% – 20% every three months since the launch of a new product. In fact, more and more consumers are choosing strategic consumption when purchasing such products because they know the price reduction law of these products.

This study consisted of a pre-experiment and a post-experiment. Before the experiment, the subjects were informed of the study purpose, experimental procedures and requirements and were asked to read the assigned experimental scenario carefully and fill out the questionnaires based on their true thoughts. In Experiment 1, subjects were put into this scenario: Subjects planned to buy an A brand mobile phone which was sold at a uniform price on the market. Subjects had understood the attributes, price and after-sales service of this phone product, and also learned that the phone would be remained at the original price until nine weeks later when the phone price would be cut by 20%. Then the subjects were asked to fill in their consuming intentions in the near and far future and answer the measuring questions about temporal distance. After that, music was played for a 10-minute interval before the second experiment. In Experiment 2, subjects were told that they saw A brand mobile phones were sold in an S store. Subjects were grouped randomly and given a questionnaire on social distance. Half of the subjects were informed of close social distance to the S store; while the other half of the subjects were informed of far social distance to the S store. Under different scenarios, subjects were asked to reconsider, fill in their consuming intentions in the near and far future, and answer the measuring questions about their perception of social distance. After the experiments were completed, subjects were asked to fill in their demographic information, such as sex, age, occupation and level of education.

2.2. Sample

In this study, a preliminary experiment was conducted first, and details of experimental design were improved according to the results of the preliminary experiment. In the formal experiment, volunteers were invited to participate in the laboratory experiment by online and offline methods, and a total of 300 subjects participated in the formal experiment. After the experiment was completed, 230 valid questionnaires were collected. Of the valid respondents, men accounted for 30.9%, and women accounted for 68.1%; subjects were at the age of 18 to 50, with 18 to 30 accounting for 94.3%; most subjects were students, accounting for 75.2%; most subjects had the educational education of junior college degree/bachelor's degree and master's degree, accounting for 67% and 29.1% respectively.

2.3. Measures

Temporal distance in this study referred to the distance from the temporal point when the consumers were expected to purchase the products to the present point. Compared with consuming intentions in the near future, the temporal distance to the present point is longer for consuming intentions in the far future. In this study, the time cycle control of Liberman and Trope (1998) was used to control the temporal distances for the near and far future, respectively within 1 week (short temporal distance) and 9 weeks later (long temporal distance).

Social distance in this study referred to the differences between self and others, between members within the group and others outside the group, between similar people and dissimilar people, and between friends and strangers (Pronin et al., 2008; Stone, 2008; Liviatan et al., 2008; Kim et al., 2008). Social distance is a very important dimension of psychological distance. It is closely associated with interpersonal relationships. As shown by the study of Ray L. Benedicktus (2008), larger psychological distance will increase the uncertainty of interpersonal communication and hinder the establishment of interpersonal relationships; while smaller psychological distance will promote interpersonal communication and the establishment of stable and reliable interpersonal relationships. Since consumers' purchasing decisions are a complex psychological process, the relationship between the buyer and the seller can influence consumers' purchasing decisions. Therefore, degree of familiarity for the relationship between the buyer and the seller was used in this study to characterize social distance.

In the formal experiment, 7-level Likert Scale was used to valuate temporal distance and social distance (1 = extremely close, 7 = extremely far, and so on) of the subjects. For short-sighted and strategic consuming intentions, 7-level Likert Scale was also adopted to measure the attitude of the subjects towards the questions (1 = extremely unwilling, 7 = extremely willing, and so on).

3. Result

3.1. Test on experiment control

To test whether the control of temporal distance was reasonable, subjects were asked to fill in the measuring questions about "1 week from now" and "9 weeks from now" after

reading the materials. Results of T test showed that difference between short and long temporal distances was significant for the subjects ($t = -36.535$, $p < 0.001$), indicating that the control of temporal distance was reasonable.

Similarly, in order to test whether the experiment had effectively control the subjects' perception of social distance, subjects were asked to fill in the measuring questions about social distance in Volume A (close social distance) and Volume B (far social distance) after reading the materials. According to the analysis of variance on the results, difference between close and far social distances was significant ($F = 417.932$, $p < 0.05$), indicating the control of social distance was successful.

3.2. Impact of social distance on intertemporal consumption decisions

Experiment 1 was an initial experiment on consumers' intertemporal consumption decisions; in Experiment 2, the impacts of close social distance and far social distance were added to Group A and Group B respectively. Analysis of variance was adopted first to discuss the impact on strategic and short-sighted consuming intentions when the social distance was controlled. The results showed that social distance had a significant impact on both short-sighted consuming intentions and strategic consuming intentions. In the scenario of close social distance, subjects had stronger short-sighted consuming intentions compared with far social distance ($3.60 > 2.35$, $F = 27.446$, $p < 0.05$). On the other hand, in the scenario of far social distance, subjects had stronger strategic consuming intentions compared with close social distance ($5.39 > 4.91$, $F = 4.421$, $p < 0.05$). Hypotheses H1 and H2 were verified.

Consuming Intentions	Social Distance	Descriptive Analysis		Analysis of Variance				
		N	Mean Value		Quadratic Sum	df	F	Sig
Short-sighted	Close	123	3.60	Inter-group	90.245	1	27.446	.000
	Far	107	2.35	Within the group	749.685	228		
	Total	230	3.02	Total	839.930	229		
Strategic	Close	123	4.91	Inter-group	13.291	1	4.421	.037
	Far	107	5.39	Within the group	685.530	228		
	Total	230	5.13	Total	698.822	229		

Table 1 – Impact of Social Distance on Short-Sighted and Strategic Consumption

3.3. Impact of consistent social distance and temporal distance on consumers' online intertemporal choices

Short-Sighted and strategic consumers were classified according to the initial test data of Experiment 1. In Experiment 1, the consumers with stronger short-sighted consuming

intentions than strategic consuming intentions were short-sighted consumers; otherwise, the consumers were strategic consumers. The impact of consistent social distance and temporal distance on consumers' intertemporal decisions was analyzed based on this.

Data of Experiment 1 showed that a total of 49 subjects chose immediate shortsighted purchase, and they were short-sighted consumers; 181 subjects chose strategic purchase, waiting for price reduction, and they were strategic consumers. After that, Experiment 2 was divided into Group A and Group B and the impact of social distance was added randomly. Based on 2×2 grouping according to the types of consumers and social distance, paired-samples T test was carried out for the consuming intentions obtained in Experiment 2 and the data in Experiment 1. The analysis results showed that in the group with consistent social distance and temporal distance, the consuming intentions of 85 strategic consumers affected by far social distance were significantly enhanced ($6.09 > 5.58$, $P < 0.05$); the short-sighted consuming intentions of 27 short-sighted consumers affected by close social distance were also significantly enhanced ($6.00 > 5.22$, $P < 0.05$). Hypotheses H3 and H4 were verified.

Type of Consumers	Social Distance	Pair Analysis	Mean Value	Statistic		T Test		
				N	t	df	Sig.	
Strategic	Far	Pair 1	Strategic consuming intentions (Experiment 1)	5.58	85	-3.286	84	.001
			Strategic consuming intentions (Experiment 2)	6.09	85			
Short-sighted	Close	Pair 2	Short-sighted consuming intentions (Experiment 1)	5.22	27	-2.603	26	.015
			Short-sighted consuming intentions (Experiment 2)	6.00	27			

Table 2 – Impact of Consistent Social Distance and Temporal Distance

3.4. Impact of inconsistent social distance and temporal distance on consumers' online intertemporal choices

On the other hand, the scenario of inconsistent social distance and temporal distance was also considered. Similarly, according to the data in Experiment 1 and Experiment 2 and based on 2×2 grouping as per the types of consumers and social distance, paired-samples T test was carried out for the consuming intentions of the subjects. The results showed that in the group with inconsistent social distance and temporal distance, the strategic consuming intentions of 96 strategic consumers affected by close social distance were weakened ($5.60 < 6.17$, $P < 0.05$); the consuming intentions of 22 short-sighted consumers affected by far social distance were weakened ($3.32 < 6.18$, $P < 0.05$). Hypotheses H5 and H6 were verified, indicating that in the scenario of inconsistent social distance and temporal distance, social distance may partially offset the impact of temporal distance: Far social distance would weaken consumers' short-sighted consuming intentions and close social distance would weaken consumers' strategic consuming intention.

Type of Consumers	Social Distance	Pair Analysis Mean Value	Statistic		T Test			
			N	t	df	Sig.		
Strategic	Close	Pair 3	Strategic consuming intentions (Experiment 1)	6.17	96	4.546	95	.000
			Strategic consuming intentions (Experiment 2)	5.60	96			
Short-sighted	Far	Pair 4	Short-sighted consuming intentions (Experiment 1)	6.18	22	7.033	21	.000
			Short-sighted consuming intentions (Experiment 2)	3.32	22			

Table 3 – Impact of Inconsistent Social Distance and Temporal Distance

4. Discussion

The experiments were conducted to verify the impact of social distance on consumers' strategic and short-sighted consuming intentions: With the impact of farther social distance, consumers' strategic consuming intentions were stronger compared with closer social distance; and with the impact of closer social distance, consumers' short-sighted consuming intentions were stronger. It could be seen that social distance and temporal distance had the same mechanism of action, and the two psychological distances were mutually accessible. This is consistent with previous studies. Therefore, according to the results of this study, enterprises can affect consumers' intertemporal decisions by controlling the social distance between enterprises and customers. Specifically, in order to reduce the adverse impact of strategic consumption on enterprises and strongly promote consumers' immediate consuming intentions, enterprises can build better customer relationships and closer customer contacts to reduce the social distance between enterprises and customers, i.e., enhancing customers' immediate consuming intention by closer social distance.

This study not only verified the conclusions from previous studies that social distance and temporal distance has the same mechanism of action, but also further proved that in the scenario of consistent social distance and temporal distance, these two psychological distances had synergistic effects. Strategic consumers tended to purchase the product in a longer temporal distance because of the expected price reduction. In the scenario of farther social distance, their strategic consuming intentions were enhanced. The reason may be that farther social distance brings more risks and uncertainties, enhancing the consumers' intentions of making decisions by delaying purchases and waiting for more information. Short-sighted consumers preferred to purchase the product in the near future in a shorter temporal distance. In the scenario of closer social distance, their short-sighted consuming intentions were enhanced. The reason may be that closer social distance means being more familiar with the enterprise and reduction of purchase risks, thus enhancing their immediate consuming intentions. At the same time, there is a restrictive relationship between strategic consuming intentions and short-sighted consuming intentions. Consumers often need to balance the two and make decisions. Therefore, for enterprises, reduction of strategic consuming intentions also means increase of short-sighted consuming intentions. One of the most important strategies is to utilize the impact of social distance and promote the familiarity degree of the

relationship between enterprises and customers to establish closer social distance and enhance short-sighted consuming intentions. Therefore, good management of customer relationships and enhanced social interaction and social relations between enterprises and customers can effectively inhibit strategic consumer behaviors.

This study also further discussed whether the inconsistency of social distance and temporal distance would have the action mechanism of mutual offsetting to some extent. The results showed that for short-sighted consumers, emphasis on far social distance would weaken short-sighted consuming intentions; and for strategic consumers, emphasis on close social distance would weaken strategic consuming intentions. Therefore, this study verified that temporal distance and social distance, as two dimensions of psychological distance, not only had the same mechanism of action, but also would superimpose and amplify the impact on consumer behaviors in the scenario of consistent temporal distance and social distance, and offset and weaken the impact on consumer behaviors in the scenario of inconsistent temporal distance and social distance. Therefore, for strategic consumers who prefer to wait for a longer temporal distance to purchase the product at a lower price, social distance can be used to reverse their strategic consumption preferences. The experiment results of this study also verified the impact of social distance on reversing of preferences. In the first experiment, there were 181 subjects with preference of strategic consumption. Among them, 96 subjects were affected by close social distance in the second experiment, and 11 subjects (accounting for 11.5%) were reversed to short-sighted consumption. It illustrated that social distance can be used to reverse consumers' strategic consumption preferences, thus reducing the adverse impact of strategic consumption. The reason for reversing of strategic preferences may be that closer social distance increases the trust between enterprises and customers and reduces purchase risks. Coupled with the time saving of immediate purchase, they may make up the benefits brought by future price discounts.

In summary, this study proved by experiments that social distance and temporal distance had a similar mechanism of impact on consumer behaviors, and there were interactions between these two psychological distances. Therefore, in addition to such operating strategies as inventory management and pricing strategy, enterprises can also utilize the impact of social distance to reverse strategic consumption preferences, thereby reducing the adverse impact of strategic consumption behaviors on enterprises. Firstly, future studies may expand the sample size. Secondly, the impact of different price discounts may be considered. Thirdly, this study used the degree of familiarity for the relationship between businesses and consumers to characterize social distance. Future studies shall comprehensively measure social distance and discuss the impact of social strategic on strategic consumer behaviors in a more systematic method. Fourthly, this study discussed the interaction between social distance and temporal distance. Future studies may discuss the correlation and the mechanism of action between other dimensions of psychological distance, and also the intermediary role of risk perception.

Acknowledgement

The authors would like to thank for the System science and Enterprise development Research Center Planning Project, Sichuan (No.Xq15B05), Fundamental research funds for the Central Universities Research Projects(No. skqy201648).

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The Application of the Improved Chaos Algorithm in the Football Performance Prediction

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Pages: 380–388

Abstract: With the continuous progress of the science, the physical training is also gradually scientific. As a kind of important football phenomenon and rule, the statistics and the quantitative analysis method in the football field will be paid more and more attention by people. During the training process, using the scientific methods to predict the football performance can find out the game rules of the players and make the training plans. In this paper, we use the chaos prediction method to predict the football performance. In order to improve the performance of the algorithm, we improve the traditional chaos prediction algorithm and propose the improved chaos algorithm. According to the examples, we analyse the accuracy of the prediction.

Keywords: Improved Chaos Algorithm, Football Performance Prediction

1. Introduction

It is the current developing trend to combine the football with the prediction. The scholars studied the prediction of the football industry (Xia and Jiang, 2015) and the prediction of football talents (Chen and Zhao, 2006). The improvement of the football performance cannot be separated from scientific training. The prediction of the football performance can help the coach analyze the rules of the game. Then, that can formulate the scientific and reasonable training plan. In the modern football development, the professional trainers will find rules from training data and help the athletes for the football training. Under this background, it is very necessary to predict the football performance.

The Chaos theory is an important part of the nonlinear theory (Andr, 2016; Lino et al., 2016). The sensitive characteristics of the initial value for the chaotic system makes the changes of the system input can be reflected quickly in the output. The feature indicates that the chaotic model is closer to the reality of the world (Konrad and Rafa, 2015).

