Critical Evaluation of Competitiveness of SMEs in Chinese Yangtze River Delta

A thesis submitted for the degree of Doctor of Philosophy

By

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Abstract

China has continued the economic reform and open door policy over 30 years with many great achievements, such as the second largest GDP, the largest import and export economy with the largest infrastructural investment in the world. On the other hand, the conflicts and risks the firms especially for small and medium sized manufacturing enterprises (SMEs) have faced are extremely serious and more acute due to the economy growth and increasing social wealth, especially in Yangtze River Delta, in the general context of ever increasing cost such as labour, land and higher customers' expectations such as the quality of product. These serious problems are challenges for the competitiveness of SMEs in Yangtze River Delta.

This research aims to investigate and improve the competitiveness of SMEs by the main variables such as enterprise's resources, product's competitive issues and innovation activities related barriers. To achieve the aim, the research employed a mixed method of quantitative and qualitative approaches to build the competitiveness's belief network model by Bayesian Belief Networks and analyze the factors of the most important variables by the SPSS software. Secondly, 36 entrepreneurs of small and medium sized manufacturing enterprises in Yangtze River Delta have been carefully selected to participate in the questionnaire survey and face to face interviews. All participants are entrepreneurs who have run enterprise for at least three years.

Five kinds of resources, competitive issues and innovation have been identified as the variables of competitiveness. The findings of research are mainly related to the three

aspects which are general view of variables; barriers to innovation activity and importance of variables for improving the competitiveness; and the factor analysis of quality management practices. Firstly, the general condition of financial resource is the worst in resource sector of SMEs; Dependability is the best performance in competitive issues of SMEs; Lack of finance is generally identified the biggest barrier to innovation of SMEs. Secondly, the Physical resource in resource sector and Quality in competitive issues sector are the most important variables for improving the competitiveness of SMEs after BBN assessment; Lack of technical experts is the most serious barrier when the SMEs are really focusing on the innovation according to the BBN assessments. Thirdly, the factor analyses have identified the key independent factors explaining the quality management practices in these SMEs.

Finally, these findings can help the SMEs build variables' impact tables based on the outputs from the conditional assessment of BBNs to make more efficient and effective decisions when they try to improve the enterprise competitiveness, with detailed recommendations. At the same time, the importance and factors of good quality management practices have also been argued to help the entrepreneurs improve the quality performance and their enterprise competitiveness.

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Abbreviations

BBN	Bayesian Belief Network
C	Cost Issue
CIA	Causal Independence Assessment
CP	Competitiveness Performance
CPC	Communist Party of China
D	Dependability Issue
DAG	Directed Acyclic Graph
DOE	Design Of Experiment
F	Financial resource
FDI	Foreign Direct Investment
FL	Flexibility Issue
GDP	Gross Domestic Product
H	Human resource
I	Informational resource
INP	Innovation Performance
LFC	Lack of Financial Capital
LGS	Lack of the Government Support
LRI	Lack of Research Institutions
LSA	Lack of Social Innovation Atmosphere
LTE	Lack of Technical Expert
LTI	Lack of Technical Information
O	Organizational resource
P	Physical resource
Q	Quality Issue
S	Speed Issue
SME	Small and Medium Enterprise
TT	Technology Transfer
WPAP	Weak of awareness Intellectual Property Rights Protection

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Chapter 1 Introduction

1.1 Background

The Yangtze River Delta is the alluvial plain of the Yangtze River into the sea and used to be one of the early big economic zones in China. It is one of the strongest economic centers in China and has the advanced global manufacturing base with important international portal in the Asia-pacific region. This delta mainly consists of Shanghai, south part of Jiangsu and north part of Zhejiang province, as shown in Figure 1.1 with red borders. It has about 210,700 square kilometers with a population of 150 million people (Chinese National Bureau of Statistics, 2013).

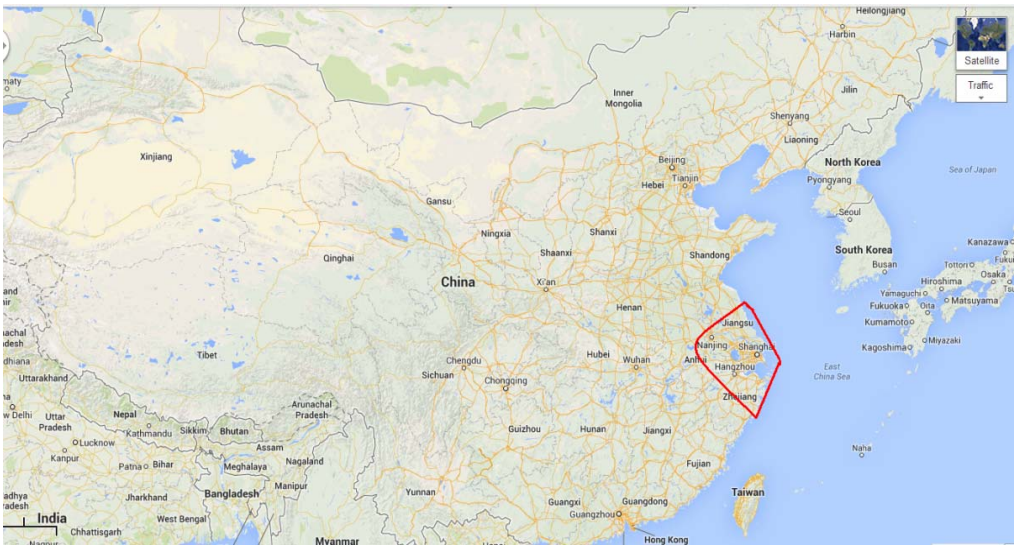


Figure 1.1 Area of Yangtze River Delta

1.1.1 Economy

In 2012 the Chinese National Bureau of Statistics released the analysis of its economic operation. According to a report the GDP in Yangtze River Delta reached 8.9951 trillion yuan (about 1.45 trillion US dollar) in 2011, with an average GDP growth rate of 10.1%, down 1.0% from the previous year, representing 17.3% of the whole country's economy. According to the analysis in the report, the Yangtze River Delta region is one of the most important growth poles in Chinese economy, and has

achieved the world-class urban agglomeration (Chinese National Bureau of Statistics, 2012).

Moreover, the import and export trade of Yangtze River Delta account for 33.5% and 36.2% in China. Meanwhile, the import and export of Yangtze River Delta totaled $1.2204 trillion in 2011 at an increase of 17.6%, with exports of $687.5 billion at an increase of 16.0%. However, the growth in import and export trade dropped 17.5% and 16.8% respectively over the previous year, below the national 4.9% and 4.3%, respectively (Chinese National Bureau of Statistics, 2012).

In addition, Yangtze River Delta cities had actual use of foreign capital of $50.4 billion in 2011, an increase of 10.7% compared with the previous year. Its actual use of foreign capital was 43.4% of the whole nation (Chinese National Bureau of Statistics, 2011).

1.1.2 Transportation and Infrastructure

The transportation of Yangtze River Delta is extremely intensive and convenient in China. The main railway and highway networks radiate the whole areas of China, especially the high speed railway. The main global port of the delta has two largest ports which are Shanghai-Yangshan and Ningbo container ports. The main river transports include Yangtze River and Beijing-Hangzhou Canal. The whole Yangtze River Delta region has 17 civil airports, located in 16 large and medium-sized cities, such as Pudong International Airport.

The network of high speed railway covers Shanghai, Nanjing and Hangzhou as the centers, and also other cities and main towns in Yangtze River Delta. It forms a safe

and efficient intercity rail transit network within one to two hours traffic circle, and has greatly enhanced the core area of the Yangtze River Delta region and also peripheral area transport links. The area is about 350000 square kilometers, and has a population close to 200 million people. High-speed railway's minimum speed of 250 km/h (155 mph) on lines strongly and efficiently helps the Yangtze River Delta linking to the whole area of the China. The railway networks of Yangtze River Delta spread and connect the whole country, as showed in Figure 1.2, where the red line is the high-speed railway, black line is the normal railway (China Railway Corporation, 2013).

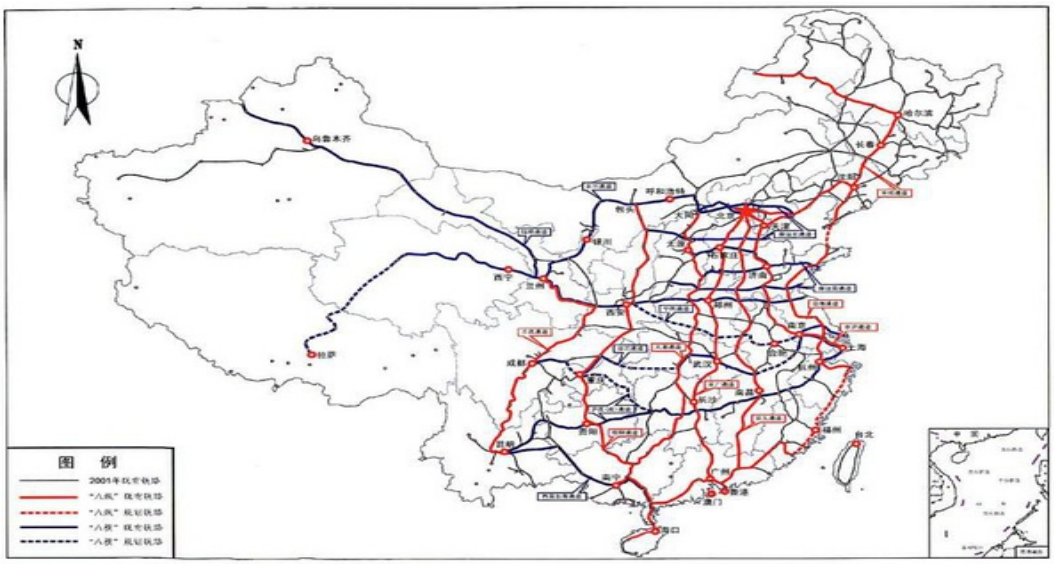


Figure 1.2 Chinese Railway Network adapted from China Railway Corporation

In the world's top 10 busiest container ports in 2012 (Table1.1), two of them are located in Yangtze River Delta, Shanghai (No.1) and Ningbo (No.6). In 2012 Shanghai Container Traffic was 32530 thousand TEUs, and Ningbo Container 16830 thousand TEUs.

