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Research on Influence Factors of Information Technology Enterprise's Operating Performance

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Abstract: This paper uses grounded theory to interview a listed information technology company in Guangzhou, and establishes the influence factors model of information technology enterprise's operating performance. The model concludes 17 key factors, including national policy, regional environment, market situation, strategy, execution, corporate values and leadership. The purpose of research is to help listed information technology enterprises improve their operating performance.

Keywords: information technology enterprise, operating performance, grounded theory, influence factors model

1. INTRODUCTION

China's ministry of industry and information technology (MIIT) released "The Development Plan of Software and Information Technology Services (2016-2020)" on December 18th 2016. MIIT proposed that the revenue of the industry will exceed 8 trillion yuan with an average annual growth rate of over 13% by 2020, and IT service revenue will account for 55% of business revenue. The revenue from information security products will reach 200 billion yuan with an average annual increase of over 20%. Moreover, the software exports will be more than \$68 billion and the software practitioners will reach 9 million. The development of information technology enterprise grows stronger and becomes more important to the social economy and people's daily life. Therefore, it is worth studying the influence factors of information technology enterprises' operating performance and the sustainable development. Just as Berliner, C and Brimson, J said, performance evaluation is a key factor in ensuring successful implementation of enterprise strategy ^[1].

This paper is organized as follows: section 2 is literature review, section 3 is research design, section 4 is open coding, section 5 is axial coding, section 6 is selective coding, and section 7 is conclusions.

2. LITERATURE REVIEW

According to the data released by MIIT, there were 40,900 nationwide software and information technology service enterprises with a total revenue of 4.32 trillion yuan in software business and a year-on-year growth of 16.6% in 2015. Software business revenue accounted for 28% of the electronic information industry with an increase of 1.4% over the last year. The income from information technology services was 2.21 trillion yuan with a year-on-year growth of 18.4% and an increase of 1.7% over the last year in the software and information technology service industries. The revenue from operation services, including online software operation services, platform operation services and infrastructure operation services, increased by 18.3% over the same period of the previous year. The revenue from e-commerce platform technical services, including online trading platform services, online transaction support services, increased by 25.1% year on year. The revenue from integrated circuit design increased by 13.3% year on year. The revenue from other information technology services, including information technology consulting and design services, system integration, operation and maintenance services and data services, increased by 17.8% year on year ^[2].

Anandhi S. Bharadwaj developed the concept of IT as an organizational capability and empirically examines the association between IT capability and firm performance ^[3]. Wang et al. chose total assets,

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operating costs, human resources cost and R&D investment as input indicators, net profit after tax, turnover ratio, the proportion of core business income and total assets growth rate as output indicators when he studied on the evaluation of the operating efficiency of the software and Internet industry GEM listed companies [4]. Xiong et al. took R&D expenses, R&D personnel, advertising investment, human resource costs and management costs as input indicators and sales revenue and brand equity as output indicators when she researched on the operating efficiency of Chinese high-tech start-ups [5]. Wan et al. proposed the business ecosystem of software industry, and constructed the evaluation model of the health of the commercial ecosystem and applied it to the health analysis of the commercial ecosystem in Chinese software industry [6]. Wan et al. also analyzed three ICT enterprises in Guangzhou, 21 risk factors of ICT commercialization were identified with grounded theory and the three-level ICT commercialization risk factor model was established in the views of technical management, project management and dynamic capability [7]. Wan et al. selected two investors and three entrepreneurs to research on the risk factors of entrepreneurship in Internet industry with the grounded theory and established the model of risk factors that affected entrepreneurship in Internet industry with three dimensions [8].

3. RESEARCH DESIGN

Grounded theory is a research method developed by Anselm Strauss and Barney Glaser of Columbia University [9]. Grounded theory requires researchers to start from the original data, abandon all the theoretical hypotheses, and based on the collected data, find out the concept of reacting social phenomena through induction, and then establish the relevant theories by developing the connection between these concepts.