In the long development course, the Chaos theory unceasingly consummates. The research direction has included the chaotic dynamics (d'Aquino et al, 2016), the chaos prediction (Heydari et al, 2016), the chaos control (Chattopadhyay et al, 2015) etc. with the urgent demand of the social practice to the prediction theory and the limitations of the traditional forecasting models, the chaos prediction has become a focus of the chaos theory study (Wu et al, 2009). Therefore, in this paper, we choose the chaos prediction theory to study. It has the great theoretical value and the practical significance.

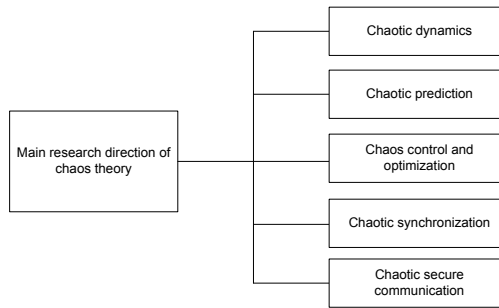


Figure 1 – The main research direction of chaos theory

In the long development course, the Chaos theory unceasingly consummates. The research direction has included the chaotic dynamics, the chaos prediction, the chaos control etc.

In this paper, we study the prediction of the football performance. By using the thought of chaos prediction, we forecast the football performance. In order to achieve a good prediction effect, we put forward the improved chaos algorithm. Then, we use the algorithm to study and predict the athletes' football performance. Finally, the experiment shows that the algorithm which applies to the football performance prediction has achieved the good results.

2. The chaos algorithm

Li Yorke definition gives the first mathematical definition of the chaos. It is the first time that the scholar gives the chaos the strict scientific significance. It is the chaos mathematical definition which has the great influence. It is defined from the interval mapping. For the continuous self-mapping on the interval, if it satisfies the following conditions, it can have the chaos phenomenon.

1. For the periodic point f , the periodic has no the upper bound. f has the periodic points with arbitrary positive integer period. That is, for any natural number n , there is $x \in I$ making $f_n(x) = x$.
2. For the closed interval I , there exists S satisfying,

When $\forall x, y \in S, x \neq y$

$$\limsup_{n \rightarrow \infty} |f^n(x) - f^n(y)| > 0 \quad (1)$$

When $\forall x, y \in S$

$$\liminf_{n \rightarrow \infty} |f^n(x) - f^n(y)| = 0 \quad (2)$$

When $\forall x \in S$ and the any periodic point of is y ,

$$\limsup_{n \rightarrow \infty} |f^n(x) - f^n(y)| > 0 \quad (3)$$

$\sup |f^n(x) - f^n(y)|$ is the upper bound of the distance between $f^n(x)$ and $f^n(y)$.
 $\inf |f^n(x) - f^n(y)|$ is the lower bound of the distance between $f^n(x)$ and $f^n(y)$.

Li-York theorem: we assume that $f(x)$ is the mapping in $[a, b]$. If $f(x)$ has three periodic points, for any positive integer n , $f^n(x)$ has n periodic points.

Takens theorem: M is d dimensional space, $\varphi: M \rightarrow M$, φ is a smooth diffeomorphism.
 $y: M \rightarrow R$, y has two order continuous derivative. $\phi(\varphi, y): M \rightarrow R^{2d+1}$, where,

$$\phi(\varphi, y) = (y(x), y(\varphi(x)), y(\varphi^2(x)), \dots, y(\varphi^{2d}(x))) \quad (4)$$

Therefore, $\phi(\varphi, y)$ is a embed from M to R^{2d+1} .

There are many ways to choose the delay time and embedding dimension. According to the embedding theorem, if $m \geq 2d + 1$, we can reveal the chaotic attractor. There are many ways to choose the embedding methods. We introduce the Cao method and the C-C method.

The Cao method was proposed by Cao Liangyue in 1997. Firstly, we define,

$$a(i, m) = \frac{\|Y_i(m+1) - Y_{n(i, m)}(m+1)\|}{\|Y_i(m) - Y_{n(i, m)}(m)\|} \quad (5)$$

Where, $Y_i(m+1)$ is the i vector in $(m+1)$ dimension reconstructed phase space. In m dimension reconstructed phase space, $n(i, m)$ makes $Y_{n(i, m)}(m)$ as the nearest neighbor integer of $Y_i(m)$. $n(i, m)$ is determined by i and m . $\|\cdot\|$ is Euclid records. It can also be calculated and achieved by the maximum norm. That is,

$$\|X_p(p) - X_i(p)\| = \max_{0 \leq j \leq p-1} |x_{k+j\tau} - x_{l+j\tau}| \quad (6)$$

We define that all the average value of $a(i, m)$ is,

$$E(m) = \frac{1}{N - m\tau} \sum_{i=1}^{N-m\tau} a(i, m) \quad (7)$$

Then, we define the change from m to $m+1$,

$$E1(m) = E(m+1)/E(m) \quad (8)$$

In Cao method, at the same time, we use another parameter to distinguish the new good and random signal of the deterministic chaos. That is,

$$E^*(m) = \frac{1}{N - m\tau} \sum_{i=1}^{N-m\tau} |x_{i+m\tau} - x_{n(i,m)+m\tau}| \quad (9)$$

$$E1(m) = E^*(m+1)/E^*(m) \quad (10)$$

For each time series of the C-C method, C-C method adopts the following to calculate.

$$\overline{S}(\tau) = \frac{1}{16} \sum_{m=2}^7 \sum_{j=1}^4 S(m, r_j, \tau) \quad (11)$$

$$\Delta \overline{S}_1(\tau) = \frac{1}{4} \sum_{m=2}^7 \Delta S(m, \tau) \quad (12)$$

$$S_{cor}(\tau) = \Delta \overline{S}_1(\tau) + |\overline{S}(\tau)| \quad (13)$$

$S(m, r_j, \tau) = C(m, r_j, \tau) - C^m(1, r_j, \tau)$ reflects the system's self-correlation characteristic. r is the size of the neighborhood radius.

$C(m, r, \tau) = \frac{1}{M^2} \sum_{1 \leq j \leq k \leq M} \theta(r - \|X_j - X_k\|)$ is the correlation integral of the system. $\theta(\cdot)$ is the Heaviside function.

$$\theta(x) = \begin{cases} 0, & x < 0 \\ 1, & x \geq 0 \end{cases} \quad (14)$$

For the estimation of the correlation dimension, we adopt G-P algorithm [22]. When $r \rightarrow 0, N \rightarrow \infty$, the associated integral function is approximated to the following function.

$$\log_2 C(m, r, \tau) \rightarrow \nu \log_2 r$$

When m continues to increase, the limit value of ν is the correlation dimension of the system.

We select the first zero point of $\overline{S}(t)$ or the first minimum point which goes through $\Delta S(t)$ at the first time as the most appropriate time delay τ . The minimum point of $S_{cor}(r)$ is the optimal time delay window.

3. Improved chaos prediction method

During the prediction process of the chaotic time series, the selection of the embedding dimension and delay time is the basis of chaotic time series prediction. At present, there are a lot of computation methods (Li et al, 2011). The same chaotic time series can be embedded in different (or multiple) phase space. The predicted results are also different. In order to improve the reliability and practicability of the chaotic time series prediction, we propose a new multi-embedding dimension method. Near the obtained embedding dimension, the method takes several different dimensional numerical and calculate the load forecasting results under different embedding dimension. Finally, we weight and average the obtained results and they are the final prediction value.

For the known time series $\{x, i=1, 2, \dots, N\}$, firstly, according to the certain embedding dimension and the delay time calculation method, we calculate the embedding dimension m and the delay time τ . Then, we reconstruct the phase space and establish the first order linear prediction model. In general, the different embedding dimension calculation method or the difference of the artificial subjective factor can make the different value of the embedding dimension. The predicted results are also different in different embedding dimensions. We assume that there are k different embedding dimensions. In each embedding dimension, the prediction result of $x(n+1)$ is $\hat{x}_1(n+1), \hat{x}_2(n+1) \dots, \hat{x}_k(n+1)$.

The prediction error is,

$$\Delta e_i = \hat{x}_i(n+1) - x(n+1), i=1, 2, \dots, k \quad (15)$$

Where, $x(n+1)$ is the actual value. $\hat{x}_i(n+1)$ is the prediction value of the i embedding dimension. We assume that the prediction average value in k embedding dimension is x_p . That is,

$$x_p = (\hat{x}_1(n+1), \hat{x}_2(n+1), \dots, \hat{x}_k(n+1))/k \quad (16)$$

The error of each prediction is,

$$r_i = \hat{x}_i(n+1) - x_p \quad (17)$$

We assume that the probability that we obtain r_i is,

$$p(r_i) = \frac{1}{\Delta e_i \sqrt{2\pi}} e^{-\frac{r_i^2}{2\Delta e_i^2}} \quad (18)$$

Because the prediction results are independent in different embedding dimensions, the occurrence probability for all k is,

$$p = \prod_{i=1}^k p(r_i) \quad (19)$$

If p is bigger, it shows that the prediction results are reliable. That is, when $\min \sum_{i=1}^k r_i^2$, the prediction results are the most reliable. Therefore, according to the least square method, the final prediction result in different embedding dimension is,

$$\hat{x}(n+1) = \frac{\sum_{i=1}^k p(r_i) \hat{x}_i(n+1)}{\sum_{i=1}^k p(r_i)} \quad (20)$$

Where, $\hat{x}_i(n+1)$ is the prediction value of the I embedding dimension at $n+1$ time. $p(r_i)$ is the probability of the prediction error for the i embedding dimension.

In the phase space, any two adjacent tracks diverges with the trend that largest lyapunov exponents λ_1 . That is, in normal circumstances, if the initial two state displacement $d(o)$ is not entirely along the vertical λ_1 , we can easily get,

$$d(t) = d(o)e^{\lambda_1 t} \rightarrow \text{Ind}(y) = \text{ind}(o) + \lambda_1 t \quad (21)$$

We assume that there is a time series. We use it to reconstruct the phase space. We select arbitrarily two adjacent initial positions. In general, the two points are the initial point and the nearest neighbor. Then, we calculate the initial distance $d(o)$ of the two points. Next, we select appropriately the step size Δt and the time length $t = k\Delta t$. We calculate the distance $d(k\Delta t)$ that elapsing the time t . Then, we can get,

$$\lambda_1 = \frac{1}{k\Delta t} \ln \frac{d(k\Delta t)}{d(o)} \quad (22)$$

We select the different initial distance $d_j(o)$ to calculate $d_j(k\Delta t)$ and calculate the average value.

$$\lambda_1 = \frac{1}{k\Delta t} \ln \frac{d_j(k\Delta t)}{d_j(o)} \quad (23)$$

4. Experiment

We take the football school 1500 meter race as the example. We apply the improved chaos method to predict the 1500 meter long-distance race performance. We select the performance of 4 athletes to predict. Among them, the first 20 data are as the training

set and the last 10 data are as the prediction set. The training set data are shown in the following table.

No	Play1	Play 2	Play 3	Play 4
1	275	243	257	248
2	277	248	246	241
3	265	245	253	244
4	266	243	258	237
5	268	238	253	235
6	273	235	254	238
7	272	233	246	243
8	270	230	244	246
9	265	236	241	237
10	267	231	242	240
11	262	230	238	241
12	268	226	235	249
13	264	234	241	247
14	265	237	232	253
15	266	243	240	248
16	259	238	245	251
17	261	232	244	254
18	263	234	251	247
19	258	236	246	244
20	260	233	243	239

Table 1 – Data of the training set

We put the data in a figure.

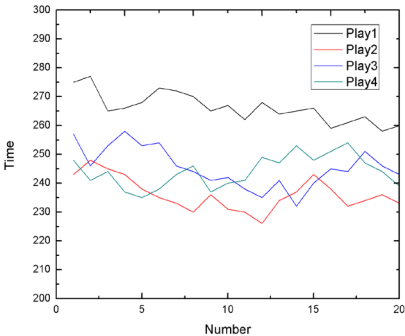


Figure 2 – Data of the training set

Then, we predict the performances. The prediction value and the actual value are as follows.

No	Play 1		Play 2		Play 3		Play 4	
	Actual results	Predicted results	Actual results	Predicted results	Actual results	Predicted results	Actual results	Predicted results
21	257	258	238	240	248	249	241	244
22	264	266	237	239	246	247	248	250
23	261	264	235	237	254	254	247	251
24	253	256	236	236	246	248	253	252
25	255	255	231	233	247	244	256	254
26	260	261	230	231	245	246	249	252
27	265	263	235	233	244	245	248	247
28	257	261	233	234	249	247	242	246
29	259	260	231	235	245	240	241	242
30	261	262	235	234	243	241	239	240

Table 2 – The actual values and the predicted values

From the above table, we can see that the actual values and the predicted values of the four athletes are very similar. The errors are very small. It shows that the improved chaos algorithm has achieved the good results for the football performance. The experimental results demonstrate furtherly the effectiveness of the improved algorithm.

5. Conclusion

The development of the football cannot have the science. Training the football by the scientific way can find out the rule, improve the training performance of the athletes and promote the development of the football. Chaos prediction is a mature forecasting method. In this paper, we use the chaos prediction method to study the prediction of the football performance. At the same time, we put forward the improved chaos prediction method to make the result more accurate. Firstly, this paper introduces the basic theory of the chaos prediction. Then, this paper puts forward the improved chaos algorithm. In the experimental part, we use the improved chaos algorithm to predict the performance of the athletes and achieve the good experimental results.

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An Empirical Study on China's Real Estate Industry Sustainable Development Based on Entropy Law

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Abstract: The article has carried on an empirical analysis to the sustainable development of real estate industry about China's 24 provinces and cities. Applying the entropy law, this paper carries on four respective aspects from the field of the environment, the ecological protection, the economical development and social life, and obtains the score points.

Keywords: Real Estate Industry, Sustainable Development, Entropy Law

1. Introduction

The real estate is not only the material base of humanity's livelihood, but also the establishments of people's life and production activities (Pian, 2003). The sustainable development of the real estate industry is on the basis of planning of urban and rural and energy conservation, to solve the relationship between the immediate interests and the long-term interests, the regional interests and the overall interests, the economic interests and the interests of the community relations, the sustainable development and the sustainable growth, and to shape the planning construction, residential features, environmental benefits, cultural characteristics of sustainable development (Zhou and Zheng, 2004) In this paper, we use the entropy law on China's real estate industry in various index of sustainable development for analysis, establish a comprehensive model, and then determine the capacity of sustainable development on the real estate.