Table 1.1 World Container Ports (Ranking of container ports of the world, 2013)

Rank	Port	Country	2012	2011	2010	2009	2008	2007
1	Shanghai	China	32,530	31,740	29,069	25,002	27,980	26,150
6	Ningbo-Zhoushan	China	16,830	14,720	13,144	10,502	11,226	9,349

Moreover, the Beijing-Hangzhou Grand Canal is about 1750 km which is the world's longest, largest canal project, from Beijing (the capital of China) in the north to Hangzhou in the south. The canal flows through Beijing, Tianjin, and Hebei, Shandong, Jiangsu and Zhejiang provinces, and well connects the Yangtze River Delta and Beijing-Tianjin-Hebei which are the two of the largest economic zones in China with a history of more than 785 years. By 2020, the Grand Canal capacity will exceed 140 million tons (Ministry of Transport of the People's Republic of China, 2010).

Figure 1.3 Yangtze River adapted from (Yangtze River Organization, 2013)

Yangtze River flows from the west and middle to the east of China which has formed Yangtze River Delta, connecting 29 cities such as Chongqing and Wuhan, as shown in Figure 1.3. Since 2010, the Yangtze River's main cargo throughput of 1.502 billion

tons is three times as that of the United States' Mississippi River, and five times that of the Rhine River in Europe, ranks the first in the world (Ministry of Transport of the People's Republic of China, 2010).

In 2012, the average passenger traffic volume of 73.8% focused on Shanghai's two airports, 87% of the average goods traffic volume also gathered in Shanghai, freight volume concentration in the Pudong airport (more than 70%); the rest of the traffic volume is located in Xiaoshan airport (Hangzhou), Lukou (Nanjing) airport and Ningbo airport, less than 10%. The world's largest air cargo hub continues to be Hong Kong. Memphis is the second followed by Shanghai in the third rank (see Table 1.2).

Table 1.2 Airports (Airports Council International, 2013)

RANK	AIRPORT	CARGO (Metric tonnes)	
		Loaded and unloaded	Percent change
1	HONG KONG, HK (HKG)	4 161 718	2.3
2	MEMPHIS TN, US (MEM)	4 137 801	3.0
3	SHANGHAI, CN (PVG)	2 928 527	-0.3
4	INCHEON, KR (ICN)	2 464 384	0.3
5	DUBAI, AE (DXB)	2 435 567	6.8
6	ANCHORAGE AK, US (ANC)	2 421 145	-1.7
7	LOUISVILLE KY, US (SDF)	2 216 079	2.2
8	FRANKFURT, DE (FRA)	2 094 453	1.4
9	PARIS, FR (CDG)	2 069 200	-3.8
10	TOKYO, JP (NRT)	2 019 844	0.7

1.2 SMEs in Yangtze River Delta

There are mainly three strong types of SMEs in the Yangtze River Delta region, Jiangsu township enterprises, Zhejiang private enterprises and Shanghai state-owned and collective SMEs in Yangtze River Delta. The three types of SMEs and the different stages of development in different regions have played a significant role. According to the data from Jiangsu province in 2012, 645,000 SMEs employed more

than 20 million people and accounts for 89% of the enterprise employment, they achieved the added value of 640 billion yuan (100 billion US dollar), accounting for more than 60% of the total cost of the production in the province (SME of Jiangsu, 2012).

1.2.1 Development of SMEs in Yangtze River Delta

The policies of Chinese government are one of the most important issues for enterprises. China had dramatically changed its economic policy from the unconditional public owned sector including the state and collectively-owned sectors to mixed own sector economic structure at the end of the 1970s when China started with open-door policy by Deng Xiaoping (Di Tommaso *et al.*, 2012). Overseas capital and FDI (Foreign Direct Investment) were attracted by the promotion policies such as Tax-free and established manufacturing factories in some selected special economic zones located in southeast coastal region such as Yangtze River Delta and Pearl River Delta (Démurger *et al.*, 2002). More and more multinational enterprises not only created lots of jobs, but also bring approved knowledge for the employees such as technology and good training skills.

The Yangtze River Delta was one of the first selected special economic regions by the open-door policy, and it attracts not only the multinational firms, but also absorbs lots of young persons from the middle and western provinces. Between 1980s and 1990s, the Chinese government authorities have further implemented long term plans of industrial development and structural reform for the Chinese economy: economic experimentations started to involve a growing number of people, companies, sectors and territories (Di Tommaso *et al.*, 2012). In 1990s, a variety of small and medium private enterprises increased fast in Yangtze River Delta and the other two economic

zones. During this period, a large amount of the cheap labour force from the middle and western provinces created huge revenues for the SMEs. Moreover, Technology Transfer (TT) by the multinational enterprises from developed countries has become one of the main sources for competitiveness enhancement (Di Benedetto *et al.*, 2003; Waroonkun and Stewart, 2008; Audretsch, 2009). Yangtze River Delta as one of the earliest selected economic region for open-policy has also gained the huge benefit from the TT. Meanwhile, the competitiveness of Yangtze River Delta SMEs was strongly supported, benefited and enhanced. Until the world financial crisis in 2008, SMEs of Yangtze River Delta got almost 20 years' golden developing period.

1.2.2 Challenges and Problems of SMEs in Yangtze River Delta

35 years' economic reform and open-door policy have enabled China's economy to grow rapidly, and its comprehensive national strength has increased substantially. China's gross domestic product (GDP) has jumped from 364.5 billion yuan in 1978 to 51.8942 trillion yuan in 2012. China has been one of the fastest developing countries in the last three decades. The position of Chinese economy in the world has been rising steadily, making more and more contribution to world economic growth. In 2010, it became the world's second largest economy after the United States. Its share of the world economy was up from 1.8% in 1978 to 11.5% in 2012. In the second half of 2008 since the outbreak of the international financial crisis, China has become an important engine driving the world economic recovery. During 2008-2012, it had an average annual contribution rate of more than 20% of the world economic growth. (Chinese National Bureau of Statistics, 2013)

However, despite the fast growth in the last three decades, many hidden problems started to occur in China. Low labour cost and relatively low exchange rate have often

resulted cost competitive advantage for Chinese manufacturing and were very low compared with a large number of other countries in 2002. In 2007, several press reports and studies suggested that China started to lose the competitiveness. In accordance with Ceglowski and Golub studies (2007), the percentage gap of the different labour costs to manufacture the same item between China and United States had been reduced from 67.5% to 40.6% from 1998 to 2009. Meanwhile, Ceglowski and Golub also suggested that manufacturing in Indian, Indonesia or Chile would have a cheaper of unit labour cost than China. The cost of Chinese labour force has presented the more obvious upward trend in recent years. The average income of Chinese was more than 6000 US dollar in 2013, which may be classified as a country with middle income in the world. In experience, lots of developing countries get bogged down in the middle income trap.

According to official figures, since 2010, in the two major manufacturing centers of the Pearl River Delta and Yangtze River Delta, the labour costs rose by 20% to 25% and the national minimum wage up 12% on average. Obviously, the SMEs in Yangtze River Delta take more labour cost pressure than the average rate in China (Chinese National Bureau of Statistics, 2012).

Thus, the Chinese Prime Minister reported that the GDP will be controlled around 7.5% during next ten years in the 3rd Plenary Session of 18th CPC Central Committee 2013. The government cannot keep the GDP growth as before, and will pay more attention to high quality products and rational structure of economy to improve languishing competitiveness. In the following paragraph, the author will introduce objectives of the research, scope of the research and layout of the thesis.

1.3 Research Aim and Objectives

Whilst the competitiveness performance of SMEs has been increasingly regarded as an essential engine to drive the economic development, most SMEs have only achieved moderate or low competitiveness performance. This is particularly true for those SMEs with little experience and limited resources. They will undoubtedly generally need more effective feasible methodology and practical knowledge/skills to implement improvement of competitiveness. In addition, after 2007-2008 world financial crises, it has been recognized that "*companies have to innovate in order to survive and innovation can help convert a crisis into an opportunity*" (Mahroum, 2008). Unfortunately, the research in the competitiveness of the SMEs in the Yangtze River Delta is still lacking despite many theoretical studies for SMEs of Yangtze River Delta.

Critical analysis will be applied to model the current competitiveness of SMEs through the resources of production, competitive issues, the barriers and impact of innovation using the Bayesian Belief Networks (BBNs) and factor analysis. The research will try to make sound recommendations based on the research outcomes and findings to improve the competitiveness performance of SMEs in Yangtze River Delta.

The aim of this thesis is to evaluate and improve the competitiveness of Chinese SMEs in Yangtze River Delta. To achieve this goal, the following research objectives are proposed:

1) To identify and analyze the manifestation of competitiveness of the small and medium manufacturing enterprises, mainly through resource based views, competitiveness issues and innovation performance related barriers;

2) To simulate and combine the variables of competitiveness to determine key variables' impact by means of Bayesian Belief Network modelling. Ranking the general condition of variables and the importance of variables helps the enterprise find more efficient and effective ways to improve the innovation and competitiveness performance for SMEs in Yangtze River Delta.

3) To clarify the key factor of Quality management using factor analysis to support the findings from the BBN modelling to improve the overall competitiveness performance of SMEs.

1.4 Scope of the Project

The research area is based on the small and medium manufacturing enterprises in Chinese Yangtze River Delta including Jiangsu, Zhejiang Province and Shanghai. All of the research data collection and interviewees are from this area. This empirical research focuses on the 36 SMEs. During July to December in 2012, the researcher contacted more than 100 entrepreneurs of small and medium manufacturing enterprises, 36 of them were willing to accept the interview and answer the questionnaire. Each participant not only answered the questions, but also offered the chance to visit their factories.

The research has focused on the current competitiveness performance of SMEs mainly through the resource based view, competitiveness issues and innovation performance by the questionnaires survey, factor analysis and BBNs.

Through the question survey, this research will gain enough and reliable knowledge of the background of entrepreneurs and company, the condition and problems of resources, the situation of competitive issues, the barriers of innovation and current performance of innovation and general competitiveness in Yangtze River Delta.