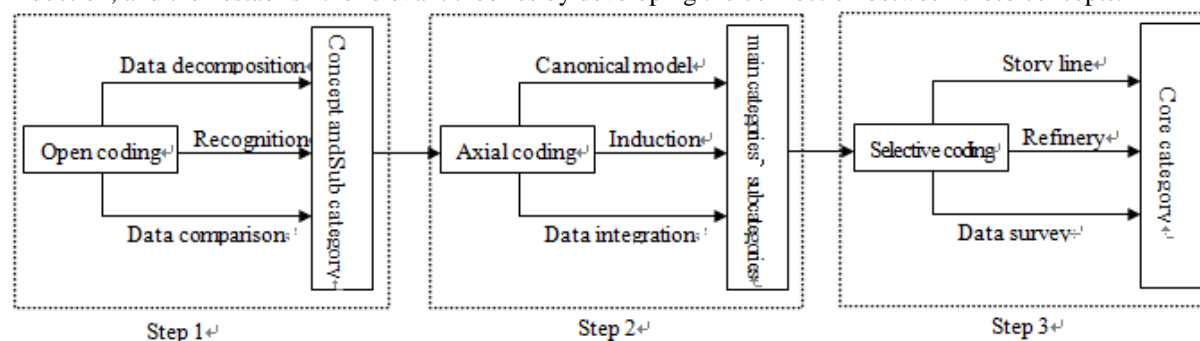


Figure 1. Coding analysis steps of grounded theory

Considering the diversity and uncertainty of the sources of information technology business performance impact factors, this paper adopts a more operational procedural grounded theory. Procedural grounded theory is mainly divided into four steps as follows: (1) A research problem arises. The problem of grounded theory research is usually the action and process about the phenomenon. After the definition of the research problem, we chose the research object. (2) Collect data. We collected data by means of observing, in-depth interviews and document analysis. (3) Open coding, axial coding and selective coding the documents and analyze the codes (Figure 1). (4) Build theories. We compared the concepts, categories, subcategories and main categories formed in the coding process, established their mutual relations, constructed and judged the theory.

We chose one of the 69 information technology listed companies as our interviewee, hereinafter referred to as J Company. J Company, located in Guangzhou, focuses on the development and application of smart technologies and products and is the leading provider of smart city products and solutions in China. The main businesses of the company include smart security, intelligent rail transit, value-added communications, integrated services (including network and cloud computing products and services, and IT integrated services), of which the smart security and intelligent rail transit business are the key businesses.

Participants in the interview included the vice president and CTO, and deputy general manager of company J, who were representative, scientific and professional. We designed a semi-structured interview questionnaire

(Appendix) for interviewees. The questionnaire focused on the key factors that led to the success or failure of the IT business. And the listed questions were open, which gave full play to the enthusiasm of the interviewees and facilitated further understanding of deeper information. We recorded the key information from the interview recording and converted the recording into words on the same day to ensure that the interview information was true and accurate.

4. OPEN CODING

Open coding refers to the decomposition of the original data, continuous comparison between events and between events and concepts through word-by-word analysis, and the formation of concepts and categories [9]-[10]. The procedures of open coding include: (1) Follow the rules of native coding, extract the subject words from the original sentences of interview records, and conceptualize them. (2) Mine categories and name them from multiple sources, such as literature, interview records or the results of discussions with experts. (3) Find the nature and dimensions of categories. In the open coding process, it is necessary to maintain an open mind, not to build any preconceived and predetermined theoretical framework.

After the interview, we carried out structured disorganization of the interview records, discussed with experts in relevant fields with the literature and interview records. Next, we repeatedly compared the records, concepts and categories, deleted low occurrence initial concepts and merged some initial concepts in order to refine initial concepts. Then, we got 32 initial concepts and finally obtained 17 categories after refining. Table 1 lists the open codes of interview records. 2-3 corresponding sentences were selected for each category.