2. Entropy law

In information theory, entropy is a measure of the degree of disorder systems, and information is the measure of degree in an orderly manner system, the absolute value is equal, the sign reverse. An indicator of the index value become greater degree of variation, the smaller the information entropy, the greater the amount of information provided by the indicators, the index weight should also be greater; on the contrary, the information entropy bigger, the smaller the amount of information provided by the indicators, the index weight are smaller. Therefore, based on the indicators index value of the degree of variation, using the tool, information entropy, we can calculate the weight of the

indicators for many indicators, and provide the basis for comprehensive evaluation. Entropy Law is a method which determines the weight of the various indicators based on establishing weight function by entropy. Compared with AHP and Delphi, the entropy law accords with the obtained actual information to implement the decision, and its accuracy and reliability of the decision-making is superior to the subjective empower law (Wang et al, 2002; Mejia and Helton, 2016).

Assume: m -question assessment unit, n -evaluation index, the formation of the original target data matrix $X = (x_{ij})_{m \times n}$, $i = 1, 2, 3 \dots 24$, $j = 1, 2, \dots 16$, a target for x_{ij} , the index value x_{ij} the greater the gap, the indicators in the comprehensive evaluation of the role played bigger; if the index value of all the indicators are equal, the indicators in the comprehensive evaluation are non-functional.

The basic steps of entropy method which is a comprehensive evaluation are as follows:

- Standardized the original target data matrix by the coefficient of effective law:

In order to remove the non-comparability which due to the different dimension and the dimension unit, apply the effective coefficient law to treat the index for non-dimensional, concrete steps as follows:

For positive index (the bigger the better), assume:

$$y_{ij} = \frac{x_{ij} - x_{\min(j)}}{x_{\max(j)} - x_{\min(j)}} \quad (1)$$

For negative index (the smaller the better), assume:

$$y_{ij} = \frac{x_{\max(j)} - x_{ij}}{x_{\max(j)} - x_{\min(j)}} \quad (2)$$

For appropriate index (In a certain interval for the best), assume:

$$y_{ij} = \begin{cases} 1 - \frac{L_{1j} - x_{ij}}{\max(L_{1j} - x_{\min(j)}, x_{\max(j)} - L_{2j})} & x_{ij} < L_{1j} \\ 1 & L_{1j} \leq x_{ij} \leq L_{2j} \\ 1 - \frac{x_{ij} - L_{2j}}{\max(L_{1j} - x_{\min(j)}, x_{\max(j)} - L_{2j})} & x_{ij} > L_{2j} \end{cases} \quad (3)$$

In them, $x_{\max(j)} = \max\{x_{ij}\}$, $x_{\min(j)} = \min\{x_{ij}\}$, $[L_{1j}, L_{2j}]$ is the appropriate interval. Through the transformation, y_{ij} is the non-dimensional of x_{ij} they were compressed in $[0, 1]$, apparently y_{ij} the bigger the better.

- In order to avoid the negative value by logarithm making the data meaningless, transition coordinate:

$$y'_{ij} = y_{ij} + 1 \quad (4)$$

- Make every index the same degree, calculate the weight of j index under i unit,:

$$P_{ij} = \frac{y'_{ij}}{\sum_{i=1}^m y'_{ij}} \quad (5)$$

- Calculate the entropy value of j index:

$$E_j = -K \sum_{i=1}^m P_{ij} \ln(P_{ij}) \quad (6)$$

Therein, $K > 0$, $K = 1 / \ln(m)$

- Calculate differential coefficient G_i of j index. For the given the j , the smaller the variation of x_{ij} , the greater the E_i . When all x_{ij} equal, $E_i = E_{\max} = 1$, x_i in the index the greater the variation, the E_i smaller, the greater the index played relatively:

$$G_i = 1 - E_i \quad (7)$$

- Define the weight:

$$w_j = \frac{G_j}{\sum_{i=1}^m G_j} \quad (8)$$

- Calculate the comprehensive evaluation coefficient of i unit: V_i :

$$V_i = \sum_{j=1}^n w_j P_{ij} \quad (9)$$

V_i is the synthetic evaluation value for i unit s judges value

3. The empirical analysis of China's real estate sustainable development

3.1. Establish the index system

The index of real estate sustainable development is to be reflected not only meet the housing needs of people, but also for the human future generations to meet their

own needs, it can be researched through the field of resources utilization, economic development, ecological protection and social life. If the general index value of sustainable development is greater, it means that the region has stronger ability; then, the smaller, the capacity weaker. Based on the content of sustainable development and the principles of establishing the index system, which are scientific, serviceability, commensurability, absolutely and relative index union, we elect 16 index, concrete index system as follows (Yang, 2002; Hu, 2000):

Total Index	Category Index	Individual index	Character
<i>Resources Utilization</i>	the Level of Use of Land Resources	the Completion of Land Development Area This Year	Reflect the Utilization of Resources and Development Potential
		the Growth Rate of Expropriated Agricultural Land	
	the Level of Use of House Resources	the Completion of Area / Construction Area	
		the House Sale Space / the Floor Space of House Completed	
<i>Ecological Protection</i>	Green Situation	The Rate of Green Situation	Reflect the Conditions of Real Estate with the Ecological and Environmental
	Atmospheric Quality	the Annual Level of Suspended Particulate Matter Atmosphere Averages	
<i>Economic Development</i>	the Relation of the Real Estate with the National Economy Coordinated Development	the Growth Rate of Real Estate Investment/ the Growth Rate of GDP	Reflect the Real Estate Industry with the Coordination of National Economic Development Situation
		the Balance of Real Estate Loans / the Balance of Financial Loans	
		the Growth Rate of Real Estate Development Land/he Growth Rate of GDP	
	the Relation of the Real Estate Market Coordinated Development	the Sales Ratio	
		the Index of Commercial Housing Sales/ Rental Index	
	the Relation of the Real Estate Structure Coordinated Development	the Floor Space of Dwelling House Completed / the Floor Space of Commercial House Completed	
<i>Social Life</i>	the Living Space	the per Capita Housing Floor Space	Reflect the Real Estate Impact on the Lives of the Residents
	the House Loans	the Growth Rate of House Consumer Loans	
	the Real Estate Practitioners	the Growth Rate of Real Estate Practitioners	
	the Urban Population	the Urban Population Growth Rate	

Table 1 – Sustainable Development Evaluation Index System

According to the entropy law, we divide the 16 indicators into positive index, the negative index and the appropriate index. Therein, the positive index include: the completion of land development area this year, the completion of area / construction area, the rate of green situation, the sales ratio, the per capita housing floor space, and the growth rate of real estate practitioners; the negative index include: the growth rate of expropriated agricultural land, the annual level of suspended particulate matter atmosphere averages, the balance of real estate loans / the balance of financial loans, the growth rate of house consumer loans, and the urban population growth rate; the appropriate index include: the house sale space / the floor space of house completed (0.7-0.9), the growth rate of real estate investment/ the growth rate of GDP (1.5-2), the growth rate of real estate development land/he growth rate of GDP(0.25-0.6), the index of commercial housing sales/rental Index(about 1), and the floor space of dwelling house completed / the floor space of commercial house completed(0.8-0.9). After each target attached the moderate data area rests on the national formulation standard, as well as the 21 social index system's international standard proposed by the United Nations Social Development Research Institute. Before analysis, we process the three kind of targets according to the formula (1), (2), (3).

3.2. Data origin and explanation

The data originates from "China Statistical Yearbook – 2014", the 2013 regional "Finance Operational report", as well as the 2013 regional statistical bulletin, after being settled and calculated. When we determine the object of research, some areas in the Yearbook also are able to find corresponding data, but these area's data could not satisfy the content which this article needed to research, therefore in determination object of research we have not considered this part, chosen the following 24 provinces and cities to conduct the research. The determined areas respectively is: (1) eastern area: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan; (2) middle area: Henan, Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Hubei, Hunan; (3) western area: Chongqing, Sichuan, Guizhou, Yunnan and Shanxi. This article applying the entropy method analyzes our country real estate industry sustainable development.

3.3. Empirical analysis

Applying the entropy law, we calculate the coefficient of the comprehensive evaluation and the rank of every area, the results as follows:

Provinces	Coefficient	Rank	Provinces	Coefficient	Rank	Provinces	Coefficient	Rank
Hainan	0.0473	1	Liaoning	0.0422	9	Guizhou	0.0403	17
Shanghai	0.0461	2	Beijing	0.0421	10	Jilin	0.0401	18
Shandong	0.0444	3	Heilongjiang	0.0418	11	Hebei	0.04	19
Guangdong	0.0437	4	Yunnan	0.0418	12	Zhejiang	0.0397	20
Jiangsu	0.0435	5	Henan	0.0412	13	Tianjin	0.0394	21
Chongqing	0.0433	6	Fujian	0.0408	14	Shanxi	0.0392	22
Shanxi	0.0432	7	Hubei	0.0405	15	Anhui	0.0391	23
Jiangxi	0.0429	8	Hunan	0.0405	16	Sichuan	0.039	24

Table 2 – the Coefficient of the Comprehensive Evaluation and the Rank

The results of the research has broken people's inherent ideological concept, namely the traditional eastern, central, and west of the three major economic zones, the eastern region represents a better regional economic development, so in people's minds too much emphasis on the eastern region's economic status, neglect other aspects, since the economic aspects of development can be so good in the eastern region, then in other aspects is also logical in front row. In fact, due to some eastern regions to chase short-term benefit, while neglecting the long-term interests of human existence, only striving for developing for a quickly while, applying certain "short, even, and fast" policy. The short term can bring tremendous economic benefits from the policy, excessive use certain resources of real estate development, resulting in the "irreversible" damage to the human survival resources and the environment, affecting the sustainable development of China's real estate industry.

4. Conclusions

The sustainable development of the real estate industry is an important objective of macroeconomic regulation and control. According to the theory of sustainable development, evaluating sustainable development of the real estate industry for some provinces and cities, we can see the potential of real estate development about these areas, with a view to assist the development of China's real estate.

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A Case Study of Interaction Analysis between “Flipped Classroom” and “Traditional Classroom”

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Abstract: High Education institutions have been exploring informative instructional technology to adapt fast development of teaching mode. Flipping classroom is the reflecting of this need. However, the efficacy of highly interactive flipped classroom model has not properly evaluated. The purpose of this study is to compare the teacher-students interactive behavior characters between flipped classroom and traditional classroom in advanced second language class. Flanders Interaction Analysis System (FIAS) is adopted and modified to measure the teaching process. By analyzing matrix calculation results and characteristic describing curves, the study indicates that the flipped classroom can provide students more language feedback in classroom real activity communication, therefore encourage active language learning. This research is significant by adopting the FIAS measure to evaluate the interaction behavior of flipped classroom, and contributing reference for flipped classroom mode in advanced second language learning.

Keywords: interaction analysis, Flipped classroom, second language, teaching

1. Introduction

In recent years, there is an increasing need to explore the use of instructional technology to improve student outcomes (Chen, 2016). Flipped learning instruction as an innovative and effective approach, which can promote student-centered instruction has gradually gained High Education institution teachers’ attention (Hamdan et al, 2013).

The flipped classroom is a learning approach in which foundational content is offloaded for students to learn on their own before class, while instructor engages students in active learning exercises in class (Bergmann, 2012). This approach transformed teaching practice by changing traditional role and increasing interaction between instructor and students during class (Gerstein, 2012).

The efficacy of the flipped classroom has been widely reported by researchers in various education fields (Kavadella et al, 2012, Critz et al, 2013, Ruiz et al, 2006). For example, McLaughlin et al, (2014) reported improved exam performance and increased engagement in a flipped pharmaceuticals course. Research suggests that, in addition to enhancing student learning and problem solving skills, the flipped classroom can also promote student commitment and motivation to learn (McLaughlin et al, 2014).

Zhai XueSong et al, (2014) perceived students’ high acceptance of applying the flipped classroom model in College English teaching, by utilizing professional assessment survey to investigate students’ learning expectations and satisfaction.

Most researchers hold positive attitude for applying flipped classroom. However, the efficacy of highly interactive flipped classroom model still needs to be properly evaluated. In college second language teaching class, the interactive activities between teacher and students are critical to the learning effects. Therefore, this study intends to compare the teacher-students interactive behaviour characters between flipped classroom and conventional classroom, explores advantages in adopting the flipped classroom.

2. Research method

2.1. Identifying the initial research questions

1. What are the characters of teacher-student interaction in language learning Flipped Classroom Model (FCM)?
2. What are the characters of teacher-student interaction in language learning Traditional Classroom Model (TCM)?
3. By comparing the different characters of teacher-student interaction in FCM and TCM, explore whether FCM has the advantage to stimulate students’ language learning.

2.2. Research design

Subjects are freshmen of applied chemistry major in Zhejiang Sci-tech University. There are 40 students in FCM and 40 students in TCM. The textbook is “New College English” published by Foreign Language Teaching and Research Press. The teaching content is Book II Unit 7 Bridging cultural Gaps Gracefully. Teaching objectives are helping students comprehend the text content, integrating the listening, speaking, reading and writing skills training; enhancing students’ awareness of cross-cultural communication; cultivating the ability to introduce Chinese culture by English. The class activities of TCM plan are warming up questions, teacher- assisting text-reading comprehension, group discussion, and homework assignment. FCM teacher provides video and learning materials, assigns text related questions and class presentation before class, in the class, teacher checks the video comprehension, assists text reading and organizes class presentation and discussion, finally assigns homework.

2.3. Interaction analysis categories

The research method is instructed by the Flanders Interaction Analysis System, referred as FIAS, which was proposed by American educationist Ned. Flanders (1970). FIAS was an innovation which can help make possible significant insights into the analysis and improvement of instruction, by classifying the verbal behavior of teachers and pupils as they interact in the classroom (Veronica et al, 2015). Research procedure includes designing analysis category system, recording the verbal behavior, making the matrix table, calculating matrix, analyzing ratio and characteristic describing curves.

Flanders Interaction Analysis Categories (FIAS) is a Ten Category System of communication, in which seven categories are used for teacher talk and two for pupil talk and the tenth category is for silence or confusion. Combined with the research aim and teaching mode, we modify the system and divide it into 17 categories:

1. Direct influence of teacher: lecturing, directing, criticizing, demonstrating, correcting; indirect influence of teacher: encouraging and praising, adopting opinions, asking open questions, asking closed questions.
 2. Student behaviors: passive response, active response, asking questions actively, discussing.
 3. Silent activities: chaos, thinking questions, doing exercise, watching ppt.
- According to our research, a new category system is designed as Table 1 below.