1.5 Layout of the Dissertation

The current dissertation is constructed as follows: Chapter 2 will present the literature review corresponding to each research objective with the purpose of finding the correlations and agreements from different authors. Chapter 3 will describe and justify the research methodologies and scientific analysis tools applied throughout this dissertation. Chapter 4 will mainly provide the outcomes from the data collected and analysis. Chapter 5 will present the findings and discussions based on the outcomes from the BBNs and factor analysis of quality management practices. Chapter 6 will argue recommendations for improving the performance of innovation and competitiveness in SMEs and present contributions to knowledge. Chapter 7 will draw conclusions and further work.

Chapter 2 Literature Review

2.1 Understanding the competitiveness of enterprises

This section is going to define, learn and understand the different views and knowledge about the enterprises' competitiveness. In a fundamental sense, Robert and Colin (2002) argued creation of value is the purpose of a firm. Values – measured by creating and gaining profits, cash flows, stock prices, or some strategic objectives are the life of firms. Competitiveness of enterprise is the general manifestation or measurement of value creations. Many authors argued what the competitiveness of enterprises is. Some of them define that the better competitiveness of enterprise has better performance of competitive issues or more advantages compared with their competitors and call it competitive advantage (Rosenzweig and Roth, 2004; Ketokivi and Schroeder, 2004). Porter (1985) argued that competitiveness is to recognize that, in whole competition the enterprises are seeking competitive advantages and that competitive advantage will be the heart of corporate success. Thus, competitiveness has been described as enterprises' real strength of competitive issues.

Today's business world are experiencing significant pressures for the enterprises from increased levels of competition, rapidly changing market requirements, higher rates of technical obsolescence, shorter product life-cycles and the heightened importance of meeting the needs of increasingly sophisticated customers. The ways in which companies meet these challenges depend largely on the nature of the business they are in, the dynamic competitive issues of the product or service which they operate.

Increased global competition with the rapid integration of economies and the globalization of products, markets, and consumer preferences, has made companies to

focus on their competitive priorities. This goal should be accomplished through a continuing adaptation to a changing social and economic environment (Chicán, 2008). And Hao (1999) argued that competitive advantage allows the firm to better create customer value than others do. The competitive advantage of firms is often argued to derive from their specific context and environment.

Moreover, company resources refer to a company's ability to deploy resources (Amit and Schoemaker, 1993). Resources based advantage theory has been defined as a general theory of competition that describes the process of competition, which is explicated using a descriptive approach (Hunt and Arnett, 2001). Thus, the resource-based views of the firm can be traced (Wernerfelt, 1984). This view what calls the "competence perspective" in evolutionary economics and the "capabilities" approaches of resource was argued by Teece and Pisano (1994) and Langlois and Robertson (1995).

In addition, innovations boost growth for any country as it will likely add higher values to products and consequently enhance the competitiveness of a country, as well as enterprises. The common perspectives consider that innovation is a key or weapon which allows firms to compete better. According to Kohli and Jaworski (1990), a successful company not only increases the organization's ability to determine the market demand, the company also must compete to satisfied customers' needs.

Small and medium sized enterprises (SMEs) play critical roles in a country's economic development. Moreover, Zhu and Sarkis (2006) argued, "*SMEs exert a strong influence on economic growth and technological development of many countries through their ability to innovate new products and processes"*.

In the following sections, this research will study and develop these understandings. Firstly this thesis will find the widely approved understandings about what kinds of the resources the enterprise owns; who are involved in using these resources; how to improve the capacity of using the resources. Secondly, the research will clarify what kind of competitive issues will be related to the competitive advantages and will further embody by the authors' perspectives. Thirdly, the research will explore effects of the innovation for competitiveness of enterprises and define the barriers as the main variables of innovation performance in SMEs of Yangtze River Delta. Furthermore, the importance of entrepreneurs and the main differences between SMEs and Large enterprises will be discussed. Finally, this research will introduce and justify the BBNs and factor analysis as the main tools.

2.2 Resources of Enterprise

According to Barney (1991), Hall (1992) and Galbreath (2005) classified resources of enterprises as financial resource (e.g. cash reserves, access to financial markets), physical resource (e.g., plant and equipment), human resource (e.g., skills, intelligence, insight of individual managers and workers), and organizational resource (e.g., reporting structure, coordinating systems, planning processes). In addition, informational resource (e.g., market research data) also plays more and more important role in current business world as the information technology advanced.

Moreover, Hunt and Morgan (1995) argued that firms can gain an advantage in resources over their competitors. They called it resource based advantage that the firm enables resources to produce efficiently and/or effectively a market offering that has value for some market segments. Although firms can possess similar resource sets,

the compilation of a firm's set of resources is unique. That is, the complexities of resource sets ensure that their competitors cannot gain exactly. The analysis of enterprise resources usually refers to the resource based views.

Yangtze River Delta is one of Chinese largest economy regions as mentioned in the background chapter. Firstly, the SMEs of this region have to recognize that they can possibly gain the resources from macro (external) and micro (internal) environment. The macro environment is based on the background of Yangtze River Delta. This research mainly focuses on the micro (internal) environment which is the first view of the internal of enterprises.

2.2.1 Human Resource

Cambridge Business Dictionary defines Human Resource is people, when considered as an asset that is or can be employed and that is useful to a company or organization. Human Resource focuses on training, recruitment, organizational design and effectiveness.

Thurow (1992) argues that the education and skills of the work force will be the dominant competitive weapon in this in the 21st century. In a similar note, Vernon (1986) argues that the development of a literate and flexible labour force increased the ability of the U.S. to maintain a higher living standard than other countries. No matter an organization or a country, Human Resource always plays a significant role. Meanwhile, these arguments also reported enterprises need to pay more attention to improving the skills / abilities or quality of the employees.

2.2.2 Financial Resource

Business Dictionary defines the Financial Resource *"is the money available to a business for spending in the form of cash, liquid securities and credit lines. Before going into business, an entrepreneur needs to secure sufficient financial resources in order to be able to operate efficiently and sufficiently well to promote success"*.

In addition, more capital allows enterprise to pursue a broader range of activities as well as more ambitious projects. Financial Resource can be invested into capital-intensive projects that may enable firm to secure existing markets as well as enter new market. Further, lack of financial resource may be removed if a principal founder has been able to secure external sources of finance based on his/her experience (or the experience of the team of partners) (Westhead *et al.*, 2001).

2.2.3 Physical Resource

Cambridge Business Dictionary defines Physical Resource is the material assets that a business owns, including buildings, materials, manufacturing equipment and office furniture which used to produce goods or service.

2.2.4 Organizational Resource

Business Dictionary defines Organizational Resources are *"all assets that are available to a firm for use during the production process. The four basic types of organizational resources are human, monetary, raw materials and Capital. Organizational resources are combined, used, and transformed into finished products during the production process"*.

2.2.5 Informational Resource

Cambridge Business Dictionary defines Informational Resource that *"a piece of information, such an employee record, a customer list, or a financial report, that is valuable to a company or organization"*.

2.2.6 Resource based views in related studies

Günerergin *et al.* (2012) explored the problems and advantages from 300 Turkish SMEs. They found the major disadvantages of Turkish SMEs: unfair competition, problems in institutionalization process, lack of government support, and financial difficulties. The major advantages of Turkish SMEs: being a family business, the small organizational structure that support quick decision making, the ability of quick intervene in organizational problems, harmony at work, and quick response to changes.

Even this empirical study was not original intention on the resource based views, it still clearly distinguishes that the major obstacles of SMEs are bad conditions of financial resources and the major advantages of SMEs are good condition of organizational resources in Turkish SMEs' sustainable development. It is very interesting to analyze if the findings also correspond to the competitiveness performance of SMEs in Yangtze River Delta.

2.3 Competitive Issues

Competitive issues normally are traced by manufacturing enterprises, including dimensions such as cost, quality, speed, flexibility and dependability (Flynn, 2004). Competitiveness has been referred to as a firm's actual competitive strength, relative to its competition, along common competitive issues. People identified several aspects by empirical research and correlated these positive impacts with the competitiveness performance measures including reduced cost, improved quality, increased productivity speed, improved flexibility and improved satisfaction of customers which is related to the dependability. Lots of the empirical researches focused on analyze how the competitive issues may cause the competitive advantages to improving the general competitiveness performance include Saraph *et al.* (1989), Adam (1994), and Ahire *et al.* (1996).

This thesis follows five main major competitive issues to study the competitiveness performance which are cost, quality, speed, flexibility and dependability. These five factors also are defined as the main competitiveness issues by Honda Motor Company.

2.3.1 Cost

Hooshang (2006) argued that if the enterprise can create the lower cost without negative impact on the other factors such as the quality or service, then the cost competitive advantage can be achieved. Improving the value of products is to achieve equivalent or better performance at a lower cost while satisfying the customers' all functional requirements (Fowler, 1990).

2.3.2 Quality

Grant (1991) argued that the competition in the maturity stage shifts not only to price but also to customer service and quality as well. In the 1980s and 1990s, ISO 9000 series of quality standards and quality systems were introduced. Nowadays, many companies achieved the ISO (9001) quality system certifications to gain trust from customers.

Quality management systems try to help the enterprise improve their product quality, and provide organizations with a means of achieving higher quality processes to satisfy customer better (Pfeifer, 2002). Meanwhile, ISO 9001:2000/2008 has depicted eight quality management principles: (A) Customer focus; (B) Leadership; (C) Involvement of people; (D) Process approach; (E) System approach to management; (F) Continual improvement; (G) Factual approach to decision making; and (H) Mutually beneficial supplier partnership (ISO, 2011).

2.3.3 Speed (delivery)

Brian (2006) who is CEO of Herman Millier demonstrated that the speed of delivery increases the satisfaction of customers and could cause competitive advantages. Indeed, if the products or service can be produced quicker and delivery faster to the final customers than competitors, speed is an important competitive issue.

2.3.4 Flexibility

Some researchers argued that manufacturing flexibility is not only as a reactive tool to environmental uncertainties using the widely accepted positioning theory of strategic management, whereby the firm chooses a competitive strategy, but it is also the most appropriate proactive tool by which given the surrounding industry and market

conditions, firms can create and sustain a competitive advantage (Chang and Newman, 1995).

2.3.5 Dependability

Mahmoud *et al.* (2004) argued that dependability as one of the firms strategies responding to the market realities is becoming increasingly a critical factor in the criteria of customer decision. The increasing expectation of customers with regard to dependability is one of the most important competitive issues.