Table 1. Open coding analysis

The records of company J	Initial concept	Category
China vigorously develops smart city and strongly supports smart security, intelligent transportation and other fields.	Industrial policy	National policy support
The state encourages the promotion of the public infrastructure PPP model and gradually introduces social capital to meet the funding needs for construction and financing of rail transit construction. It is foreseeable that PPP mode will be a strategic opportunity in the next three years.	Access to social capital	
Our company is a key software enterprise within the national planning layout and its income tax is at a preferential tax rate of 10%.	Tax incentive	
The general situation of intellectual property protection is better than before, and there has been a great improvement in national legal protection and market respect of intellectual property.	Intellectual property protection	Intellectual property protection
Technology development and industry development become more closely. We provide a series of solutions, including demand research, design and development, operation and maintenance, etc., which is not one or two copied pirated software.	Technology barrier	
The economic situation in the past two years is not very good. Some enterprises are struggling with their development.	Economic situation	The level of economic development
Our development of intelligent security and rail transit is a strategic industry vigorously developed by the country in recent years. With the progress of urbanization, the development of the industry is promising and the development situation is relatively good.	Prospect	Industry development cycle
Guangzhou is the center of traditional trade, and the attention and service to science and technology enterprises are still in the progress.	Government service	Local government service
The Guangzhou Municipal Science and Technology Bureau had a meeting a few days ago to find out what difficulties the enterprise encountered in the current development, and the government tried to help solve those.	Problem solution	
Guangzhou has many college resources, we have a lot of research collaboration with Sun Yat their-sen University.	Research collaboration	The level of science and technology
Guangzhou has well-developed trade, but it needs to learn from other cities such as Shenzhen so as to enhance the overall scientific and technological level.	Technological prowess	
The BT project and the PPP project of our company need huge capital. Some developed finance cities such as Guangzhou can help us raise more funds. By now, the company has set up an industrial fund.	Developed financial industry	Financing environment

The records of company J	Initial concept	Category
We are a listed company that can raise funds by issuing stocks, bonds, etc. There are many financing channels.	Financing channels	
With the development of smart city, the customer demand are increasingly differentiated, refined and integrated, which requires the enterprise to have both depth and height. It is necessary to have a deep insight into the personalized intelligent service needs of different industries such as security, transportation, finance, justice and education in smart cities. On the other hand, it can provide solutions for high-quality housing construction and help customers to solve problems and innovation management and service with various intelligent technologies.	Customer demand	Market insight
Based on our own technological advantages and experience, we focus our development on smart security and rail transit, and we will further promote the development of these two businesses in the future.	Core business	Market positioning
According to the company's strategic adjustment, we stopped IT products supply chain management services business.	Strategic adjustment	
Our company has invested a lot of resources to carry out research on advanced technology related to big data, cloud computing and other industries in order to promote the industrialization of frontier technology, In 2015, the company added 3 new patents, 28 software copyrights, 3 software product registration certificates and 41 product inspection reports. The Video Intelligence Analysis System won the first prize of Guangzhou Science and Technology Progress Award. And the Comprehensive Monitoring of Large-scale Rail Transit System Software Platform passed the identification, and the experts concluded that the results had reached the international advanced level.	Technology research and development	Technical innovation
Our company developed the automatic fare collection system and completed the research of face recognition gates, cloud gates, two-dimensional code payment and a new generation of PSD control system, and applied them to the newly opened Guangzhou Metro Line 6 and Line 7, Guangfo Line.	Technical transformation	
Smart city, smart security and intelligent rail transit require high level of technology and product quality, which can bring high profits.	Target customer	Value proposition
The automatic fare collection system developed by the company supports UnionPay flash and cloud flash payment, making passengers travel more convenient, and the operation of metro companies is more efficient. In the future, mobile payment and face payment will also be vigorously promoted.	Convenience and efficiency	
Our company is mainly responsible for research and development, Our suppliers, including H3C and Hikvision, are responsible for production, operation and maintenance.	The division of value chain	Value network
We signed a cooperative agreement with the Information School of Sun Yat their-sen University to promote the research of vehicle image intelligence analysis technology and products. In April 2015, the company cooperated with Chongqing Research Institute of Chinese Academy of Sciences to invest in Cloudwalk company, and jointly promoted the industrialization of face recognition and machine vision technologies in security, finance and other fields.	R&D collaboration	
The company's customers and suppliers are all over the China. We have been working with our partners for a long time, mutual trust, smooth communication and stable suppliers.	Good relationship	
While maintaining close cooperation with upstream manufacturers, our company strengthens the construction of service network for end users and downstream application integrators, continuously strengthens the optimization of upstream and downstream operation systems and business processes, and improves operational efficiency and project delivery capabilities.	Industry chain collaboration	
Our company's organizational structure and personnel are constantly changing, and constantly improve the business structure in order to meet the needs of business development.	Organizational structure	Organizational change
In 2014, the company began to carry out the equity incentive plan and the employee stock ownership plan.	Equity incentive	Talent policy
Our company is flexible in performance assessment, we set salary by job, skill and performance.	Salary policy	
The company's organizational climate is harmonious, and we respect highly qualified, sincere, open and dedicated high-quality talents. We encourage everyone to trust and understand each other, keep on learning and keen innovation..	Organizational climate	Corporate culture
Our company pays attention to knowledge and often carries out employee training, new staff training, professional ability training and management personnel reserve training, so that employees continue to grow.	Employee training	