Classification		Code	Description	Contents
Teacher	Direct impact	1	Lecturing	Provide information, objective facts, personal opinions, cite authority, explain teaching steps, analyze the text content etc.
		2	Directing	Make instructions to students, such as start discussion, stop doing exercises, watch video, read textbook etc.
		3	Criticizing	Justify the authority, blame students
		4	Demonstrating	Demonstrate the pronunciation and right language expression.
		5	Correcting	Correct the pronunciation and syntax error of students.
	In-direct impact	6	Encouraging and praising	Encourage and praise the students' language or behavior.
		7	Adopting opinions	Agree with the students' opinions, modify or repeat the student's ideas, apply the student's view to solve the problem, compare the insights with other students, and summarize the students' speaking content.
		8	Asking open questions	Propose the questions with unknown answer which are expressed by students' individual opinions, the main purpose is to encourage the students to think actively and express freely.
		9	Asking closed questions	Propose the questions with fixed answer, the main purpose is to check whether the students understand the knowledge or facts. Propose the questions that can be answered by all students. Propose the questions with answers are "yes" or "no" in order to arouse students' response. Freedom to express own ideas is limited

Classification	Code	Description	Contents
<i>Student</i> 11 12 13	10	Passive response	Response to Code 9. Students briefly answer teacher's question with “yes” or “no”. The teacher designates some students to answer the questions with fixed answer. The students are not allowed to express their ideas or opinions freely. Students reading, repeat after teacher's demonstration, answer the question in chorus.
		Active response	
		Response to Code 8. The students express their ideas and opinions freely. The students make a statement in discussion, role playing etc.	
		Asking question actively	
		Students initiate topic by asking questions.	
<i>Silent activities</i> 15 16 17	14	Discussing	Temporary pause, silence or chaos insignificant to teaching or learning. No significant communication between teacher and students.
		Discussion between teacher and students or students in groups, pairs, etc.	
		Chaos	
		Thinking questions	
		Silence when the students are thinking questions.	
		Doing exercises	Students do exercises
		Watching ppt	
		The students watch ppt, but there is no communication between teacher and students.	

Table 1 – New Interaction Analysis Categories

3. Data collecting

We collected the data by recording two teaching videos of TCM and FCM. According to the category system in Table 1, the data was input in the Excel every 3 seconds. Each class we set the teaching process as 45 minutes, therefore 900 codes were obtained respectively from the videos. In order to demonstrate clearly, some sample codes of FCM are shown in Table 2.

sec min	3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60																		
1	1	1	1	1	9	9	9	10	10	9	9	10	7	7	7	1	1	1	1
2	2	1	1	1	1	2	2	1	1	1	1	9	9	10	9	10	10	6	6
.....																			
10	1	1	2	8	1	1	1	2	2	8	8	1	1	1	2	2	8	8	8
.....																			

Table 2 – Coding Diagram of FCM

According to the data, we made the matrix. Each row and column of the matrix represents 17 different categories in table 1. The number in each cell of matrix represents the occurring frequency of this particular code behavior. Take the tenth minute of FCM as an example to demonstrate how to make the matrix. According to Table 2, we recorded the data as 1, 1, 2, 8, 1, 1, 1, 2, 2, 8, 8, 1, 1, 1, 2, 2, 8, 8, 8, 2. These codes can be generated as 19 sequences, they are (1,1), (1,2), (2,8), (8,1), (1,1), (1,1), (1,2), (2,2), (2,8), (8,8), (8,1), (1,1), (1,1), (1,2), (2,2), (2,8), (8,8), (8,8), (8,2). In each sequences, we put the first code as the row number, the second code as the column number, therefore (2, 8) represents the cell in second row and the eighth column. If (2, 8) occurs 3 times, the number in the cell will be 3. The number in the cell can be added up with the same sequence, therefore we can find (2, 8) occurs 4 times in FCM. 112 in the cell of row 1 and column 1, which means lecturing behavior has occurred 112 times in the class. The matrixes of FCM is shown as Table 3.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	112	36	0	4	2	1	1	6	10	3	3	0	0	0	0	0	1	179
2	19	39	0	1	1	1	0	10	8	3	3	0	1	0	1	2	4	93
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3	0	0	2	0	1	0	2	1	3	0	0	0	0	0	0	0	12
5	1	0	0	3	3	0	0	0	0	1	0	0	0	0	0	0	0	8
6	12	3	0	0	0	3	5	1	2	0	2	0	0	0	0	0	0	28
7	8	0	0	0	2	14	6	2	0	0	1	0	0	0	0	0	0	33
8	6	4	0	0	0	0	0	14	0	0	11	0	1	0	1	0	0	37
9	1	5	0	0	0	0	0	0	11	20	0	0	0	0	1	0	0	38
10	11	1	0	2	0	3	8	0	3	20	0	0	0	0	1	0	1	50
11	1	1	0	0	0	5	13	0	0	0	143	2	0	0	0	0	0	165
12	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3
13	1	1	0	0	0	0	0	0	2	0	0	0	126	0	0	0	0	130
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1	1	0	0	0	0	0	1	0	0	0	0	0	0	3	1	0	7
16	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	63	0	66
17	2	1	0	0	0	0	0	0	0	0	1	0	2	0	0	0	8	14
Total	179	93	0	12	8	28	33	37	38	50	165	3	130	0	7	66	14	863

Table 3 – FCM matrix analysis

4. Data analysis

4.1. Ratio analysis of FCM and TCM interaction behavior

According to the matrix, the ratio of teacher-student interaction behavior of FCM and TCM can be calculated with certain formula, the results and formula are shown as Table 4 and Table 5.

The ratio contrast of teacher’s direct influence is FCM 49.5% vs. TCM 56.5%, indirect influence is FCM 40.3% vs. TCM 42.6%. This indicates both teachers of FCM and TCM pay attention to students’ language practice, focusing on classroom interactive communication, both of them tend to provide more speaking opportunity for students. This result reflects language class teaching mode, in which teacher’s vital task is setting the learning environment and organizing interactive activities, encouraging students to participate, stimulating students’ active learning.

Variables	Formula	FCM	TCM
Ratio of teacher language	$\sum_{i=1}^9 \text{Row}(i) \div \sum_{i=1}^{17} \text{Row}(i) \times 100$	49.5 %	56.5 %
Ratio of student language	$\sum_{i=10}^{13} \text{Row}(i) \div \sum_{i=1}^{17} \text{Row}(i) \times 100$	40.3 %	42.6 %
Ratio of teacher’s direct influence	$\sum_{i=1}^5 \text{Row}(i) \div \sum_{i=1}^{17} \text{Row}(i) \times 100$	33.8 %	43.1 %
Ratio of teacher’s indirect influence	$\sum_{i=6}^9 \text{Row}(i) \div \sum_{i=1}^{17} \text{Row}(i) \times 100$	15.8 %	13 %

Table 4 – Ratio analysis of teacher’s direct influence and indirect influence

Variables	Formula	FCM	TCM
Ratio of teacher’s open questions	$\text{Row}(8) \div \sum_{i=8}^9 \text{Row}(i) \times 100$	49.3%	11.9%
Ratio of teacher’s closed questions	$\text{Row}(9) \div \sum_{i=8}^9 \text{Row}(i) \times 100$	50.7%	88.1%
Ratio of students’ active response	$\text{Row}(11) \div \sum_{i=10}^{13} \text{Row}(i) \times 100$	47.4%	27.9%
Ratio of students’ passive response	$\text{Row}(10) \div \sum_{i=10}^{13} \text{Row}(i) \times 100$	14.3%	29.8%
Ratio of silent activities	$\sum_{i=14}^{17} \text{Row}(i) \div \sum_{i=1}^{17} \text{Row}(i) \times 100$	10.1%	1.3%

Table 5 – Ratio analysis of teacher’s questions and student’s response

There are significant differences between the ratios of teacher's open questions: FCM 49.3% vs. TCM 11.9%, and teacher's closed questions: FCM 50.7% vs. TCM 88.1%. Closed questions have fixed answers, they can be answered by memorizing the learnt content, which is not helpful for language productive output. However, the open questions intrigue students in exploring new ideas, outputting language creatively, and therefore they encourage students' active learning. Language output hypothesis (Swain, 1985) believes that understandable output is important for the learner to obtain the grammar accuracy, expression consistency and pragmatic appropriateness. This result implies FCM reform the teaching process by reversing "learning knowledge in the classroom, digest it after class", it encourages students to self-learn the knowledge and related information before class on learning platform, while practice and digest the knowledge via class activities. In this experiment, FCM teacher designed many open questions to stimulate students' interest and cultivate their ability in applying second language to solve problems.

The ratio contrast of students' active response is FCM 47.4% vs. TCM 27.9%. According to Table 3, active response behaviors include students' expressing their ideas and opinions freely, making a statement in discussion, role playing, etc. In active response, the target language is hypothesized and used. During class activities, students can check the language usage with constant feedback which is from teacher or classmates. It promotes student's significant language output. Apparently, students in FCM perform better than those in TCM.

The ratio difference of class silent activities is also great, FCM 10.1% versus TCM 1.3%. The class silent activities cover Code 14 to 17, which includes the useless chaos, thinking problems, doing exercises, watching ppt, etc. From the matrix, it can be observed that both two classes have no chaos behavior. However, the time that students spent in thinking problems and doing exercises, FCM is much more than TCM. This result implies that FCM teacher pay more attention to cultivate the students' active thinking, and provide more opportunity for them to explore and apply new knowledge.

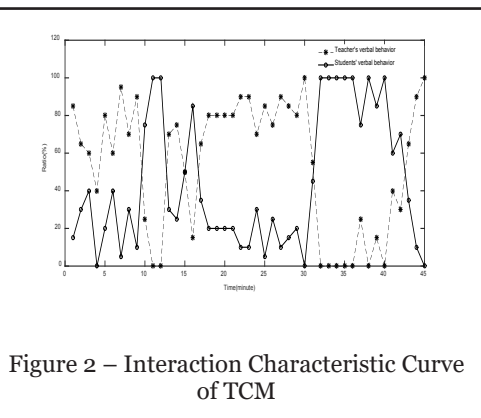
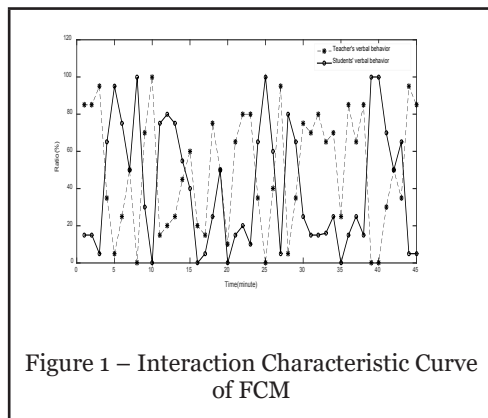
4.2. Analysis of interaction characteristic curve

To further study the interaction difference, we made interaction characteristic curve. In each figure, the horizontal axis represents the time with minute unit, and the vertical axis represents the behavior ratio of teacher or student in that minute. The curve figure intends to reflect behavior ratio change of teacher and students over time.

4.2.1. Teacher-student interaction frequency difference analysis

From Figure 1 and Figure 2 below, we can find the Teacher-student interaction frequency difference is obvious. In FCM, teacher interacts with students more frequently, teacher does not dominate the speaking activities, teacher and students take turns to speak. As Figure 1 shows, during minute 7-9, 9-11, 11-15, 24-26, 26-28, 28-30, 39-42, 42-44, students speak while teacher responses and gives feedback, or communicates instead of dominating the speaking activities. Review the class observation video tape, we find the teacher in FCM creates language environment, designs many activities, guides students to talk. At the same time, teacher joins the discussion and gives timely feedback while students are outputting languages. However, the curve character of TCM reflects that

teacher-students take-turn deep interaction is less frequent. Similar interactive activities only appear during minute 9-13, 11-15, and 15-17. Most of the time, teacher dominates the class, students responses passively.



These interactions are very important for language learning. In the second language acquisition process, when learner outputs language creatively or communicates with prompt feedback, he can timely adjust and amend their language knowledge. The accuracy of language knowledge is built upon variety of language output. In the process, learner set assumptions, confirm or amend language knowledge by adopting feedback. It is a high-level processing of linguistic analysis, rather than superficially practicing language skills (Swain, 1985). Therefore, if teacher provides more positive and real interactions and feedback, learner will be benefited more in language learning. Thus, FCM has more advantages in encouraging students in language learning.

4.2.2. Teacher-student interaction character curve difference analysis

It can be seen from Figure 2 that during minute 1-9 and 17-31, the verbal activities of TCM teacher is much more than the students. According to the video observation, at the beginning, the teacher assigns some warm-up exercises to raise students' interest in classroom topic. Teacher dominates the class, mainly asks closed questions, followed with few open questions, and therefore students' response was passive. Then, teacher analyzes the text content and grammar points, we can find students verbal activity is at a relative low level, they still make some passive response. During minute 31-37, teacher's verbal activity is close to zero, indicating the teacher assigns the students to discuss with each other. During minute 37-41, students output language and speak. Although teacher provides some feedback, he is not involved in their discussion, since there is not strong interactive curve appearing.

However, Figure 1 curve character indicates FCM teacher and students run into verbal interaction state immediately during minute 0-5. The reason lies on the reform of teaching mode, students are assigned to preview video, learn some background information and read the text before class. Therefore, at the beginning of class, students can respond quickly to teacher's question. After the warming up activity, FCM teacher

continues to conduct three rounds of intense interactive discussion, motivate students to participate. During minute 16-18 and 20-21, we find that the teacher-student verbal activities suddenly drop to very low level. According to video, teacher organizes students to think questions and do exercise. And then another three rounds of teacher-student verbal interactions are carried on. Students are encouraged to take part in the class interaction activities as more as possible. While in TCM class, students' performance is relative passive, they are mostly under the teacher's guidance and control.

From these teacher-student interaction character curves, it can imply that FCM innovates the classroom teaching process. It saves the time of informing the background knowledge, assigns students to carry on creative task, leaves more time for students to output language and solve problems in class. It can better motivate the students' enthusiasm and interest in participating interactive activities, therefore prompt students' language learning better.

5. Conclusions

By adopting and modifying FIAS, this study compares FCM and TCM teacher-student interaction behavior ratio and analyses interaction character curves. The result implies FCM may have the advantages in encouraging students to participate actively in class activities, and provides more opportunities in real language output while giving timely useful language feedback; therefore prompt students' second language learning. With the development of informative instructional technology, teaching mode in High Education institutions innovates, such as online course, flipped classroom, MOOC etc. They challenge teachers and students. For making the new teaching mode service our education better, we need further exploration and more case studies.

Acknowledgments

This research is supported by Higher Education Research Project of Zhejiang Province (No. KT2015055), Education and Teaching Reform Project of Zhejiang Sci-tech University (No. jgel201534) and General Research Project of Zhejiang Provincial Education Department (No. Y201534595).