2.3.6 Competitive Issues in Related studies

Li *et al.* (2008) concluded that the importance orders of the competitive priorities in the Chinese manufacturing enterprises in 1997, 2001, and 2005 are as follows: Quality> Delivery> Flexibility> Innovation> Cost in 1997, Quality> Delivery> Cost> Flexibility> Innovation in 2001, Quality> Delivery> Flexibility> Innovation> Cost in 2005. Obviously, Quality competitive issue always played the most significant place in 1997, 2001 and 2005. It is very interesting to prove if the competitive issues priorities changed and if the finding also applies to the SMEs in Yangtze River Delta nowadays.

2.4 Definition and Exploration of Innovation

This section will clarify the definition of innovation, and further explore if innovation is one of the best keys to improve the competitiveness of enterprises under different situations, and what affect the successful innovation.

2.4.1 Definition of Innovation

Innovation has many definitions and can be understood in various ways. By associations with economic development, Schumpeter (1934) defined innovation within five specific cases: "*introduction of new products, new production methods, exploration of new markets, conquering of new sources of supply and new ways of organizing business.*"

Myers and Marquis (1969) gave out a more comprehensive definition of innovation "innovation is not a single action but a total process of interrelated sub process. It is not just the conception of a new idea, nor the invention of a new device, nor development of a new market. The process is this entire thing acting in an integrated fashion". Moreover, Van de Ven (1986) continues: *"An innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved"*.

In 2012, Trott defined innovation in a new and distinctive way as a management process: "innovation is the management of all the activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment."

2.4.2 Innovation and the competitiveness of enterprise

An innovation strategy try to satisfy the more and more captious need to establish a linkage between customer needs and the needs satisfied by new products or better service. This linkage must be not only better and stronger than competitors', but also sustainable over time, something that translates into a true competitive advantage. Innovation is mainly related to knowledge, routines, strategy, technology, structure and culture, and these issues may be variables for competitiveness performance (Rouse and Daellenbach, 1999)

Moreover, Darroch and McNaughton (2002) reported innovation can be a necessary considerable element of company needs to remain competitive. Thus, enterprises mainly tend to determine the perceptions and requirements of the market in order to create products with a great value for customers successfully. To gain this kind of superior value, the innovations have to highly focus on customers' needs, it is essential to learn their opinions about the usefulness of the product.

However, innovation performance does not necessarily mean that each innovation has a positive impact. In other words, it is a necessary but not sufficient condition to gain profit. Moreover, there are further risks inherent in the innovation (Wang and Zheng, 2008) and product innovation is considered to be particularly risky business activity (Stevens and Burley, 1997). In addition, more intense competitions, rapid changes in technology and the expectations of customers often make innovation more complex, leading to low profit and increase of the exposure of innovators (Keizer *et al.*, 2002). Therefore, determining if the innovation has a positive impact on organizational performance requires serious efforts.

To understand these perspectives, the research can think innovation as one kind of variable which impacts on the competitiveness performance. This thesis argued that positive innovation is one of the keys to improve the competitiveness of the enterprise. Specifically, for the innovation to cause positive impact for the enterprise, the positive impact should create the more or better real competitive advantages for the enterprise than the competitors. The key issue is how the enterprise can avoid barriers to innovate successfully, and how to identify the innovations for positive impacts on the competitive issues to improve the competitiveness of SMEs.

2.4.3 The Barriers to Innovation of SMEs in Yangtze River Delta

According to the empirical research of Xie *et al.* (2010), innovation has been one of the key drivers of sustainable competitive advantage for small and medium-sized enterprises (SMEs) in Shanghai which is the core area of Yangtze River Delta. 295 questionnaires collected from SMEs in Shanghai, with eleven major barriers of innovation in SMEs outlined by ranking (Table 2.1): (1) lack of technical experts; (2) lack of financial capital; (3) lack of technical information; (4) low rate of return; (5) high-cost and high-risk of innovation; (6) lack of correct business strategy; (7) weak awareness of IPR protection; (8) lack of marketing channel; (9) lack of external innovation partners; (10) lack of effective management system; and (11) policy constraints.

Table 2.1 the Major Barriers of Innovation (Xie *et al.*, 2010)

Major barriers to innovation	Mean		SD (σ)				RII				Cronbach's Alpha
	WCOEs	FIEs	WCOEs	FIEs	*t*-statistic	*p*-value[a]	WCOEs	FIEs	Total	Rank	
Lack of technical information	3.39	3.34	1.608	1.353	–0.222	0.824	0.677	0.668	0.673	3	
Lack of financial capital	3.13	3.83	1.478	2.489	2.431	**0.016***	0.625	0.766	0.683	2	
Low rate of return	3.03	3.27	1.210	1.232	1.360	0.176	0.605	0.655	0.626	4	
Lack of technical experts	3.83	3.87	1.043	1.056	0.266	0.791	0.766	0.774	0.769	1	
High-cost and high-risk of innovation	3.00	2.88	1.314	1.298	–1.242	0.202	0.600	0.590	0.596	5	
Lack of correct business strategy	2.95	2.19	1.451	1.246	–0.305	0.761	0.589	0.577	0.584	6	
Lack of external innovation partners	2.71	2.22	1.384	1.273	–2.621	**0.009****	0.542	0.439	0.500	9	0.773
Lack of marketing channel	2.77	2.25	1.463	1.172	–2.690	**0.008****	0.555	0.444	0.510	8	
Lack of effective management system	2.66	2.43	1.449	1.517	–2.064	0.051	0.532	0.449	0.498	10	
Weak awareness of IPR protection	2.70	2.09	1.431	1.310	–1.260	0.209	0.541	0.486	0.518	7	
Policy constraints	2.14	3.34	1.347	1.353	–0.269	0.788	0.429	0.418	0.425	11	

[a] Bold print indicates level of significance at $p < 0.05$; ** $p < 0.01$, * $p < 0.05$

This section is going to explore and discuss main barriers of innovation of the Yangtze River Delta SMEs. This research is focusing on seven main barriers of innovation which may affect the innovation performance of Yangtze River Delta SMEs. The seven main barriers of innovation are as follows:

A Lack of financial capital

Financial capital is the fundamental resource to SMEs. Andrews (2007) reported that innovation required the funding support which means taking funds away from other program or extra budgets. Thus lack of financial capital has a negative impact on the scale of innovation and results in the low R&D expenditure. Acs and Audretsch (1990) as well as Baldwin and Gellatly (2004) argue that financial bottleneck is a major problem of innovation in SMEs. Moreover, Hall (1989) argued that the reluctance in funding innovation was due to the high risk and inability of financiers. Hence, innovation will be especially difficult and risky for SMEs' limited financial resources.

B Lack of technical experts

As Xie *et al.* (2010) stated, technical experts have the significant impact on SMEs' innovation and technically qualified staffs are found to be more conducive to innovations in SMEs. Generally speaking, technical experts refer to engineers, entrepreneurs, and R&D staff.

C Lack of external research institutions

Kim, Song and Lee (1993) studied 49 manufacturing firms and suggested that external technology linkages are significant for SMEs as innovation partners. Industrial cooperation normally include sector of production, technical partners and linkages to external resource formed affection to SMEs for innovation based on 247 small and medium firms. These cooperation partners could be universities or government research institutions (Bougrain and Haudeville, 2002).

D Lack of social innovation atmosphere including culture and environment

Razavi and Attarnezhad (2013) presented that innovation success is vitally conditioned by the organizational culture and climate. Moreover, Anonymous (2011) supported that truly innovative companies depend on the culture of innovation and the wider culture—national, regional, or even local—also plays a central role in creating and sustaining innovation. In addition, O'Regan (2005) considered culture to be one of the most common impediments to the implementation of innovation.

E Lack of technical information

Technical information is essential to secure a business success. Accurate information not only will enhance the innovation development in SMEs, but also ensure the

current business strategy to be in the right direction. However, Xie *et al.* (2010) reported that many Chinese SMEs were still not aware of the fact that technical information is an important driving force for innovation.

F Weak awareness of IPR protection

Intellectual Property Rights (IPR) protection is also very essential to innovation in SMEs. There is an approach that considering of innovation is bringing new knowledge to the market and investments in intellectual property and Intellectual Property Right to protect the investment. In Deloitte (2013) report, China has had the Intellectual Property Protection Law since 1979, but the lack of the enforcement is a critical issue and forms a barrier to innovation in SMEs, which is supported by Baldwin and Gellatly (2004) and BMBF (2006) as well.

G Lack of the government support

Changing governmental policies has large influences on innovations in SMEs. Based on an analysis of 224 Turkish SMEs, Demirbas (2011) discovered that SMEs are lack of the government support, especially in less developed countries. This argument also is supported by Piatier (1984), Rammer *et al.* (2006) and Günerergin *et al.* (2012). All of them stated that policy constraints form a large barrier to innovation in SMEs.

Although marketing channel becomes more and more important for the survival and competitiveness of SMEs, SMEs is impeded by constraints such as lack of market expertise and insufficient market channel to explore the information of consumers' needs and seek directions of new products and services (Carson, 1985; Weinrauch *et al.*, 1991; Doole *et al.*, 2006).

All of these are critical barriers for the performance of innovation in Yangtze River Delta. The seven barriers will be used as the basic variables of the model for the innovation performance. According to the empirical study, this research will describe the hazard analysis on barriers of innovation as well as try to prove if lack of technical experts is also the most serious barrier of innovation for the SMEs in Yangtze River Delta compared with the empirical study.

2.5 Relationships between Resource, Competitive issues and Innovation

According to Hunt (2000), resources can be combined into complex or "higher order" resources. In general, since a company needs to use the combination of various basic resources in any innovation, the ability for the company to develop innovative products may be viewed as a high order resource. In the development of innovative products, for example, the company will have to make use of the employees' knowledge and skills (human resources), machines and/or computing equipment (physical resources), market research (information resources), and some other basic resources.

The various basic resources can work together to develop necessary synergy to increase both the effectiveness and/or efficiency of the company, resulting in positive impacts on the improvement of competitive issues. It is interesting to note that disadvantageous companies will often try to eliminate and/or jump frog the advantageous company by means of purchase (s) and/or innovation. In this way, they try to make better use of the resources of the same company and/or achieve innovation through the limited resources, in order to find equivalent resources, or create superior resources (Hunt, 2000). This kind of innovation is clearly reactive in nature, i.e. the signals in the market places indicate the competitive disadvantage position of the company and prompt the company to take strategic actions. Thus different innovations may be characterized by the different use of resources.