The records of company J	Initial concept	Category
The concept of company value is "The City Will Become Better", which means that technology and intelligence makes the city better. And this value concept is also our vision to actively participate in the construction of smart city.	Value concept	Corporate values
The company set up a 3×3 development strategy, which means 2013-2015 years is integration and development period, 2016-2018 is leaping development period, and 2019-2021 is company's innovation and development period. The three-year specific goals are further detailed and detailed. We all have the same goal and make concerted efforts for development.	Development goal	
Our boss, a courageous and far-sighted person, plans and promotes the company's decision-making on major issues, making the company develop better and better.	Leadership	Leadership

5. AXIAL CODING

Axial coding is to classify categories in open coding by cluster analysis, establish the association between correlation and logical order among different categories, and construct a relation network around "main axis" of category to form main categories and subcategories. We can use the model of "antecedent conditions - theoretical phenomena - context - mediated condition - action / interaction strategy - action consequence" to connect categories to the main categories^[6].

We repeatedly compared the concepts and categories in Table 1, considered the relationships among the categories, and ultimately obtained 2 main categories and 7 subcategories (Table 2).

Although the axial codes in Table 2 cannot present a complete influence factors theoretical model of information technology enterprise, we draw the following conclusions:

(1) The influence factors of information technology enterprise' operating performance are divided into external and internal factors.

(2) The external factors are divided into the national policy, market situation and regional environment, which are the factors that are difficult for information technology enterprises to control, but those will indirectly have a significant impact on the operation and development of information technology enterprise. The national policy includes industrial policy, access to social capital and tax incentive. The market situation includes the level of economic development and industry development cycle. Regional environment includes local government service, financing environment and the level of science and technology.

(3) The internal factors are divided into strategy, execution, corporate values and leadership. The four interrelated factors form the internal operation system of information technology enterprise, those have a direct impact on operating performance. The strategy includes market insight, market positioning, technical innovation and value proposition. The execution includes value network, organizational change, personnel policy and corporate culture.

6. SELECTIVE CODING

Selective coding is to aggregate all categories from the open coding and axial coding to the core category, verify their relationship, and complete the category with incomplete conceptualization^[6]. The core category is a dominant concept that summarizes all categories and occupies a central place related with all categories.