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Research on Systemic Risk Contribution on the System of Listed Banks in China

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Abstract: After the 2008 global financial tsunami, domestic and foreign academia, government agencies and regulatory authorities are actively coping, with more and more financial institutions in our country, the relationship between each other more and more closely, the system of financial supervision has become more difficult. In order to better understand and analyze the role of banks in the system of financial risk, on the basis of clarifying the systemic risk, systemic risk contribution and the importance of the system, the systematic risk transmission mechanism and influencing factors are studied by using the method of systematic expectation loss and marginal expected loss of Acharya to make a quantitative empirical analysis.

Keywords: Bank systemic risk, Systematic importance bank, Systematic risk contribution, SES, MES.

1. Introduction

Recently property market regulation and control policies sweep the China and capital markets have just experienced the turmoil over the last year. One of the important reasons for the real estate policy adjustment and the stock market crash is that the credit growth is too fast to flow into the place where it should flow in. Many studies have shown that the excessive leverage of the banking system may cause the real economic crisis. From the experience, due to the 2008 global financial tsunami triggered by the United States subprime mortgage crisis, the world economic development and financial system of many countries and regions have been subject to varying degrees of impact, and government agencies and many scholars has in-depth research and analysis on the crisis. At the same time, one of the reasons of the global financial crisis is that the government's regulatory control measures is invalid to a certain extent. The United States, the European Union and other financial regulatory agencies began to reflect on their regulatory system problems and the failure of existence of regulatory means and rescue methods, then, many scholars put forward the concept of prudential supervision for regulators. According to the FSB, IMF and BIS reports (FSB, IMF and BIS, 2011), prudent analysis, the more important part of prudential supervision, is able to analyze systematic risk by existing data, quantitative analysis of the method, and to provide appropriate advice and recommendations to the regulatory authorities. In the US subprime mortgage crisis, the crash of Lehman Brothers was seen as an important fuse

of the subprime mortgage crisis, and the US regulatory authorities also recognized the importance and special role of supervision of important financial institutions. From the academic research, there are many research results and papers on the financial crisis, but from the perspective of systemic risk analysis is not a lot, the current systemic risk research on this one has not yet a complete theoretical analysis framework and content. The comparative analysis of many literatures have the main focus on two aspects: the time level and cross-section angle, and there are some research gap of the study of systemic risk contribution.

At present, China's economic output ranks second in the world, but the economic system, especially the financial system is in transition period. According to the World Bank's statistical analysis, more than 185 countries have experienced crises during the process of deepening economic reform and the transformation of the financial system since the 1970s, the most important of which is the crisis of the banking system. It can be seen that the outbreak of the crisis in the banking system is accompanied by the transition of economic reform and the instability of the financial system, especially at the stage where the current economic ties are close and the cross-business links between different financial institutions are becoming closer. Based on the above background, in view of the fact that China's bank is an important part of the financial system, the regulatory authorities should pay more attention to the banking system of risk prevention and supervision. In this paper, based on the previous studies and the failure of traditional regulatory methods after the global financial crisis in 2008, and combined with China's actual situation, this paper studies the role of systemic risk contribution mechanism to identify important key factors, identify the importance of financial institutions through the quantitative analysis of data, and put forward targeted recommendations and comments for China's systemic risk prudential supervision by empirical analysis of the relevant conclusions.

2. The concept of definition

There are many researches on systematic risk both at home and abroad. There are many definitions about systemic risk, systemic risk contribution and systemic important institution. At present, there is not a unified definition of scholarly recognition. In order to better carry out the research of systemic risk, this paper needs to define the important concepts of research.

2.1. Bank systemic risk

The research on systemic risk of banks has been extended from the in-depth study on the liquidity risk of banks. Along with the gradual deepening of systematic risk research, scholars study the payment settlement system, banking system and financial ecology, so there is no uniform definition of systemic risk. Kaufman describes systemic risk as a risk that a ripple effect due to a single event or multiple events in the capital market will cause significant losses to the financial system (Kaufman, 2010). On the basis of their research, Kaufman and Scott analyze the systemic risk by decomposing them. They think that systematic risk is the probability or possibility of the collapse of the whole financial system, which is manifested in the correlation of various departments in the financial market (Kaufman and Scott, 2003). From the definition of large international finance,

FSB, IMF and BIS at the 20 leaders' summit define the system, mainly emphasize the fact the disruption or weakening of financial services poses a risk of damage to the real economy, and it can be seen that international organizations are primarily concerned with the damage done to the real economy (FSB et al., 2011). Zhang xiaopu believes that the concept of the system is mainly reflected in the financial structure and the impact of associated other parties at the same time and summarizes the systemic risk characteristics of sudden, contagious, complex, etc. (Zhang, 2010).

Through the analysis of domestic and foreign scholars for systemic risk, this paper summed up the following three main aspects: first, systemic risk is sudden and not easily detected; the second aspect is the systemic risk affecting the real economy and the financial system; and the third aspect is the wide extent of the damage.

2.2. The contribution to systemic risk

For the contribution to systemic risk, some scholars in China call it “systemic risk contribution” or “systemic risk contribution”. This concept is often the process of measuring systemic risk. Domestic and foreign scholars in the article rarely define this concept, mostly for direct reference.

How should systemic risk contributions be defined? First of all, it is clear that, for the contribution of systemic risk, its existence has two basis, macro-based and micro-foundation. The macro basis is systemic risk. Systemic risk contribution is out of the question without the systemic risk. Micro-foundation is the basic unit of system, for example, the basic unit of the banking system is each bank. Without a single bank as a micro-foundation, systemic risk contribution also loses its object. After clarifying the macro and micro foundation, we try to qualitatively describe the systemic risk contribution from a theoretical point of view. Starting from the research and description of the macroscopic foundation of systemic risk, there are two main research perspectives. A perspective is based on the systemic risk of the banking system and the mechanism of infection, from the system point of view of its qualitative characterization and quantitative measurement, this paper emphasize the interpretation of systemic risk of infection process. Another perspective is the analysis of results from systemic risks, focusing on the measurement and analysis of losses in the banking system. To sum up, we can define the systemic risk contribution of banks as the degree of bank's influence on systemic risk of banks.

2.3. SIFIs

The concept of SIFIs is closely related to the subprime crisis. However, with the development of the world economy and the changes of financial institutions, the concept of SIFIs has been constantly changing. Earlier, the perception of SIFIs was rooted in the “big but failing” financial institutions of the Illinois State Bank's run-of-the-mill crisis in 1984. Academia and the banking industry are beginning to pay attention to these “big but not to” the bank's special status and influence in the entire financial system. With the continuous development of finance, people began to break the awareness that the scale is the standard of the importance of financial institutions, and establish a more comprehensive diversity of content and awareness. BCBS's definition of systemic importance for financial institutions in 2010 is the financial institutions that plays a

key role in the financial system as a whole, its collapse will be likely to cause substantial damage to the financial system and have a significant negative impact on the underlying economy mechanism.

In short, systematic systemic risk is the basis of systematic risk contribution and systemic important bank. Systematic risk contribution is the key dimension to measure system importance.

3. Analysis on the mechanism of systematic risk contribution of banking system

3.1. The impact of bank's important factors on the systematic risk contribution of banks

At present, the importance of systemic financial institutions for systemic risk does not form a complete logical framework and theoretical system, and the literature mostly explore the generation and infection of general financial institutions on systemic risk, such as financial fragility, information asymmetric and run-on model theory. Although the systemic importance of financial institutions on systemic risk impact is able to apply to these basic theories, the system importance of financial institutions has its own unique characteristics. Because of limited space and research priorities, this paper briefly put forward three important factors: negative externalities, associated channels and their own leverage. Figure 1 shows the impact of the above three important factors on systemic risk, that is, institutions play a greater role in the transmission of systemic risk, which leads to their systemic risk contribution.

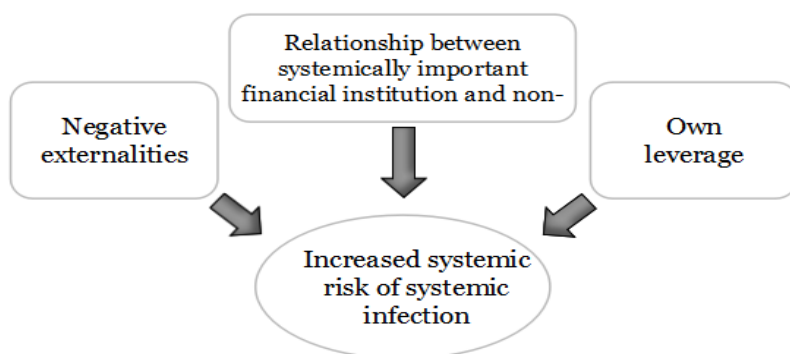


Figure 1 – The channels of systemic importance of financial institutions on systemic risk of infection

3.2. The impact of market status on the systematic risk contribution of banks

Based on previous studies, it is found that the market state also affects the systemic risk contribution of banks. Through the summary, we find that there are three important

ways for the risk transmission of different market states to the banking system: The first is the impact of the economic subsystem crisis outside the financial system to the banks, and the second is the diversification and complication of the infection brought by the banks in the banking system. Thirdly, the banks run into trouble because of information asymmetry. Factors affecting the contribution of systemic risk under different conditions are shown in figure 2 below.

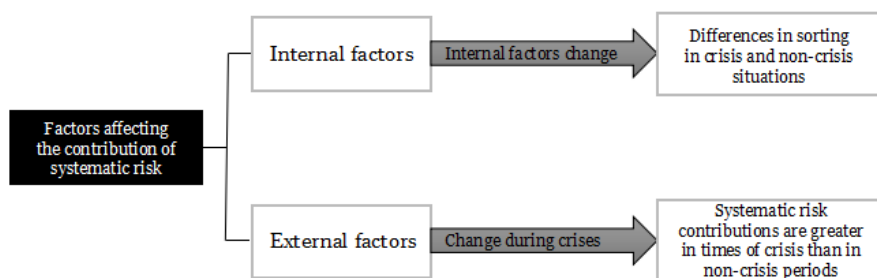


Figure 2 – Mechanism of impact of systemic risk contribution in crisis and non-crisis situations

3.3. The influencing factors of the bank's systematic risk contribution in China

1. Leverage

Financial analysis shows that the greater the bank's financial leverage, the greater the financial risk, and the greater the leverage which will deepen its endogenous vulnerability. When the risk outbreaks, it is more susceptible to be affected, so its contribution to systemic risk is greater. Fan et. al found that the leverage of China's banks has a significant impact on the losses during the crisis, which is an important factor affecting the systemic risk contribution of the banks (Fan et.al, 2011). Fang et.al used DCC-GARCH model and stochastic simulation method to measure the systemic risk in China's financial system. It is found that the systemic risk level and systemic risk contribution of Chinese banks are directly proportional to the marginal loss, leverage ratio and asset size (Fang et.al, 2011).

2. The extent of government implicit guarantees

Because of our special national conditions and political system, China's banking system is more special than foreign countries and China's banking system has more political color and social responsibility. (Dong ,2008) believes that the soft budget constraint of banking industry is the root cause of the existence of China's banking system risk. The existence of soft budget constraint can lead to the moral hazard and adverse selection of the bank (Dong, 2008). (Yang,2008) believes that our country's banking system risk belongs to the system leakage type. The transition of economic system, the uncertainty of economic policy and the vulnerability of financial supervision are the unique reasons for the systematic risk of China's banking system (Yang, 2008). The paper further finds that those banks with government guarantees will provide more credit to the real economy during crises, thereby facilitating the ability of the economy to recover from the crisis.

3. Bank size level

The size of banks is divided into absolute size and relative size. The remarkable characteristics of the scale of China's banks are very different. Among them, the five large state-owned commercial banks have the largest asset size. China's system of importance in financial institutions are large commercial banks. There are two different voices on the impact of the size of Chinese banks on the systemic risk of Chinese banks. Fang Yi found that the scale of China's banks and the contribution of systemic risk is proportional (Fang et.al, 2011). Based on the data of China's 2007-1-7 to 2012-5-31 and using 14 listed banks in China as a sample, Zhao establishes the panel regression model by MES method. It is found that in China, the size of banks and leverage ratio (equity/total assets) and systemic risk contribution are inversely proportional (Zhao and Wei, 2012).

4. Capital adequacy ratio of a bank

China's banks in the capital adequacy ratio represents the ability of banks to resist risks. The more capital adequacy, the ability of banks to resist risks is better. China's banks 'capital adequacy ratio has gradually narrowed the gap since 2012, as of 2014, all listed banks' capital adequacy ratio is higher than the regulatory line (8%).

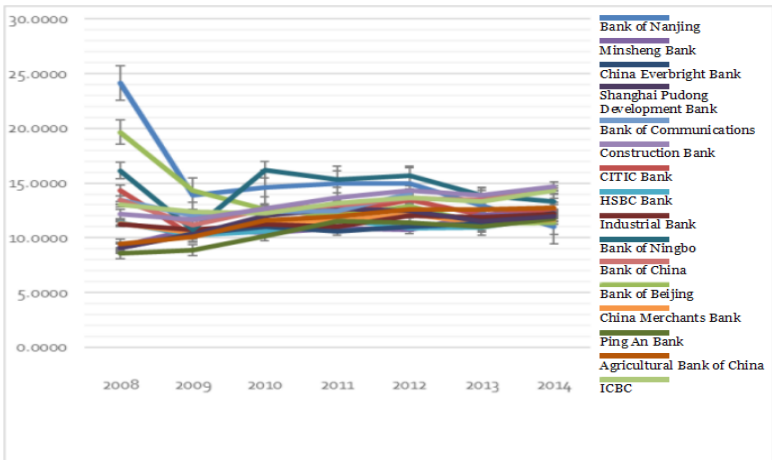


Figure 3 – China's banks capital adequacy ratio (2008-2014)

5. Non-performing loan ratio

Guo Weidong through the analysis of the panel data of 14 listed banks in our country, find out the influencing factors of the systematic risk contribution of the Bank of China (Guo, 2013). He found that the bank's leverage ratio, non-performing loan ratio and total return on assets (ROA) has a significant impact on systemic risk. Leverage ratio and total assets return rate is proportional to the systematic risk contribution, and the bad loan ratio has a negative correlation with the systematic risk.

4. The measurement of systematic risk contribution of banking system

4.1. Data Description

On the basis of studying the statistical analysis methods of internal and external scholars, this paper uses Acharya's algorithm to quantify the SES as the actual yield of stocks in a single listed bank during the crisis (Acharya, 2009).