In addition, innovation in a company's strategy generally contributes to its competitive advantage (Johannessen *et al.*, 2001) and organizational performance (Yamin *et al.*, 1999).

The above discussions help explain why competition is dynamic. By competing effectively in the marketplace, firms need to improve the competitive issues to gain advantages by efficiently using resources and take innovations by avoiding/resolving the barriers, and ensure the continual improvement of the competitiveness to survive in the constantly changing market.

2.6 Entrepreneurship and competitiveness performance

Kirzner (1997) argued that entrepreneur can have the opportunity to gain from differential valuations of resources in factor and product markets. Drucker (1985) found that entrepreneurial opportunity exists according to an entity's ability to exploit market (product and factor) inefficiencies resulting from information asymmetry. In addition, entrepreneurial activities also create value when they facilitate "access relationships" to resources and capabilities that are strategic to competitiveness and performance (Stuart, 2000).

Thus, Morris (1998) defined entrepreneurship is a process, individual and team to create value through the unique combination of resources package input environment make use of the opportunity. The definition of entrepreneurship can occur in any organization of context, and can lead to a variety of possible results, including new projects, products, services, processes, markets and technology.

Moreover, the Organization for Economic Co-operation and Development (OECD, 1998) published "Fostering entrepreneurship", which argued that entrepreneurship has a central role in the functioning of market economies. Entrepreneurs can accelerate the generation, dissemination and applications of innovative ideas. And they can

impact on efficient use of resources, and also extend the boundaries of economic activities. Entrepreneurs not only try to seek and identify potentially profitable economic opportunities, they are also willing to take necessary risks to prove their hunches are right.

On the other hand, entrepreneur may be the unique person who understands the whole current condition of firm's resources, competitive issues of products and innovation activities especially in SMEs. Consequently, in this research, the entrepreneur and their opinions will be the main participant of the model to analyze the competitiveness of enterprises.

2.7 The Specifics of SMEs

2.7.1 Definition of SMEs

This section is going to identify the characteristics of SMEs and clarify the particular differences between SMEs and large enterprises. In Asia-Pacific Economic Cooperation (APEC) economics, SMEs are referred to a business with a number of less than 500 employees. This figure can be found as the same as the American Small Business Administration (SBA) states, which defined SMEs as standalone enterprises with less than 500 employees. However, James and Robert (2000) classified the SMEs by EU approach as: micro firms (businesses with less than 10 people); small firms (10-49 employees); medium-sized firms (50-249 employees). Small and medium sized enterprises (SMEs) play critical roles in a country's economic development. Zhu and Sarkis (2006) argued, "*SMEs exert a strong influence on economic growth and technological development of many countries through their ability to innovate new products and processes"*.

2.7.2 The differences between SMEs and large enterprises

Small enterprises possess less resource than large companies, which may limit their ability to carry out innovations (Parker and Castleman, 2007). Compared with large firms, small and medium enterprises (SMEs) provide less limited resources such as finance and employees and insufficient managerial infrastructure on lower cost innovation activities (Jones and Craven, 2000).

Moreover, despite a great emphasis on innovation in SMEs as one of the key drives to economic growth, the innovation performances in most SMEs are moderate or even worse than large enterprise. Damanpour (1992) found that innovation cultures in large

organizations tend to be more formalized and based on research capabilities and operating procedures. Moreover, innovation of sustainable products, services or business models may be a more fruitful perspective to responsibility in large companies than in SMEs (Schaltegger and Wagner, 2011).

In addition, innovation in the small and medium manufacturing sector generally focuses on process improvements, for which formal structures and systems are necessary to squeeze costs out, and large manufacturing firms have generally succeeded with this strategy by focusing on process improvement (Bessant and Tidd, 2007).

On the other hand, as the entrepreneur as one important human resource, Lim and Klobas's (2000) found that owners of smaller enterprises play a critical role in knowledge management while their staffs only assume a limited role in knowledge management as defined by the owners. This is because for SMEs, unlike those of large enterprises, the owners' prior technical experiences may constrain their organization's absorptive capacity because they are the key person involved in technological scanning and in decisions making (Raymond *et al.*, 2001).

Therefore, the finding implies that to develop a SME's resources absorptive and operational capacity, the owners of SMEs' knowledge, experience, personal opinion, even the background must be enriched. Moreover, the innovation of small and medium-sized manufacturing enterprises generally focus on the process improvement, which needs to tighten the formal structure and system cost, and large manufacturing companies usually succeed in this strategy focus on process improvement (Bessant and Tidd, 2007)

2.8 Bayesian Belief Networks (BBNs)

2.8.1 Introduction of BBNs

Bayesian Belief Network (BBN), also known as belief network, is a popular statistical methodology. In practice, a Bayesian Belief Network is widely used in probabilistic risk assessment, an exercise to estimate the accident probability and consequences (Siu and Kelly, 1998). Since the BBN introduction in the 1980s (Pearl, 1988), synergistic research between statisticians, computer scientists and operational researchers, BBN and their extensions have become increasingly popular as a framework for reasoning and decision making under uncertainty. Moreover, BBNs combine principles from graphs theory, probability theory, computer science and statistics (Ruggeri *et al.*, 2007). As Holmes and Jain (2008) stated, "*Bayesian networks utilize the probability calculus together with an underlying graphical structure to provide a theoretical framework for modelling uncertainty.*"

2.8.2 Benefits of using BBNs

The benefit of using BBNs can deal with a large number of interconnected data and integrate different types of variables or knowledge from diverse sources (Bromley *et al.*, 2005). Bayesian statistics helps us to quantify the available prior probabilities or knowledge based on the evidence collected at any node in the network (Dantu and Kolan, 2005).

This research has adopted Bayesian Belief Networks (BBNs) to simulate competitiveness of enterprises under uncertainty. BBNs coding probability of the relationship between variables of interest in causal reasoning and graphical interface model has a solid mathematical foundation. Enterprise competitive advantages using

BBNs simulation is multiple. First of all, knowledge representation and reasoning ability under the condition of uncertainty makes the BBN an attractive tool to represent individual reasoning decisions. The results of the probability of the change of the inherent parameter estimation, thus implicitly contain a conditional components (Newton *et al.*, 2007). BBNs' ability to model the causal relationships between the ability resources, competition problems and obstacles of innovation are particularly valuable for our purposes, because it allows us to study various impacts on competitiveness and safely draw the conclusion concerning the SMEs' performance. Secondly, the BBNs can accommodate the qualitative beliefs and attitudes of the stakeholders concerned, i.e. the prior knowledge, as well as quantitative data (Marcot *et al.*, 2001). This ability has made it possible to develop parameterized modelling and validation of resource utilization decisions based on both the qualitative information from discussions and the quantitative information from data collection. The general use of the graphical interface and influence diagrams in BBNs can help focus group discussions and support the active participation of stakeholders in the model development. In particular, influence diagram is a useful tool for decision making, due to its ease to use (i.e. intuitive, transparent and generally easy to understand). In general, BBNs offer great flexibility to handle both qualitative and quantitative evidences and have advantages over the traditional more rigid, rule-based expert system (Marcot *et al.*, 2001).

A BBN is essentially a logical and efficient representation of joint probability distributions for a domain of variables concerned. Its great power and flexibility lie in its ease to support different types of reasoning or inference. With conditional independence assumptions regarding the variables in the domain, it avoids the need to work with the whole joint probability distribution when making inferences, thus

speeding up the task considerably. A BBN is a directed acyclic graph (DAG) with built-in probabilistic dependencies and independencies for the domain. Each node in the graph represents a variable in the domain of interest. Although continuous variables are permitted, they are usually made discrete so that each variable typically has a small number of mutually exclusive states which it can be in. An arc between two nodes indicates a direct probabilistic dependence between them, while the absence of an arc indicates a conditional independence relation. Hence, the DAG contains a large amount of information, even before we consider any probability distributions (McNaught and Chan, 2010).

2.8.3 BBNs in related studies

Bayesian Belief Networks have been applied in many fields. Recently Chavez and Ross (2011) applied Bayesian approach to simultaneously quantify assignment and linguistic uncertainty. Sun and Müller (2013) built a framework for modelling payments for ecosystem services with Bayesian Belief Network. McNaught and Chan (2010) presented a journal of technology management BBNs in manufacturing. Dantu and Kolan (2005) analyzed risk management using Behavior Based Bayesian Networks.

In many studies, an important modelling assumption has been made, namely, each individual observes all past actions. For example, Iaonnides and Loury (2004) documented the importance of information obtained from the social network of an individual for employment outcomes.

2.9 Factor Analysis

Factor analysis is a statistical technique mainly used for data reduction. For example, typically a researcher using survey hopes to explain a lot of problems with a small amount of assumed factors. Every question in the survey on its own has significant limitation as a measure of the general attitude, but combined together, they can provide a better measure of attitude. In many applications, variables can be combined together into a new variable with a score for each respondent concerning the factors (Costello and Osborne 2005; Zhao 2009).

In this study, factor analysis will be utilized to determine whether there exist groups of correlation coefficients between responses to all variables (questions) concerning the quality management practices in the survey questionnaire. According to Kakkar and Narag (2007), the presence of groups of correlation coefficients would suggest that these variables could be measuring some aspects of the same underlying dimensions. These underlying dimensions, or extracted factors, can then be used to summarize the important dimensions for quality practices and thinking for selected manufacturing SMEs in Yangtze River Delta. The questionnaire made provision only for main operators of SMEs. Under this section data screening using the correlation matrices, extraction of principal components by analysis of Eigenvalues and Scree plots, analysis of principal factors using extraction of communalities, and finally, rotation of factor structures using Varimax Rotation was performed.

2.10 Summary

Firstly, this chapter identified five kinds of enterprise resources, five competitive issues and innovation related barriers as main variables of competitiveness and their relationships. Secondly, the literature concerning resource based views and the relationship between resource, competitive issues and innovation were reviewed. Thirdly, the logical relationships between various variables have been established through literature review. Furthermore, this chapter has highlighted entrepreneur as the important role in SMEs and the main differences between the SMEs and Large enterprises. Finally, this chapter also introduced the BBNs and factor analysis as the main tools to support the research. In combination with all points of views, this thesis argued that:

1) The main objective of improving the enterprise competitiveness is to create better customer value than competitors.