The steps of selective coding include: (1) Define the story line. (2) Describe the main categories, subcategories and concepts of the codes. (3) Improve the incomplete concepts and categories. (4) Select the core categories. (5) Establish a theoretical relationship between the core categories and other categories^[7].

The theoretical model of the influence factors of information technology enterprise' operating performance was illustrated in Figure 2 through the analysis of 17 categories, 7 subcategories, 2 main categories and the original records.

Table 2. Axial coding analysis

The intension of category	Category	Subcategory	Main category
National policy orientation, encouragement of social capital and tax incentive	Industrial policy	National policy	External factor
The intellectual property protection of the country and enterprise	Intellectual property protection		
The level of national economic development, the cycle of economic development	The level of economic development	Market situation	
Industry development prospects and maturity	Industry development cycle		
Local government's attention and service awareness	Local government services	Regional environment	
Local science and technology and research ability	The level of science and technology		
The development of local financial industry and financing channels	Financing environment		
Understand customer demand and solve customer's pain points	Market insight	Strategy	Internal factor
Business market positioning, business focus and development strategy	Market positioning		
Scientific and technological innovation, technology research and development, technical transformation	Technical innovation		
Target customer orientation and customer value provision	Value proposition		
Upstream and downstream industry chain collaboration, research collaboration and value network collaboration	Value network	Execution	
Organizational structure and business architecture	Organizational change		
Talent recruitment, talent incentive and salary policy	Talent policy		
Organizational climate and employee training	Corporate culture		
Value concept and development goal	Corporate values	Corporate values	
Leadership vision planning and leader charm	Leadership	Leadership	

As illustrated in Figure 2, we can find that in the following: (1) The operating performance of information technology enterprise is the core category. Around this core category, the main categories, subcategories and concepts are organically integrated. And the operating performance of information technology enterprise is affected both by external factors and internal factors. (2) The story line around this core category is that the external factors of national policy, market situation and regional environment have an external impact on information technology enterprise and the internal factors of strategy, execution, corporate values and leadership have a direct impact on information technology enterprise. (3) The strategy, execution, corporate values and leadership interact with each other and affect the operating performance of information technology enterprises together with the external environment. (4) If information technology enterprises want to improve their performance and maintain sustained and healthy development, they should analyze their own current situation, find their advantages and disadvantages and make continuous improvements from the above aspects. In our understanding, we also should consider e-service and new economic situation in following: Chuang et al. developed an e-service capability, and an innovation strategy that emphasizes service innovation orientation to

examine information-value offering^[11], and Yang et al. proposed the performance evaluation system design of enterprise environment under the new economic situation^[12].