At present, there are 16 banks listed in Shanghai and Shenzhen stock markets, namely Ping An Bank, Shanghai Pudong Development Bank, Minsheng Bank, Industrial Bank, Bank of Communications, China Merchants Bank, Bank of Ningbo, Huaxia Bank, CITIC Bank, Construction Bank, Bank of Beijing, Bank of Nanjing, Bank of China, Agricultural Bank and Everbright Bank. The period from January 2008 to December 2008 is defined as China's banking crisis eruption time period. In order to ensure the consistency and uniformity of the samples, the paper combined the data of WIND and Bloomberg data terminal, and combined the influential factors and financial data from 16 banks. By using the principle of size matching and statistical analysis, this paper selects 10 listed banks as research samples, including four large state-owned commercial banks, four joint-stock banks and two city commercial banks, namely, Ping An Bank, Shanghai Pudong Development Bank, Minsheng Bank, Bank of Communications, China Merchants Bank, CITIC Bank, China Construction Bank, Industrial and Commercial Bank, Bank of Beijing, Bank of China. The meaning of indicators shown in Table 1 below and the data used in this paper are from the WIND database.

Name	Meaning	Time zone	Remarks
<i>SESi</i>	<i>Systematic expectation loss</i>	2008.01.01-2008.12.31	
<i>MESi</i>	<i>Marginal expectation loss</i>	2009.01.01-2015.09.31	<i>The CSI 300 Index rate of return as the market rate of return</i>
<i>F-MESi</i>	<i>Marginal expectation loss</i>	2009.01.01-2015.09.31	<i>The CSI 300 Shanghai and Shenzhen financial index rate of return as the market rate of return</i>
<i>Z-MESi</i>	<i>Marginal expectation loss</i>	2009.01.01-2015.09.31	<i>The CSI index rate of return as the market rate of return</i>
<i>S-MESi</i>	<i>Marginal expectation loss</i>	2009.01.01-2015.09.31	<i>The Shanghai Stock Exchange index return rate as the market rate of return</i>
<i>LVG</i>	<i>Leverage</i>	2015.09.31	<i>Quarterly report data</i>
<i>LOG ASSET</i>	<i>Total assets (log)</i>	2015.09.31	<i>Quarterly report data</i>

Table 1 – Main indicators

4.2. Descriptive statistics

China's banks during the financial crisis suffered heavy losses. The ranking of the banks in this paper is divided into three steps and the first one is Shanghai Pudong Development Bank, Ping An Bank, Minsheng Bank and Bank of Communications. Their losses are

relatively high, basically above 70%. The second one is China Merchants Bank, CITIC Bank and China Construction Bank and their losses are in the middle level, probably more than 60%. The third one is Beijing Bank, Industrial and Commercial Bank and Bank of China and their losses are the lower interval level, about 50%.

	SESi	MESi	F-MESi	Z-MESi	S-MESi	LVG	Log asset ASSET
<i>mean</i>	-0.59834	0.037932	0.039862	0.041894	0.043002	16.06298	0.040119
<i>median</i>	-0.65621	0.038064	0.040319	0.042981	0.042984	16.19352	0.044921
<i>maximum</i>	-0.50127	0.049017	0.050961	0.050932	0.050183	17.61	0.052084
<i>maximum- maximum</i>							
<i>minimum</i>	-0.77491	0.025021	0.026921	0.030015	0.031009	12.90313	0.031006
<i>SD</i>	0.069012	0.007019	0.006601	0.007012	0.006160	1.760137	0.005913
<i>N</i>	10	10	10	10	10	10	10

Table 2 – Descriptive statistics of major variables

Name	SES(2008.01-2008.12)	SES ranking
<i>Shanghai Pudong Development Bank</i>	-0.77491	1
<i>Ping An Bank</i>	-0.76194	2
<i>Minsheng Bank</i>	-0.75028	3
<i>Bank of Communications</i>	-0.71201	4
<i>China Merchants Bank</i>	-0.693194	5
<i>CITIC Bank</i>	-0.625243	6
<i>Construction Bank</i>	-0.610356	7
<i>Bank of Beijing</i>	-0.583491	8
<i>ICBC</i>	-0.570021	9
<i>Bank of China</i>	-0.50127	10

Table 3 – SES-based ranking of banks

	Ranking	Leverage
<i>Bank of Beijing</i>	1	16.4911
<i>Ping An Bank</i>	2	16.3927
<i>Shanghai Pudong Development Bank</i>	3	16.1047
<i>CITIC Bank</i>	4	15.8204
<i>China Merchants Bank</i>	5	14.8976
<i>Minsheng Bank</i>	6	14.6281
<i>Bank of Communications</i>	7	13.9045
<i>Construction Bank</i>	8	13.8902
<i>Bank of China</i>	9	13.4481
<i>ICBC</i>	10	13.1624

Table 4 – Leverage Ranking

Marginal expected loss of the value of the gap is very small, the average per bank in the absence of crisis in the market performance of the worst performance of 5% cases a day loss of about 4%. A longitudinal comparison of the banks' marginal expected losses shows that there is a great difference in the contribution of different banks' marginal systemic risk in different periods. From the ranking change, the banks in each of the annual ranking of change is not in a relatively stable position.

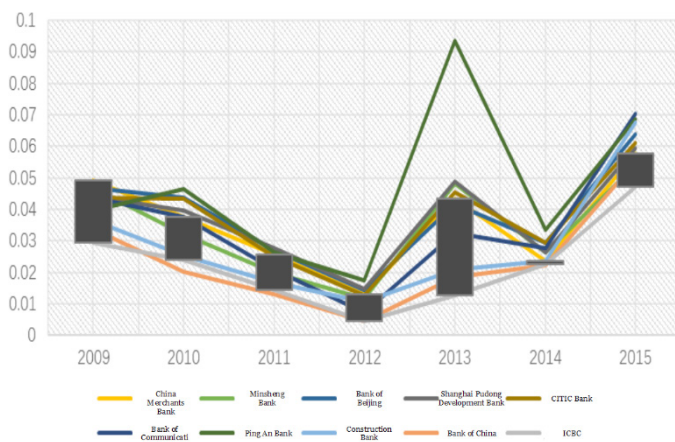


Figure 5 – The size of the bank MES

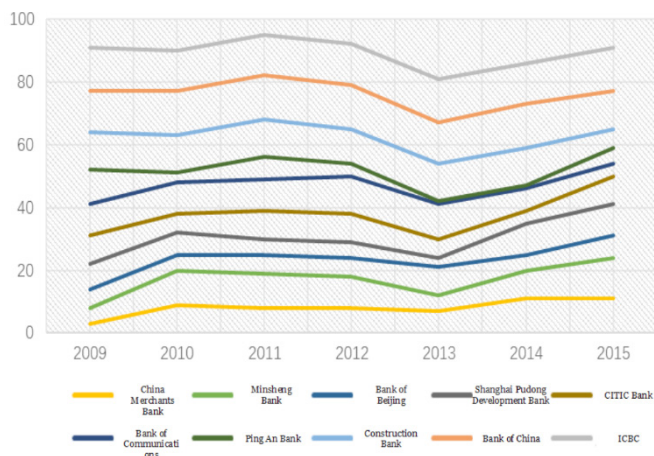


Figure 6 – Bank-based MES-based ranking

The leverage of different banks varies significantly. By ranking the banks according to the leverage ratio, we can find that the top five banks with the highest leverage are Industrial Bank, Nanjing Bank, Huaxia Bank, Ningbo Bank and Bank of Beijing.

4.3. The model

1. Data smoothness test

Since the selected data in this paper belong to time-series data, there may be a problem of stationary. Based on this, this paper uses the unit root ADF test. Using Eviews 8.0 to 10 banks of the yield series were stationary test. The results show that the ADF values of 10 banks are less than 1% significance level, and reject the original hypothesis that there exists a unit root. Thus, the conclusion is that the 10 banks' sequence is smooth.

2. SES model

In response to the 2007-2009 economic crisis, Acharya established the following model (Acharya et al., 2010):

$$SES^i = \alpha_0 + \alpha_1 \text{Leverage} + \alpha_2 MES^i + \alpha_3 \text{LogAsset} + \varepsilon \quad (1)$$

Leverage refers to the financial leverage of a financial institution, that is, the total asset / equity value. Log Asset is the logarithm of the institution's total assets, and the model has been tested for robustness to be valid. Acharya estimates SES and MES during the financial crisis of the European financial system and modifies them in the previous model (1) to arrive at a model:

$$SES^i = \alpha_0 + \alpha_1 \text{Leverage} + \alpha_2 MES^i + \varepsilon \quad (2)$$

On this basis, Fan Xiaoyun, Wang Daoping and Fang Yi set up China's financial system of systemic risk contribution model (Fan et al., 2011):

$$SES^i = \alpha_0 + \alpha_1 \text{Leverage} + \alpha_2 MES^i + \alpha_3 \text{Industry1} + \alpha_4 \text{Industry2} + \varepsilon$$

Where, Leverage is the leverage ratio of financial institutions, that is, total assets / equity value, Industry1 and Industry2 are dummy variables representing industry attributes (Industry1 = 1 for securities firms and Industry2 = 1 for insurance companies).

On the basis of the above model, this paper establishes the model as follows:

$$SES^i = \alpha_0 + \alpha_1 MES^i + \alpha_2 LVG + \alpha_3 \text{Log Asset} + \alpha_4 D_1 + \varepsilon$$

Where, SESⁱ is the extent of bank i's loss during the crisis. MESⁱ represents the marginal system risk level of banks during non-crisis periods. LVG represents the bank's financial leverage, ie, LVG (leverage) = total assets / equity; LOG Asset represents the asset size of the bank and takes a logarithmic form; D₁ represents the dummy variable of the bank. D₁ = 0 represents the bank belongs to large state-owned banks, namely, Industrial and Commercial Bank of China, Bank of China, Construction Bank, Bank of Communications; D₁ = 1 on behalf of the bank is not a large state-owned banks.

3. Empirical results

In this paper, we use OLS to carry out regression analysis, the model is set to:

$$SES^i = \alpha_0 + \alpha_1 MES^i + \alpha_2 LVG + \alpha_3 \text{Log Asset} + \alpha_4 D_1 + \varepsilon$$

The results are shown below:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<i>MES</i>	-17.9972***	3.379213	-5.10963	0.0004
<i>LVG</i>	0.039109***	0.013012	3.009213	0.0086
<i>LOG ASSET</i>	-0.079213***	0.0082123	-6.60871	0.0001
<i>D1</i>	-0.110321	0.039871	-2.51039	0.0301
<i>R-squared</i>	0.801293	Mean dependent var		-0.649721
<i>Adjusted R-squared</i>	0.742133	S.D. dependent var		0.070921
<i>S.E. of regression</i>	0.038909	Akaike info criterion		-3.392131
<i>Sum squared resid</i>	0.013982	Schwarz criterion		-3.300123
<i>Log likelihood</i>	29.00215	Hannan-Quinn criter.		-3.502134
<i>Durbin-Watson stat</i>	2.09823			

Note: *, **, *** represent 10%, 5%, 1% significant level, respectively.

Table 5 – Empirical results

Thus, the coefficient values of the model are obtained:

$$SES^i = -17.99 \text{Leverage} + 0.039 \text{MES}^i - 0.079 \text{LogAsset} - 0.11 D_1$$

From the empirical results, we can see the independent variables MES, LVG, LogAsset' P values are far less than 1%, indicating that the SES is very significant. D1 'P value is less than 5%, indicating D1 is quite significant. A negative MES_i coefficient indicates a positive correlation between MES_i and SES_i. The MES_i coefficient is -17.99, which means that if the marginal expected loss increases by 1 unit, the bank's expected loss to the whole bank during the crisis will increase by 17.99 units. The coefficient of leverage is positive, indicating a positive correlation between the bank's leverage and the systematic loss expectations of the bank. The coefficient of leverage is 0.039, which indicates that for each additional unit of leverage, the expectation of the crisis is expected to increase by 3.9%. The negative coefficient of Logasset indicates that the scale of the bank and the systemic risk of the bank during the crisis are negatively correlated. The coefficient of Logasset is -0.079, indicating that the bank's systemic risk loss is reduced by 0.079% for every 1% increase in the size of the bank. The coefficient of D1 is -0.11, which indicates

that the expected loss in the period of crisis will be 0.11 units more than the large state-owned banks when the bank is a large non-state-owned bank (Industrial and Commercial Bank, Construction Bank, Bank of Communications, Construction Bank).

On the whole, non-state-owned large-scale commercial banks, which have large marginal loss and high leverage ratio during the non-crisis period, contribute much to the systematic risk of the banks during the crisis. There is a positive correlation between marginal expectation loss during the non-crisis period, the leverage ratio and the systematic expected loss during the crisis. Moreover, the size of the assets and the nature of the banks have a significant impact on the systematic expected losses during the crisis.

The empirical results are as follows:

1. The systematic expectation losses of Chinese banks during the crisis are mainly affected by four factors: the expected loss, the leverage ratio, the scale and the nature of the banks during the crisis. In this paper, we use OLS to construct the system expectation prediction model by using Eviews8.0, which is the model of forecasting the expected loss of systematically using the four values.
2. Marginal expectation losses and leverage are positively correlated with systemic expected losses. The MESi coefficient is -17.99, which means that if the marginal expected loss increases by 1 unit, the bank's expected loss to the whole bank during the crisis will increase by 17.99 units. The coefficient of leverage is positive, indicating a positive correlation between the bank's leverage and the systematic loss expectations of the bank. The coefficient of leverage is 0.039, which indicates that for each additional unit of leverage, the expectation of the crisis is expected to increase by 3.9%. The relationship between marginal expectation loss, leverage and the systematic expected loss during the crisis is positively correlated with Acharya's conclusion;
3. The negative coefficient of Logasset indicates that the scale of the bank and the systemic risk of the bank during the crisis are negatively correlated. The coefficient of Logasset is -0.079, indicating that the bank's systemic risk loss is reduced by 0.079% for every 1% increase in the size of the bank. What needs to be explained here is the impact of scale factors on the systemic risk contribution and the magnitude of this factor on the criteria identified in the general system importance bank identification criteria. It is generally believed that the larger the bank, the more likely it is to become a systemically important bank and thus to contribute to the systemic crisis during a crisis. The reason may lie in China, the size of the first few listed banks are Industrial and Commercial Bank, Construction Bank, Bank of China, Bank of Communications, China Merchants Bank, Industrial Bank. Our government will be aware of the importance of these banks will have special preferential policies, and aid measures and invisible security. The larger the scale, the greater the benefits, aid, guarantees, so when the crisis occurs, the degree of systemic risk contribution of large-scale banks will be small. In China, large state-owned commercial banks affect the systemic risk contribution of banks because of people's expectations. People have very good expectations and confidence in large state-owned commercial banks. As a result, when banks are in trouble, it is difficult to run or to sell stocks in the banks.