2) The competitiveness of enterprise is mainly related with the capacity of deploying its various resources, performance of competitive issues and barriers of innovation.

3) The entrepreneurs of SMEs will be focused on in the research because they are unique respondents who have the knowledge of the whole situations and various enterprises' variables.

4) BBNs and factor analysis are important and approved tools which can be applied in many different studies.

The following chapter is the methodologies of research. The chapter will focus on formulation of research hypotheses, the information of respondents, the questionnaire design and development, justification and development of the structure of the BBN model and the introduction to the factor analysis of the quality management practices.

Chapter 3 Research Methodology

3.1 Introduction

In this research, the researcher will carry out both quantitative and qualitative analysis to make a critical evaluation of the general competitiveness performance of SMEs development in Chinese Yangtze River Delta. In this study, we used conversational interview techniques via face-to-face semi-structured interviews (Lee, 1999). As an interview guide, a questionnaire was developed for CEOs, firm owners, or entrepreneurs. 36 small and medium manufacturing enterprises have taken part in the questionnaire survey and interviews for the research project (See the Figure 3.1).

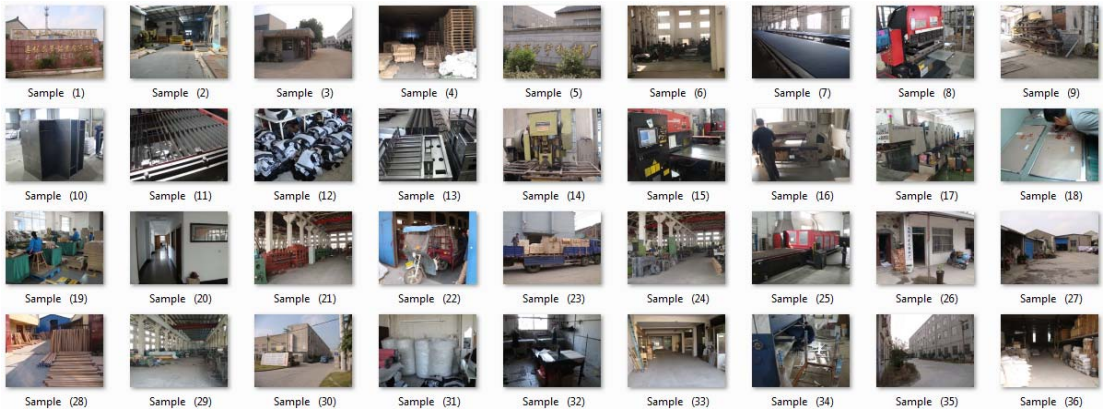


Figure 3.1 Factories of 36 participants

The quantitative research in this project consists of descriptive statistics and frequencies. On the other hand, the qualitative research methods will make use of the Bayesian Belief Networks and factor analysis.

3.1.1 Quantitative research

Quantitative research analysis is applied with the purpose of tabulating the percentage of each respondent. According to William and Lisa (2006) the method concentrates on gaining the respondents' attitudes and views by using the numerical measurement

techniques, such as survey questionnaires, tails, observations and case studies, which can be easily analyzed later by a statistical tool such as SPSS that provides results in a graphical forms, Tables and Figures. A high percentage of frequencies indicate a high concern by segment respondents.

3.1.2 Qualitative analysis

The qualitative analysis conducted in this research will have two main parts:

1) Development of the Bayesian Belief Networks (BBNs) to understand and analyze the variables' impact on competitiveness and innovation performance has detailed the understandings of each variable and helped to assess the overall impact of innovation for general competitiveness performance. BBN approach can be utilized to perform prediction and sensitivity analysis to examine the various variables in the SMEs concerned. The Microsoft Bayesian Network (MSBN) tool based on Bayesian Belief Network principle is freely available and has been used in the research.

2) Factor analysis has been performed mainly to study the quality management practices in the SMEs concerned through the detailed examination of the applications of the eight approved quality management principle promoted by the ISO 9000 series of standards.

Questionnaires have been designed to collect the data as the primary research. The groups of respondents have been carefully targeted on the small and medium manufacturing enterprises (SMEs) in Yangtze River Delta. In addition, interview surveys have also been used to help the questionnaire survey and collect data from the SMEs' entrepreneurs.

In this chapter, the research will be divided into four stages:

Stage one: Development of Research Hypotheses

Stage two: Design and development of the questionnaire

Stage three: Justification, structure and development of the BBNs

Stage four: Factor analysis

3.2 Stage one: Development of Research Hypotheses

The hypotheses are constructed upon empirical studies and the detailed background of Yangtze River Delta. The hypothesis by scientific testing method can ensure the accuracy and the adopted hypothesis can be used for further research. The hypotheses are tested through the analysis by using the Bayesian Belief Networks.

Three hypotheses have been proposed as follows according to the findings of several empirical studies (Günerergin *et al.*, 2012; Li *et al.*, 2008; Xie *et al.*, 2010):

Hypothesis 1: The general condition of financial resource in SMEs of Yangtze River Delta is worse than conditions of other resources. And the condition of organizational resource in SMEs of Yangtze River Delta is better than conditions of other resources.

Hypothesis 2: Quality is the most important competitive issue to improve the competitiveness performance of SMEs in Yangtze River Delta.

Hypothesis 3: The most serious barrier to innovation is lack of technical/research experts in Yangtze River Delta SMEs.

3.3 Stage two: Design and development of the questionnaire

Questionnaire is a very widely used research method for collecting data. In accordance with Robson and Obeng (2008), questionnaire approach will not only be able to generate a large amount of data to measure respondents' attitude, but also give reassuring scientific confidence. The questionnaire used in the research encompasses six parts with a total of 39 questions.

Part One: Background

The part one is designed to collect personal background information with four multi choice questions (Q1-4) for the enterprise and entrepreneur's age, education level and working experiences. Depending on the age of enterprise, it will clearly show how long the enterprise has existed; the segment age, education level and pre working experience of entrepreneurs can be analyzed regarding some different perspectives. By understanding of personal background it helps critical analysis to understand the different aspects due to different age groups/positions.

Part Two: Resource based questions

In order to characterize the respondent's SME, this section contains questions (Q5 to Q18) aiming to identify respondents' key company resources. The author has already defined resources which are human, financial, informational, organizational and physical. The questions are focused on the two main resources which are human and financial.

Part Three: Competitive issues

This part contains questions（Q19 to Q35), designed concerning the competitive issues of SMEs, which are cost, quality, flexibility, dependability and speed. This part

is focused on the two main issues which are cost and quality. The main issues also contain the eight quality management principles and the seven wastes in lean practices.

Part Four: Barriers and Innovation performance

This part has two questions aiming to measure the current innovation performance of SMEs. The question 36 is designed to identify the respondents' barriers to the main impacts of innovation. Question 37 is about whether SMEs are focusing on the innovation or going to innovate.

Part Five: Decision making and general competitiveness performance of SMEs

Part five contains 2 questions（Q38 and Q39）. Q38 is going to gain the basic ideas what factors are considered when the entrepreneurs make decisions. Q39 is the assessment scale applied to draw respondent's opinions on general competitiveness of SMEs.

3.4 Stage three: Justification, structure and development of the BBNs

The Bayesian Belief Network is an approach to represent uncertainty in the value of an unknown parameter. Therefore, BBNs based on uncertainty concerns the value of an unknown parameter with a higher order probability distribution in which the parameter is a random variable (Holmes and Jain, 2008). Moreover, Dantu and Kolan (2005) suggested that BBNs can be visualized to be a graph consisting of a group of nodes with links interconnecting them. Graphs can be drawn to represent the sequence of network actions for exploiting each network variables and ultimately the whole network.

3.4.1 Knowledge of BBNs

The determinant factors as the common-sense knowledge in previous literatures can be mainly summarized and categorized into following four groups: the enterprise's resource (Human, Financial, and Physical, Organizational, and Informational resource); competitive issues (Quality, Cost, Dependability, Flexibility and Speed); innovation activities (focus on barriers) and impacts, and the relationship between resource, innovation and competitive issues (see Table 3.1).

Table 3.1 Summary of variables in previous literatures

CLASSIFICATION	VARIABLES	RELATED STUDIES
Macro Environment:		
	Development and PEST in China and Yangtze River Delta	Chen (2006)
		Li *et al*. (2006) and Di Tommaso et al. (2012)
		Démurger *et al*. (2002) and Liu (2005)
	SMEs in China and Yangtze River Delta	Robert (2000)
		Zhu *et al.* (2006), Lim and Klobas's (2000)
		Yang and Zhong(1996)
		Ceglowski and Golub (2007)
Micro Environment:		
Resource	Resource-based views	Barney (1991) and Penrose (1959)
		Conner (1991), Mahoney and Pandian (1992)
		Amit and Schoemaker (1993)
		Alderson (1965) and Wernerfelt (1984)
	Human resource	Thurow (1992)
		Cambridge Business and Vernon (1986)
	Financial resource	Business Dictionary and Galbreath (2005)
		Westhead *et al.* (2001), Hall (1992) and Barney (1991)
	Physical resource	Cambridge Business and Galbreath (2005)
		Hall (1992) and Barney (1991)
	Informational resource	Cambridge Business and Galbreath (2005)
		Hall (1992) and Barney (1991)
	Organizational resource	Business Dictionary and Galbreath (2005)
		Hall (1992) and Barney (1991)
Competitive Issues	Competitive advantage	Porter (1990, 1998)
		Hao (1999) and Flynn (2004)

		Honda Motor Company
	Cost	Hooshang (2006)
		Fowler (1990)
	Quality	Grant (1991) and Pfeifer (2002)
		ISO (2011)
	Dependability	Mahmoud *et al.* (2004)
	Flexibility	Chang and Newman (1995)
	Speed	Brian (2006)
Innovation	Barrier:	Xie *et al.* (2010)
	Lack of financial capital	Acs and Audretsch (1990)
		Baldwin and Gellatly (2004)
		Hall (1989)
	Lack of technical experts	Xie *et al.* (2010)
	Lack of external research institutions	Kim et al (1993)
		Bougrain and Haudeville (2002)
	Lack of social innovation atmosphere	Crosetto (2004)
		Kim *et al.* (1993)
	Lack of technical information	Xie *et al.* (2010)
		Carson (1985), Weinrauch *et al.* (1991)
		Doole *et al.* (2006), Keringa *et al.* (2005)
	Weak awareness of IPR protection	Deloitte (2013)
		Baldwin and Gellatly (2004)
	Lack of the government support	Mole *et al.* (2008)
		Demribas (2011), Piatier (1984)
		Acs and Audretsch (1990), Hadjimanolis (1999)
		Rammer *et al.* (2006), Silva and Leitao (2007)
Resource and competitive issues		Hunt (2000, 2001)
		Arnett (2001)
Innovation with competitive issues		
and competitiveness performance		Johannessen *et al.*(2001), Yamin *et al.* (1999)
		Rouse and Daellenbach (1999), Han (1998)
		Mahroum, 2008), Darroch and McNaughton (2002)
		Lievens and Moanert (2000), Wang and Zheng (2008)
		Stevens and Burley (1997), Keizer et al. (2002)

3.4.2 Framework of Structure based on the approved knowledge

To simulate the competitiveness of enterprise as a BBN model, it is necessary to build the framework based on the knowledge presented by the experts, which can be shown in Figure 3.2.