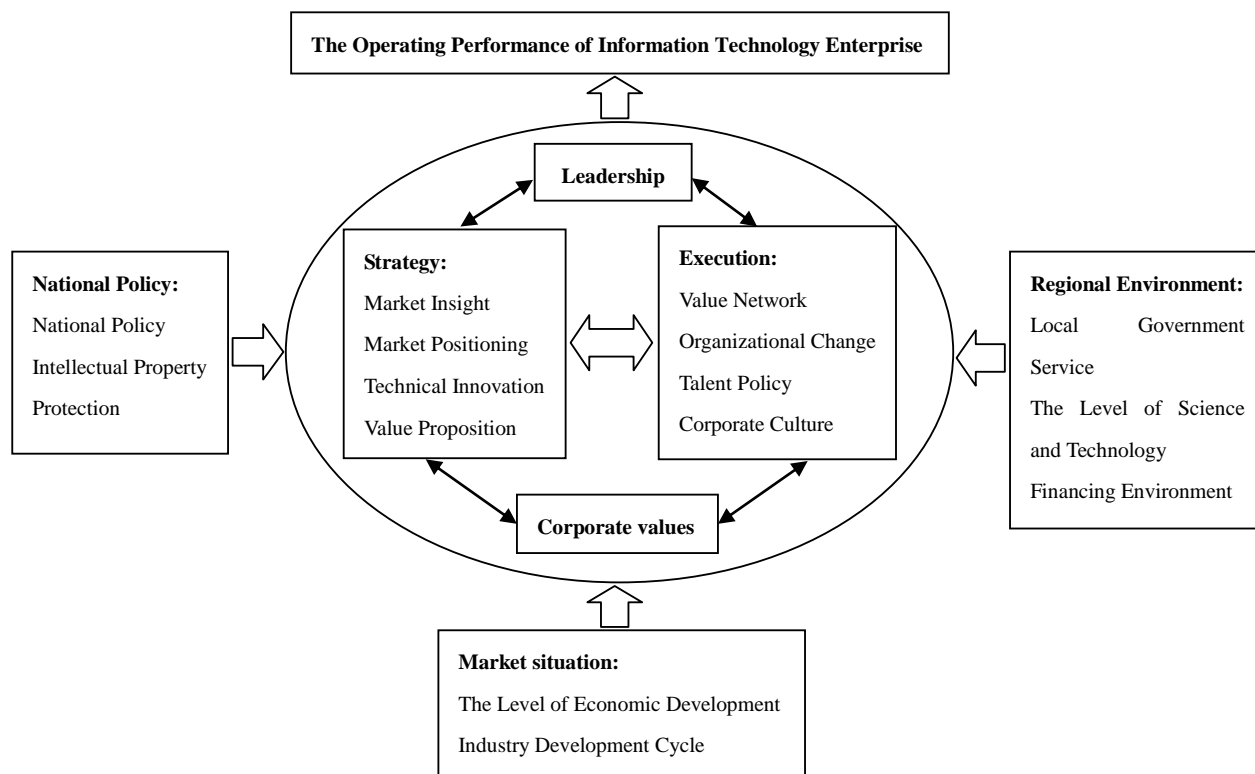


Figure 2. The influence factors model of information technology enterprise's operating performance

7. CONCLUSIONS

This paper is a partial results of the research on the operating performance and influencing factors of the Chinese listed information technology enterprises. Our research first applied DEA method to statically evaluate the operating performance of 69 Chinese listed information technology enterprises in 2015. The results illustrated that the overall operating performance of information technology enterprises was ordinary. Thus, it was necessary to improve their management, the efficiency of resource utilization and scale efficiency. Then, we applied the Malmquist index method to dynamically evaluate the performance changes of these enterprises in five years from 2011 to 2015. The results illustrated that the change of pure technical efficiency and scale efficiency played an important role for business development in 2011-2014 with a gradually reducing contribution. The technological change had a gradually reduced hindrance to business development. However, in 2015, the change of pure technical efficiency and scale efficiency had a hindrance to the business development. The technological change played a role in promoting the business development. Due to length limitation, the above research will be published in another paper. This paper uses grounded theory to interview a listed information technology company in Guangzhou, and establishes the influence factors model of information technology enterprise's operating performance, which concludes 17 key factors, including national policy, regional environment, market situation, strategy, execution, corporate values and leadership. The purpose of research is to help listed information technology enterprises improve operating performance in China. It is notability that May McCreddie et al. illustrated the potential for a new form of grounded theory methodology (GTM) drawing on discursive approaches (DGTM)^[13], in our understanding. DGTM will improve the interactive between researchers and practitioners to get deep insights.

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APPENDIX: INTERVIEW QUESTIONNAIRE

1. Please give a brief introduction to the basic situation and main business of the company.
2. Please introduce the main reasons for the company's previous transformations?
3. What do you think about the development status of China's information technology business?
4. What are the external factors that affect the operation and development of Chinese information technology enterprises?
5. What are the internal factors that affect the operation and development of Chinese information technology enterprises?
7. Which of the above key factors in the company there are advantages? What are their disadvantages?
8. Please give a brief introduction to the future direction of the company and your opinion on the future development direction of Chinese information technology enterprises.