4. The coefficient of D1 is -0.11, which indicates that the expected loss in the period of crisis will be 0.11 units more than the large state-owned banks when the bank is a large non-state-owned bank (Industrial and Commercial Bank, Construction Bank, Bank of Communications, Construction Bank). This is mainly because China's large state-owned banks have stronger expectations and strong confidence in the government because they have stronger government implicit guarantee and reputation than the city commercial banks and joint-stock banks. Based on this, they are expected to be reflected in the securities market, leading to large-scale state-owned banks in the crisis during the systemic risk contribution instead of small. It is generally believed that the larger the bank, the more likely it is to become a systemically important bank and thus to contribute to the systemic crisis during a crisis.

5. Conclusions

Based on the above quantitative analysis and qualitative analysis, the main conclusions are as follows:

1. The systematic expectation losses of Chinese banks during the crisis are mainly affected by four factors: the expected loss, the leverage ratio, the scale and the nature of the banks during the crisis. In this paper, we use OLS to construct the system expectation prediction model by using Eviews8.0, which is the model of forecasting the expected loss of systematically using the four values.
2. Marginal expectation losses and leverage are positively correlated with systemic expected losses. The economic significance of the negative coefficient is that the expected loss of the bank to the whole bank during the crisis increases when the marginal expectation loss increases for a single bank during the period of the worst 5% of the market performance during the non-crisis period. The coefficient of leverage is positive, indicating that the bank's leverage ratio is positively related to the systematic loss expected by the bank, ie the greater the leverage, the greater the expected loss to the bank during the crisis.
3. The size of our banks is inversely proportional to the systematic expectation of losses during the crisis of the bank. This is mainly because China's large state-owned banks have stronger expectations and strong confidence in the government because they have stronger government implicit guarantee and reputation than the city commercial banks and joint-stock banks. Based on this, they are expected to be reflected in the securities market, leading to large-scale state-owned banks in the crisis during the systemic risk contribution instead of small. It is generally believed that the larger the bank, the more likely it is to become a systemically important bank and thus to contribute to the systemic crisis during a crisis.
4. Non-state-owned large banks in the crisis during the systemic risk contribution than large state-owned banks. This is mainly because China's large state-owned banks have stronger expectations and strong confidence in the government because they have stronger government implicit guarantee and reputation than the city commercial banks and joint-stock banks. Based on this, they are expected to be reflected in the securities market, leading to large-scale state-owned banks in the crisis during the systemic risk contribution instead of small.

Based on the above empirical analysis conclusions, the following two policy recommendations: In the aspect of systemic risk supervision of China's banking system, in addition to focusing on those large-scale large state-owned banks, we should also focus on those small-scale and highly leveraged banks. In the recognition of the importance of the system of the bank, we should not only rely on the indicator method or the scale of this indicator, but also have multi-dimensional considerations, enrich the identification criteria and improve the identification system.

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Supply Chain Hazards Identification and a Three-dimensional Risk Matrix Model for Food Safety

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Pages: 420–432

Abstract: To address the problems that food quality and safety accidents occur frequently in China, this paper presents a methodology for food supply chain hazard identification, which is helpful to improve the understanding and perception of consumer food hazards and risks, and to provide a new perspective for food safety risk evaluation. Furthermore, considering that the capability and severity of conventional 2D risk evaluation, and introducing the concept of risk receptor vulnerability, the paper proposes a 3D risk matrix, which will better characterize the consumer behavior impact on food safety accidents. Taking fish and fish products as example and using a fuzzy comprehensive evaluation, based on the data and information about the products made in China as reported in the European Union Rapid Alert System for Food and Feed (RASFF), the paper illustrates the use of the methodology and demonstrates the methodology as a new way for food safety assessment risk evaluation.

Keywords: food supply chain, food safety, hazard identification, 3D risk matrix

1. Introduction

Food safety is a kind of guarantee that the food made or used according to its original purposes won't damage customers' health. In the broad sense, it includes food sanitation, food quality and food nutrition and others, and runs through various links of food making, such as plantation, cultivation, processing, packaging, storage, transportation, selling, consuming, and others (Wang, 2005). It means that the food safety risks in each supply chains including producing, packaging, transporting, consuming and others should all be within the acceptable scope for consumers. Food safety incidents are those having damage to human body or causing harms and originating from food, they cover food poisoning, food borne disease and food contamination.

In recent years, food safety incidents happened frequently and lead to people's concern about food safety. It can seriously harm people's health, meanwhile threatens the public health security system and social stability in China. Due to the food quality issue, the food products for export in China are called back or returned every now and then, which leads to huge amount of economic loss of enterprises and the country. What's more, the

brand reputation of domestic food products is also frustrated, thus severely restricting the development of food industry. The international competitiveness of China's food industry is faced with severe challenges.

Therefore, food safety and risk issues have become the hot research topics in domestic food industry. The paper provides innovative application value to the risk identification of China's food safety factors as well as risk evaluation researches, based on the food supply chain and the three dimensional risk evaluation matrix of the incident causes.

2. Experimental section

2.1. Hazard identification and characterization based on food supply chain- accident causation

According to relevant standards regulated by International Organization for Standardization (IOS), risk evaluation should be conducted throughout the whole supply chain of the research objects, and the risk evaluation should be carried out by relevant ways according to its purposes in different stages of the supply chain. Based on The Application Guide of the Technical Standard Laws and Regulations of food quality and safety and other relevant national standards, the food safety management should cover all food supply chain, and necessary quality and safety technologies should be conducted in all the stages of the supply chain: plantation/cultivation-picking up-processing-transporting-selling-recovery processing and other stages. The influence factors and critical control points of the food safety should be identified in order to carry out systematic quality and safety management in the whole process, thus ensuring food quality and safety (Zhang and Ma, 2002; Drye, 2011). Risk theories based on the supply chain are also applied to mine production, and the safety management of non-food consumer goods (Hu et al, 2014).

The paper divided the supply chain into several stages: plantation/cultivation--harvesting stage, processing--packing stage, market--storage and transportation stage, consuming-recovery processing stage. According to theory of the accident causation analysis, the hidden dangers in the food supply chain are divided into three major kinds, including intrinsic hidden hazards, hidden hazards of the consuming behavior and hidden hazards of the operating environment.

The surveillance data of the early warning of the food safety hazards and relevant statistic data in China are not systematic, and the data size is comparatively small, so the paper adopted the EU's Rapid Alert System for Food and Feed (RASFF) and related document literature as the analytical data source of the identification of hidden hazards. Meanwhile, the paper took the identification of aquatic products as an example to establish a "Grid Method" of food hazard identification and its characterization including 4 supply chains and 3 accident causations, referring to Table 1. Similar to Hazard Analysis and Critical Control Point (HACCP) system which set forth from the 12 critical control points formed by the various stages of food supply chain and the two dimensional accident causation, the grid method is favorable to systematically identify and characterize the existing rules and hazard model within the supply chain, including identifying and establishing

	Essential risks / hazard	Consumer behavior risks / hazard	Use environment risks / hazard
Cultivation and harvest	Residue of veterinary drugs (oxytetracycline residual and overproof)	Reach the standard requirement but the food is deteriorated due to consumer recognition	
	Include malachite green not approved officially	Unapplied albumin (from roe)	
Processing and packaging	Label lack, defective / incorrect packaging	Chromium migration in the tableware use process	Exceeding heavy metal
	Production process not put on records	Disqualified / exceeding water content	Pathogenic microorganism (such as: salmonella enteritidis contaminated)
	Application of unauthorized E500-sodium carbonate		Biological contaminants (including histamine)
	Lack of authentication report		
	Insufficient labeling information (miss the approved N°)		
	Fake health certificate, or the health certificate expires	Exceeding number of enteric bacilli	
	With wrong labeling (species mentioned on the label have been extinct for millions of years)		Include non-invasive microorganism
	Include illegal food additives		
	Parasite infection		
	Unauthorized device radiation		
Market and transport	High iodine content		
	Illegal import	With clear deterioration or sensory property abnormalities	Dangerous chemical pollution (Freon)
	Customs declaration issue		
Consumption and recovery	Poor temperature control – cold chain failure		With corrosive and decomposed substance not suitable for use
	Re-dispatch of products	Separation of raw and cooked food in the processing process	Processing tools not cleaned and sterilized rigorously
	Edible puffer fish, basket whelk, round tail and other poisonous marine lives	Egg allergen not declared	
	No retrospect record	Improper processing (not fully cleaned, or cross contamination of raw and cooked food)	Poor processing environment and health conditions
		Inappropriate eating way (eat when uncooked or semi-cooked), causing vibrio parahaemolyticus food poisoning	Inconsistent consumer behaviors and product requirements

Table 1 – Potential risk modes of aquatic products and food reported by RASFF

threshold value, monitoring requirements and related safety improvement measures and security program of the HACCP.

As shown in Table 1, the hidden hazards in the food supply chain centered on three stages including plantation - harvesting stage, processing-packing stage, storage and transportation stage, which indicates that security responsibilities in the three stages are heavy. They are also the most important three stages in the food life cycle. Food safety affairs can be prevented and the hidden hazards can also be greatly reduced if strict management are carried out and relevant technical and security standards are followed in these three stages of food supply chain. What's more, from the perspective of the causation of the safety accident, the hidden hazards are concentrated in the following two types: intrinsic hidden hazards and the hidden hazards of various consuming behaviors. The analysis results reveal that consumer cognition and consuming behavior are as the same as the food components, and can both significantly affect the development of hidden hazards into hazards.

2.2. Model building of the three-dimensional risk evaluation matrix

According to the definition of risks by CAC, food safety risk is the possibility and severity of the undesirable effects on human health and environment caused by a kind of hazards in food. Conventional risk matrixes often evaluate the risks by adopting the binary function of the possibility and severity of the accidents, that is $R=F(P,S)$. In the function: R is risk level; P is the possibility of the risk, S is the severity of the risk (Luo et al, 2005). It has been proved practically that the function above, as the basic model to evaluate the risks of emergencies, has good effects on expressing the possibility and severity of the risk factors, but it neglects the vulnerability differences of the risk carriers, thus being insufficient to comprehensively reflect the risk features and its rules.

Based on hidden hazard model, the results of RASFF in Table 1 show that consuming behaviors and consuming environment are as the same as the product itself and are both the hazard sources of the hidden hazards in food safety. It is to say that the possibility of influences of different consuming behaviors on various hazards factors is different from that on consumers' ability to resist the hidden hazards, thus causing differentiated risk levels.

Though there are different degrees of food safety hazards, which lead to frequent food safety accidents, various food safety incidents often happen all in a sudden. When the incident happens, the ability and behaviors of consumers or victims can play important roles in the development of various hazards into the possibility of the incidents as well as in the severity of the hazards (Ghaida et al, 2014; Drye, 2011). For example, the hazards of food quality and safety in all kinds of milk powder, food additives, food-borne virus and rice have different possibilities and severities of the safety accident, in terms of different consuming groups such as various vulnerable groups such as the elder, babies as well as adults, and the differences of overall risks of the society will consequently increase. Therefore, the abovementioned binary function of S and P is no longer able to comprehensively evaluate and reflect the real and complete risk level of the food safety incidents.

In order to embody the influences of subjective elements such as consuming behaviors and cognition abilities on the risk evaluation of food safety, the paper extended the

risk indicators, and built a three-dimensional risk evaluation matrix which takes the vulnerability of the victims of the risks into the consideration of influences factors on the hazards behaviors, based on the regular two-dimensional risk evaluation matrix and combined with the identified contents of food hazards above. This model is an innovative application in the field of risk management in food safety.

Weight of risk factors

Three-dimensional risk matrix consists of three-dimensional factors including possibility of the food safety hazards, severity of damaging consumer's health and the vulnerability of consumers and the social influences. In addition, each of the factors has different influence degrees on the comprehensive risk level. The paper used Fuzzy Analytical Hierarchy Process (FAHP) to decide the weight of each factor, thus forming the three-dimensional risk evaluation matrix. FAHP introduced fuzzy set theory on the basis of AHP, and the characters of which is to mathematize the decision-making thinking process by using less quantitative information. It can imitate human thoughts and improve the objectivity of the weight by moderately expresses preference in terms of describing the uncertainty [10-12]. Hence, the paper confirmed the weight of relevant factors though expert judging by using FAHP.

Assume the set U of the evaluation factors is $U = \{u_1, u_1, \dots, u_n\}$, and then the fuzzy judgment matrix that compares the degree of importance of various factors is:

$$Q = \begin{pmatrix} q_{11} & q_{12} & \cdots & q_{1n} \\ q_{21} & q_{22} & \cdots & q_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ q_{n1} & q_{n2} & \cdots & q_{nn} \end{pmatrix} \quad (1)$$

In which, $0 \leq q_{ij} \leq 1$, $q_{ij} = 0.5$, $q_{ij} + q_{ji} = 1$. q_{ij} shows the degree of membership that u_i is more important than u_j . The larger q_{ij} , u_i is more important than u_j ; $q_{ij} = 0.5$ means that u_i and u_j are equally important.

If the judgment matrix $Q = (q_{ij})_{n \times n}$ satisfies that the difference of the corresponding elements in any 2 rows, then

$$q_{ij} = q_{ik} - q_{jk} + 0.5 \quad i, j, k = 1, 2, \dots, n \quad (2)$$

The judgment matrix $Q = (q_{ij})_{n \times n}$ is fuzzy consistent judgment matrix. Meanwhile, the weight vector W is expressed as:

$$W = (\omega_1, \omega_2, \dots, \omega_n)^T, \quad \omega_i(\beta) = \beta^{\frac{\frac{1}{n} \sum_{j=1}^n q_{ij}}{\sum_{k=1}^n \beta^{\frac{1}{n} \sum_{j=1}^n q_{kj}}}} \quad (3)$$

It means that the weight function ω_i is the function of $\beta(\beta > 1)$, and to increase the value of β can raise the distinguish ability of goodness in this plan.

Level of Risk Factors

1. Level of Risk Possibility

The possibility of food safety incidents can be expressed by the occurrence probability of accidents. The paper used the fraction defective of food safety test to estimate the occurrence probability of food safety accidents which is determined by analyzing the relevant statistic data of the research object. Meanwhile, the paper judged the probability of occurrence according to experts' experiences, and divided the predicted probability into 5 levels by valuing them 1-5 as shown in Table 2.