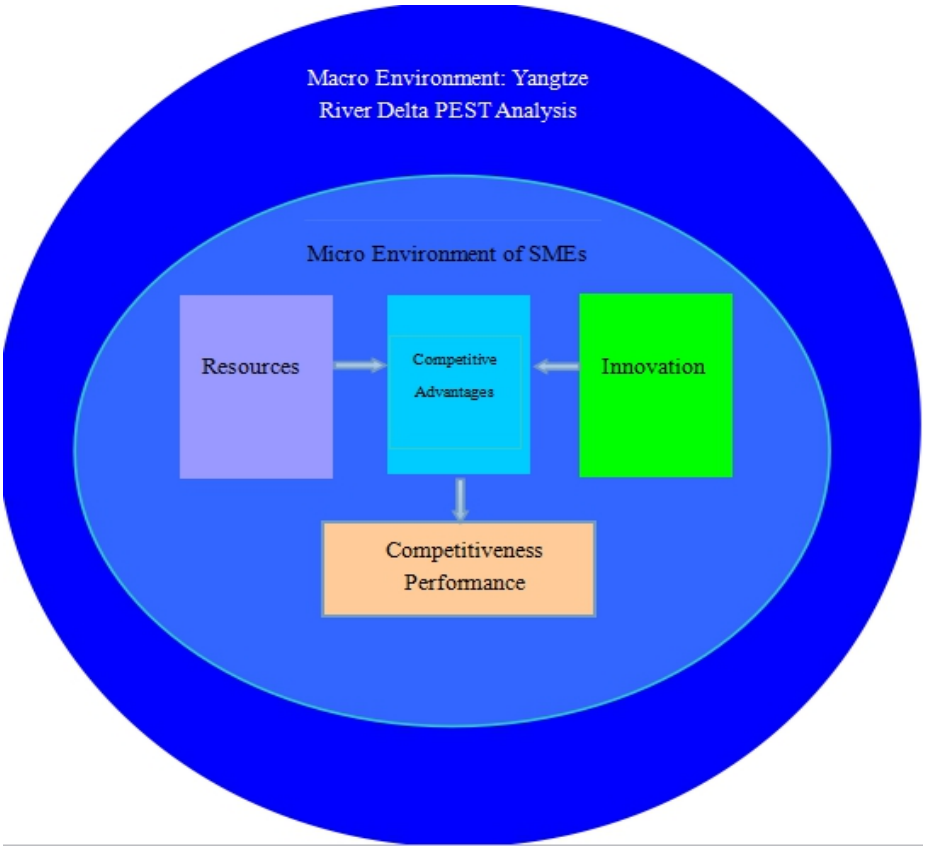


Figure 3.2 Framework of the Competitiveness of Enterprise

3.4.3Development of the BBNs

In this study, the random variables represent the condition of resources, condition of competitive issues, and barriers of the innovations drawn from the literature reviews discussed previously. The probabilities are extracted from questionnaires. Another purpose of applying BBNs is to conduct sensitivity analysis or “what-if” scenario to analyze the influences of key random variables in order to improve the innovation and overall competitiveness performance of SMEs.

Bayesian Belief Network (BBN) has played an essential part in this research. There are 11 questions prepared for obtaining data of the overall competitiveness performance of SMEs. The building of BBN are adopted from the framework and simply divided into four stages:

Step one: Obtaining information for BBNs

Step two: Relationship diagram by the BBNs' principle

Step three: Construction of BBN model

Step four: Evaluation and sensitivity analysis of BBNs' model

3.4.3.1 Step one: Obtaining information for BBNs

Accurate information is critical to any research study. Therefore, to obtain correct and precise information is the first step to construct BBNs. Information in Bayesian Network is classified into two categories. The first category of data is going to collect and pick up sensitive and important variables based on the study of resource based views and competitive issues regarding to respondents' answers in SMEs. The second category of data is about barriers of innovation which the entrepreneurs are facing when they are focusing on innovation or not.

The first category of data: Question 18 in the questionnaire belongs to this category and is for collecting information on performance of the resource variables of SMEs. Q19, 23, 28, 29, and 30 are confirmations used to avoid some particular special variables which may cause the test error. Q31 to 35 are going to collect the information on the current enterprise's competitive situations in practice. Q39 is about the general current competitiveness performance of the SMEs.

The second category of data: Q36 is about the barriers of innovation for the SMEs. It gains the information on the barriers mainly affecting innovation activities in each SME in practice. Q37 is focused on the current reliable performance of innovation whether the enterprise is focusing on innovation.

3.4.3.2 Step two: The Relationship of BBNs

Bayesian Belief Network models allow people to use the real-world knowledge or factors to build the relationships between variables by the conditional probabilities. Any such influences would be based on direct factors (Microsoft research, 2012), and there will be the competitive issues such as cost, quality, flexibility, dependability and speed (See Table 3.1 and Figure 3.2).

The key idea is to delete the meaningless relationship in a Bayesian Belief Network model by explicitly declaring the meaningful ones. After building a model of all variables, you can study the key variables leading to system changes in these variables, and their influences. These impacts are made with the adjustments of arcs linking the nodes. Each arc should represent the causal relationship between the temporal ancestor (known as the *parent*) and its later outcome (known as the *child*) (See Figure 3.3). (Microsoft research, 2012)

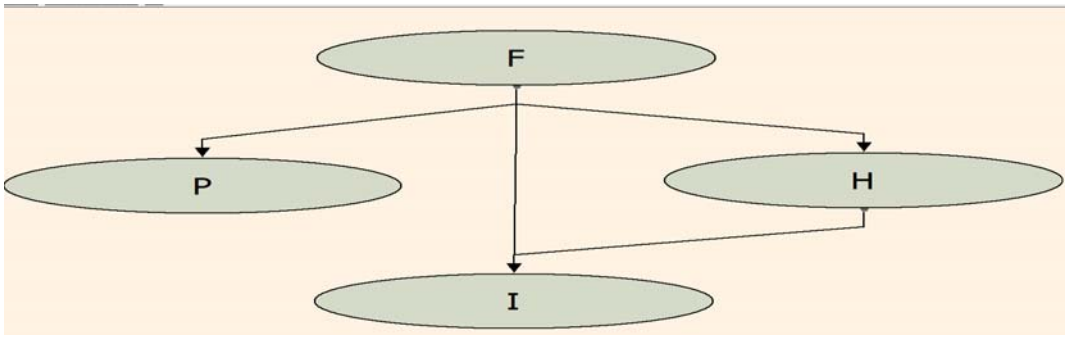


Figure 3.3 BBN Relationship (F, H, P, I)

According to Figure 3.3, there is a causal relationship between F (financial resource), P (physical resource), I (informational resource) and H (human resource). The conditional arc from the F to P, I and H represent a relationship of the “parent and child”, financial resource as parent variable could influence the physical resource as child variable, such as upgrading the machine. The more details of reason can be found in the resource based views of literature. Reasoning, or model evaluation, is the process of updating the result of the probability model and based on the relationship of evidence to know the current situation. In actual use of the Bayesian model, the end user can apply the evidence of recent events or observations. This information is applied to the model "instantiated" or "clamping" a variable with observed consistent state.

Figure 3.4 Partial draft diagram represents the relationship between Physical, Organizational, Human resource and Quality Issue.

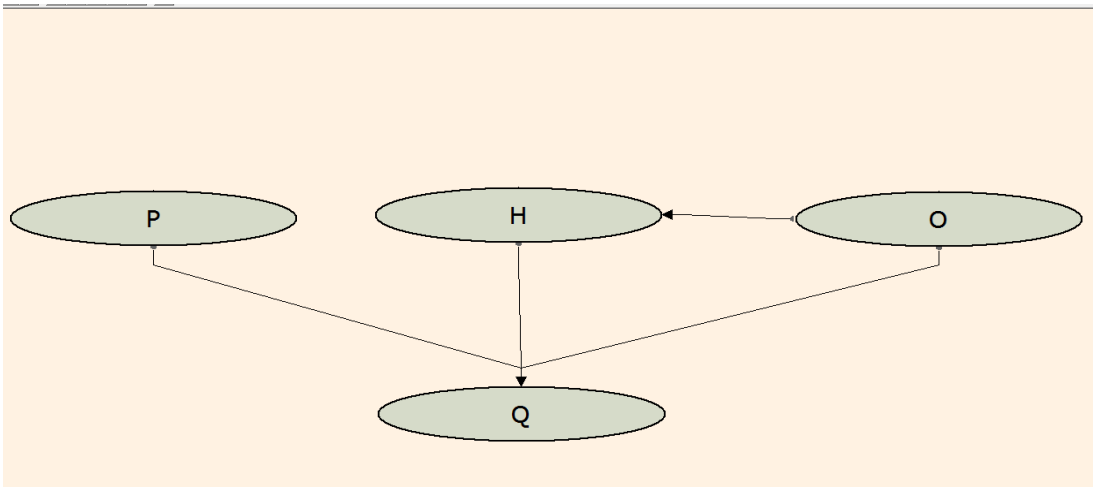


Figure 3.4 BBN relationships (P, H, O, and Q)

The physical, human and organizational resource as the parent variables can affect the competitive issue Quality, which is the child variable. For instance, condition of the

machine, skill of employee and regulations directly affect the quality of products. For the same logical reason, organizational resource also is the parent variable to the human resource.