Grade	Qualitative description	Quantitative description	Valuation
P1	Very unlikely to happen	[0,10%)	1
P2	Unlikely to happen	[10%,40%)	2
P3	Likely to happen	[40%,60%)	3
P4	Very likely to happen	[60%,90%)	4
P5	Often happen	[90%,100%]	5

Table 2 – Grading of the possibility (P) about food safety accidents

2. Severity Classification of Hazards

The severity of the results of the food safety accidents is shown in the severity of hazards in the accidents. The paper used various food safety factors as the indicators of the severity classification according to the degree of damaging to consumers' health. According to the yearbook of China's health statistics, the factors that cause residents' death include various damages such as motor traffic accident, accidental falls and other damages as well as accidental poisoning and other external reasons (Turner et al, 2003). Based on the researches of senior scholars in food safety field, the paper fully investigated the practical management work in food enterprises and designed the three-dimensional risk matrix which is applied in food safety area. The author offered the severity classification of the food safety incidents by analyzing the specific data above and combining the document of "National Emergency Plan for Food Safety Accidents" (As shown in Table 3).

3. Vulnerability Classification

The concept of vulnerability originated from natural disaster research, and its meanings are very abundant currently. It gradually becomes a set that covers a series of related concepts including "risk", "sensitivity", and "adaptability" (Li et al, 2010). Vulnerability assessment is a new concept in risk management, and it is restricted by the damage degree of the hazards and depends on the interaction between accident potentials and the vulnerability of the victims. It can effectively measure the vulnerability of the victims under the influences of harmful destabilization (Sun et al, 2011). In this paper, the vulnerability of food safety risks is indicated as the insufficient abilities of the risk suffers under the influences unfavorable environment factors such as hazards, the hazards of

Grade	Qualitative description	Quantitative description	Valuation
S1	No harm, not causing any harm or the harm degree can be neglected	[0,1)	1
S2	Little harm, no clear harm, but may be harmful to health after long-term use	[1,2)	2
S3	Medium harm, leading to slight food poisoning and body discomfort	[2,3)	3
S4	Severe harm, leading to major or large-area food poisoning and serious sickness	[3,4)	4
S5	Devastated harm, leading to death directly or large-area severe poisoning and sickness	[4,+∞)	5

Table 3 – Grading of risk severity (S) about food safety accidents

food safety are mostly in hidden state. The food safety accidents are often caused by the mutual functions between the application and vulnerability of the consumers.

The vulnerability in food safety risk evaluation mainly relies on the essential features of the targeted consumer groups including age, seriousness of disease, degree of education, food culture background and cognition ability, dietary habit and behaviors, frequency and time of duration, consuming environment, non-target consumers and other influence factors (Abreu et al, 2015; Xiao, 2004). Considering the accessibility and usability of the data, the paper used the incidence rate of food borne disease as an indicator to describe vulnerability levels; the detailed classification is shown in Table 4.

Grade	Qualitative description	Quantitative description	Valuation
V1	Uneasy to be hurt	[0,0.1)	1
V2	Normal	[0.1,0.4)	2
V3	Easy to be hurt	[0.4,0.7)	3
V4	Extremely easy to be hurt	[0.7,0.9)	4
V5	Major	[0.9,1)	5

Table 4 – Grading of receptors' vulnerability (V) about food safety accidents

According to the definition of food borne disease by the W.H.O., that is the disease with infection and toxicity caused by the food pathogenic factors that entered into human body through ingestion, and the common diseases are food poisoning, enteric infectious disease and diseases caused by Chemical poisonous and harmful substances (Zach et al, 2012). In recent years, the morbidity of food borne disease has always been on the top of the total morbidity, and is also the most obvious health issue.

The morbidity of food borne disease refers to the proportion (percentage/per millage) of the number of patients investigated who get the disease because of food to that of the patients of other diseases in a certain period. It comprehensively reflects that the target consumers, except the influences of their basic features such as gender, age, education, profession, etc., can be affected by the vulnerability factors such as food and

consuming habits, social insurance and others. It also embodies the risk suffers' active abilities to trigger the hazards and their defense capabilities to prevent the unintentional injuries (Nesbitt et al, 2014). Due to the limited available data of food safety monitoring information in China, the paper used food borne disease as the indicator to show the vulnerability of the risk suffers of the food safety incidents. The higher the morbidity of the food borne disease, the weaker the defense capability and the larger the vulnerability will be, which means that the risk suffers are more likely to be harm in food safety incidents; the lower the morbidity of the food borne disease, the smaller the vulnerability will be.

2.3. Three-dimensional matrix modeling

Risk classification

The three-dimensional matrix (Z): can be calculated by using the risk factors in Table 2-4, referring to the level value method of the two-dimensional risk matrix (Zhang et al, 2013; Liu et al, 2010).

$$Z = (z_{lmn})_{5 \times 5 \times 5} = \sqrt{\omega_1 P_l^2 + \omega_2 S_m^2 + \omega_3 V_n^2} \quad (4)$$

In the formula, ω_1 , ω_2 and ω_3 respectively signify the weight value of occurrence possibility of food safety incident, hazards severity after the occurrence of the incident and the vulnerability of consumers. $P_l = (l = 1, 2, \dots, 5)$, $S_m = (m = 1, 2, \dots, 5)$ and $V_n = (n = 1, 2, \dots, 5)$ are respectively the valuation of the three factors above. According to the real situation of the research and the Australia-New Zealand risk management standard AS /NZS4360: 2004, the risk matrix analysis method is developed. The risks are divided into four levels according to the value Z of risk classification, as shown in Table 5[23].

Risk grading	Risk degree Z	Corresponding spectral color of risk grades
Low	[0.00,1.25)	White
Medium	[1.25,2.50)	Grey
High	[2.50,3.75)	Dark grey
Extremely high	[3.75, +∞)	Black

Table 5 – Risk degree Z and risk grading

In this sense, the three-dimensional risk matrix formed by relevant risk levels of the 125 elements can be obtained, as shown:

$$\begin{aligned}
 z_{211} &= \sqrt{\omega_1 P_2^2 + \omega_2 S_1^2 + \omega_3 V_1^2} = \sqrt{0.2894 \times 2^2 + 0.5468 \times 1^2 + 0.1638 \times 1^2} = 1.00 \\
 z_{321} &= \sqrt{\omega_1 P_3^2 + \omega_2 S_2^2 + \omega_3 V_1^2} = \sqrt{0.2894 \times 3^2 + 0.5468 \times 2^2 + 0.1638 \times 1^2} = 2.22 \\
 z_{433} &= \sqrt{\omega_1 P_4^2 + \omega_2 S_3^2 + \omega_3 V_3^2} = \sqrt{0.2894 \times 4^2 + 0.5468 \times 3^2 + 0.1638 \times 3^2} = 3.32 \\
 z_{455} &= \sqrt{\omega_1 P_4^2 + \omega_2 S_5^2 + \omega_3 V_5^2} = \sqrt{0.2894 \times 4^2 + 0.5468 \times 5^2 + 0.1638 \times 5^2} = 4.51
 \end{aligned} \quad (5)$$

And so forth, the risk level of the remaining 121 matrix elements can be acquired.

Chromatogram of the Three-dimensional Risk Matrix

Taking the two-dimensional matrix as an example, the risk level distribution of each equivalent element in the risk matrix can be recognized in the risk matrix chromatogram. In the three-dimensional system of coordinate, the fifth level of possibility, severity and consuming vulnerability is taken as three dimensions in the coordinate. The obtained three-dimensional risk matrix chromatogram is shown in Figure 1 in which each small blockage respectively shows one of the combinations of the possibility, severity, and vulnerability and represents corresponding risk condition of the risk evaluation subject. The colors: red, blue, light grey and white are used correspondingly signify extreme risk (E), high risk (H), medium risk (M) and low risk (L).

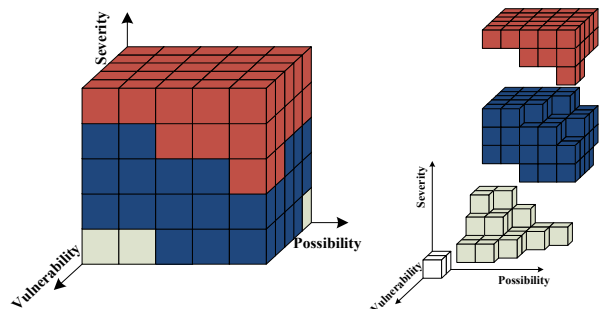


Figure 1 – Chromatogram of the Three-dimensional Risk Matrix.

3. Results and discussion

The above identified risks of various hazards factors of the aquatic products are valued through the experts' comprehensive score method, and weighted average are taken to the relevant characterization value of the three risk factors of each hazard. The level which is closest to the characterization value are chosen as the level of the factor, and the risk level Z of the hazard is calculated according to the weighted value and the corresponding characterization value of each hazard. Integrated application of three-dimensional risk matrix can successively offer the comprehensive risk level of each hazard. As shown in Table 6, there are a lot of essence hidden hazards in the stages of plantation, transportation and packaging of the aquatic product supply chain, but the risk level is low. Enterprises in the food industry chains can only reduce risks efficiently by taking improvement measures such as strictly obeying transportation standards, reasonably planning industrial chains, elaborately packing.

4. Conclusions

The author put forward the research methods based on the food supply chain and the identification and characterization of hazards, and took the aquatic products as an example to conduct the hazards identification. The regular recognition of food safety accident risks are improved thoroughly, which is favorable for enhancing individual's cognitive ability for hazards in food supply chain.

Hazard type	Life cycle	risks / hazard	possibility	severity	vulnerability	Risk value	Risk grade
Essential risks / hazard	Cultivation and harvest	Residue of veterinary drugs (oxytetracycline residual and overproof)	P4(4.0)	S3(2.8)	V3(2.6)	3.32	High
		Include malachite green not approved officially	P3(3.0)	S3(2.8)	V3(3.0)	3.00	High
		Label lack, defective / incorrect packaging	P4(3.8)	S2(2.0)	V3(2.8)	2.88	High
		Production process not put on records	P2(2.2)	S2(2.4)	V2(1.6)	2.00	Medium
		Application of unauthorized E500-sodium carbonate	P3(2.8)	S3(2.6)	V2(2.4)	2.86	High
		Lack of authentication report	P2(1.8)	S3(2.8)	V3(3.2)	2.75	High
		Insufficient labeling information (miss the approved N°)	P1(1.2)	S1(1.2)	V1(1.2)	1.00	Low
		Processing and packaging	P3(3.0)	S2(2.0)	V2(2.0)	2.33	Medium
		With wrong labeling (species mentioned on the label have been extinct for millions of years)	P1(1.4)	S2(2.0)	V2(2.0)	1.77	Medium
		Include illegal food additives	P4(3.6)	S4(3.6)	V4(3.6)	4.00	Extremely high
		Parasite infection	P3(2.6)	S3(3.2)	V4(4.2)	3.19	High
		High iodine content	P2(2.0)	S2(2.4)	V3(2.8)	2.20	Medium
		Unauthorized device radiation	P2(2.0)	S4(3.8)	V3(3.4)	3.58	High
	Market and transport	Illegal import	P3(2.8)	S4(3.8)	V3(2.8)	3.58	High
		Customs declaration issue	P3(2.8)	S2(1.6)	V1(1.4)	2.22	Medium
		Poor temperature control – cold chain failure	P4(4.0)	S3(3.0)	V3(3.2)	3.32	High
	Consumption and recovery	Re-dispatch of products	P2(2.2)	S3(2.6)	V2(2.2)	2.59	High
		Edible puffer fish, basket whelk, round tail and other poisonous marine lives	P3(2.6)	S5(4.8)	V5(4.6)	4.51	Extremely high
		No retrospect record	P4(4.2)	S3(3.0)	V2(2.0)	3.19	High

Hazard type	Life cycle	risks / hazard	possibility	severity	vulnerability	Risk value	Risk grade
Consumer behavior risks / hazard	Cultivation and harvest	Reach the standard requirement but the food is deteriorated due to consumer recognition	P4(3.8)	S3(3.0)	V2(2.3)	3.19	High
		Unapplied albumin (from roe)	P2(2.0)	S3(3.2)	V3(3.0)	2.75	High
	Processing and packaging	Chromium migration in the tableware use process	P4(3.6)	S2(1.8)	V2(1.8)	2.73	High
		Disqualified / exceeding water content	P4(3.6)	S1(1.4)	V1(1.2)	2.31	Medium
		Exceeding number of enteric bacilli	P3(2.8)	S4(3.6)	V4(4.0)	3.74	High
	transport	With clear deterioration or sensory property abnormalities	P2(2.4)	S4(3.6)	V4(3.8)	3.54	High
	Consumption and recovery	Egg allergen not declared	P3(3.2)	S2(2.4)	V4(4.0)	2.72	High
		Improper processing (not fully cleaned, or cross contamination of raw and cooked food)	P3(3.4)	S3(2.6)	V3(2.6)	3.00	High
		Inappropriate eating way (eat when uncooked or semi-cooked), causing vibrio parahaemolyticus food poisoning	P4(4.0)	S4(4.0)	V4(4.2)	4.00	Extremely high
Use environment risks / hazard	Processing and packaging	Exceeding heavy metal	P2(2.2)	S2(2.4)	V2(1.6)	2.00	Medium
		Pathogenic microorganism (such as: salmonella enteritidis contaminated)	P4(3.8)	S4(4.0)	V4(4.4)	4.00	Extremely high
		Biological contaminants (including histamine)	P3(3.2)	S3(3.0)	V4(4.0)	3.19	High
		Include non-invasive microorganism	P3(3.0)	S2(2.2)	V2(2.0)	2.33	Medium
	Market and transport	Dangerous chemical pollution (Freon)	P2(2.4)	S4(4.0)	V4(3.8)	3.54	High
		With corrosive and decomposed substance not suitable for use	P3(3.2)	S4(3.6)	V4(3.6)	3.74	High
	Consumption and recovery	Processing tools not cleaned and sterilized rigorously	P3(3.4)	S3(2.8)	V2(2.0)	2.86	High
		Poor processing environment and health conditions	P3(3.2)	S3(3.0)	V3(2.3)	3.00	High
		Inconsistent consumer behaviors and product requirements	P3(3.4)	S2(2.2)	V3(2.8)	2.49	Medium

Table 6 – Safety risk evaluation result of aquatic products and food

Vulnerability of risk suffers is introduced as the third dimension factor in the risk evaluation of food safety; the hazards receptors' cognitive abilities and the influences of consuming behaviors on the results of hazards transferring to accidental harm are fully characterized; Three dimensional risk evaluation matrix of food safety is put forward based on the two-dimensional risk matrix.

With the construction of the information monitoring platform of China's food safety risks as well as the accumulation of relevant data, it is predicted that the indicative evaluation methods used to express the possibility, severity and vulnerability of food safety incidents will be more comprehensive and systematic.

Acknowledgments

The present work is supported by Universities Research Development Program project in Shandong Province (Grant no. J16YF41) and the Basic Research Program of Dezhou University (NO. 2015skrc03). The authors are very much thankful to the editors and anonymous reviewers for their careful reading, constructive comments and fruitful suggestions to improve this manuscript.

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