Then applying the reasons and theories from the Table 3.1, we can simulate the relationships of variables of competitiveness. Figure 3.5 illustrates an overall relationship diagram of BBN. On the left hand (Model 1), 10 nodes/variables will be left after the confirmations, including the 5 resource based variables, 4 competitive issues variables and the general competitiveness performance factor. The arrows represent the relationship of the resources and competitive issues to the overall competitiveness performance of SMEs with conditional probability (left side of red dashed line). On the right hand (Model 2), 8 nodes/variables will be analyzed, including 7 main barriers and the general current innovation performance of SMEs. Combining the general innovation performance and the general competitiveness performance of the SMEs' situation, the model will be built to analyze the overall competitiveness rate of SMEs and expresses via the arrows in the diagraph (See Figure 3.5).

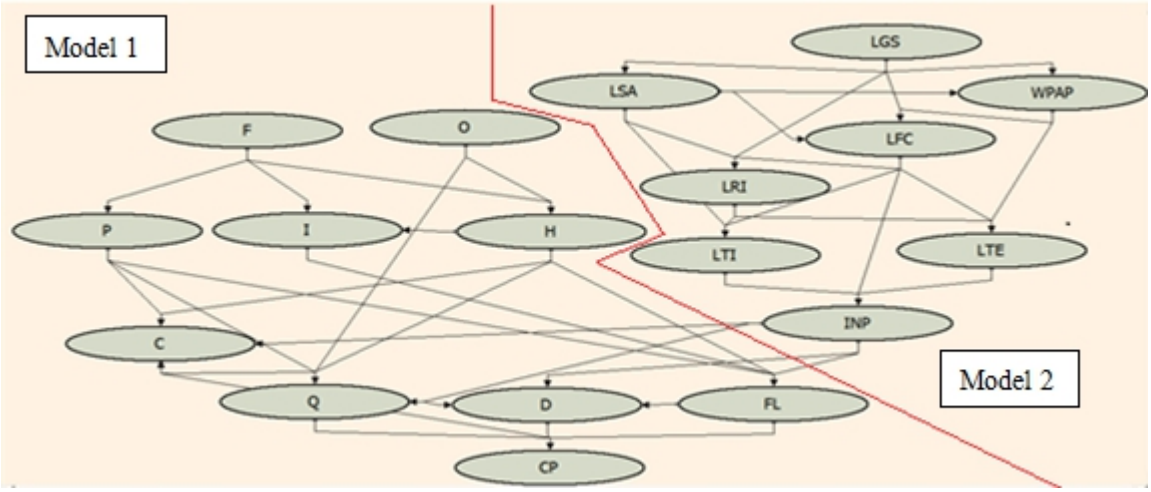


Figure 3.5 Relationship of variables of competitiveness

F: Financial resource; O: Organizational resource; P: Physical resource; I: Informational resource; H: Human resource; Q: Quality issue; FL: Flexibility issue; C: Cost issue; D: Dependability issue; LGS: Lack of the government support; LFC: Lack of financial capital; LTE: Lack of technical expert; LRI: Lack of research institutions; LSA: Lack of social innovation atmosphere including culture and environment; LTI: Lack of technical information; INP: Innovation performance; WPAP: Weak of awareness Intellectual Property Rights Protection; CP: Competitiveness performance

The main structure of Model I is based on the knowledge and framework clearly presented in the Figure 3.6.

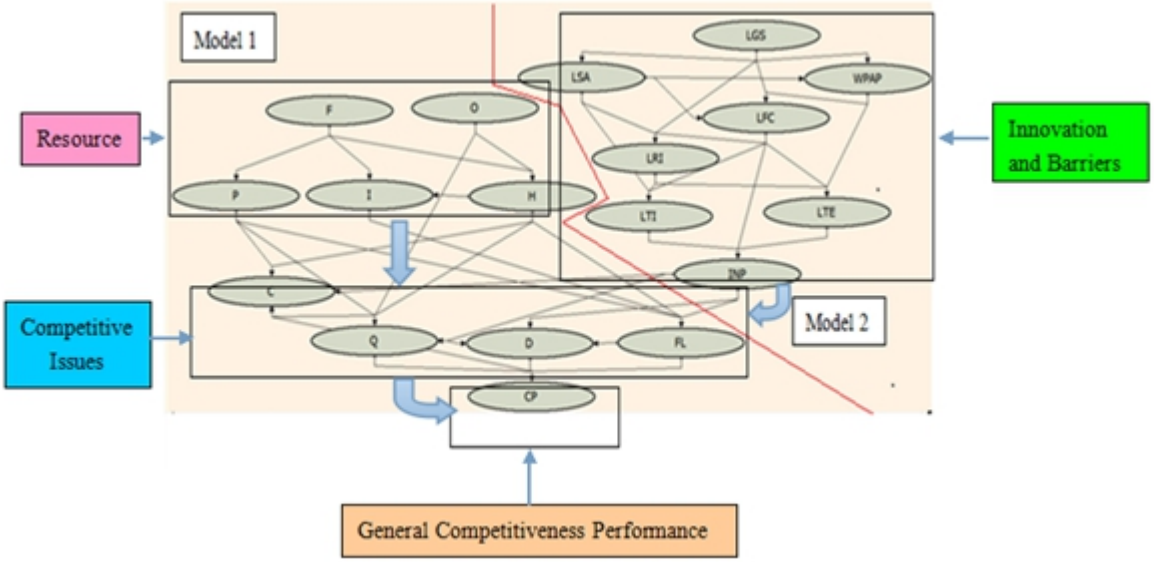


Figure 3.6 Structure of BBN

3.4.3.3 Step three: Construction of BBN model

Actually, Step Two has presented and defined the relationships between the variables. A completely specified BBN also needs for each node the construction of the conditional probability table. For a single node, you need to specify a conditional probability distribution for each possible parent variable states. Hence, this step has to apply the first hand data collected from the questionnaires and type into the node of BBN model. To ease the construction of the BBN model, this research separates the BBN as two sub-models which are Model 1(Figure 3.7) and Model 2 (Figure 3.8).

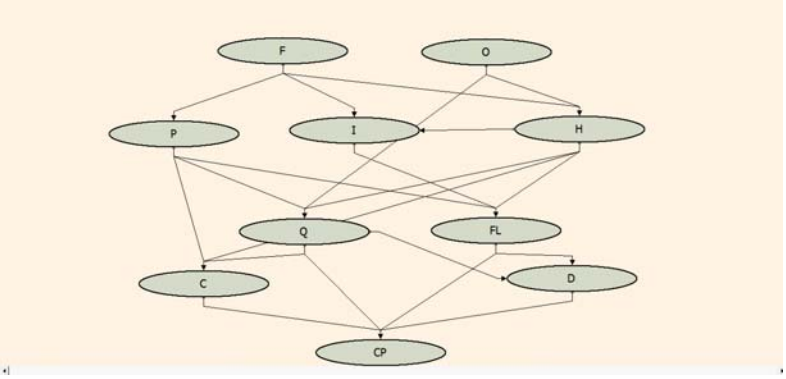


Figure 3.7 Model 1 Relationship between Recourses and Competitive issues

F: Financial resource; O: Organizational resource; P: Physical resource; I: Informational resource; H: Human resource; Q: Quality issue; FL: Flexibility issue; C: Cost issue; D: Dependability issue; CP: General competitiveness performance

The calculations of various conditional probabilities of Model 1 are based on the data from Q18, Q31, 32, Q33, Q34, Q35 and Q39.

Y: the enterprise has better condition of X (kind of resource, competitive issues)

N: the enterprise has worse condition of X (kind of resource, competitive issues)

The accounted standard assessment probabilities of resource, competitive issues and competitive performance are shown in the following Tables from Table 3.2 to Table 3.10:

Table 3.2 Probabilities of each resource

	Y		N	
H	15	0.417	21	0.583
I	15	0.417	21	0.583
P	23	0.639	13	0.361
O	23	0.639	13	0.361
F	13	0.361	23	0.639

Table 3.3 Conditional probabilities of Human resource

Parent node		**H**			
F	**O**	Y		N	
Y	Y	1	0.125	7	0.875
	N	2	0.4	3	0.6
N	Y	7	0.467	8	0.533
	N	5	0.625	3	0.375

Table 3.4 Conditional probabilities of Physical resource

Parent node	**P**			
F	Y		N	
Y	8	0.615	5	0.385
N	15	0.652	8	0.348

Table 3.5 Conditional probabilities of Informational resource

Parent node		**I**			
H	**F**	Y		N	
Y	Y	1	0.333	2	0.667
	N	3	0.25	9	0.75
N	Y	4	0.4	6	0.6
	N	7	0.636	4	0.364

Table 3.6 Conditional probabilities of Flexibility

Parent node			**FL**			
H	**P**	**I**	Y		N	
Y	Y	Y	3	1	0	0
		N	6	0.857	1	0.143
	N	Y	0	0	1	1
		N	3	0.75	1	0.25
N	Y	Y	4	1	0	0
		N	6	0.667	3	0.333
	N	Y	6	0.857	1	0.143
		N	0	0	1	1

Table 3.7 Conditional probabilities of Cost

Parent node			C			
H	**P**	**Q**	Y		N	
Y	Y	Y	5	0.833	1	0.167
		N	2	0.5	2	0.5
	N	Y	1	0.333	2	0.667
		N	0	0	2	1
N	Y	Y	3	0.429	4	0.571
		N	2	0.333	4	0.667
	N	Y	3	0.75	1	0.25
		N	1	0.25	3	0.75

Table 3.8 Conditional probabilities of Quality

Parent node			Q			
H	**P**	**O**	Y		N	
Y	Y	Y	3	0.5	3	0.5
		N	4	1	0	0
	N	Y	0	0	2	1
		N	1	0.333	2	0.667
N	Y	Y	5	0.556	4	0.444
		N	0	0	4	1
	N	Y	3	0.5	3	0.5
		N	1	0.5	1	0.5

Table 3.9 Conditional probabilities of Dependability

Parent node		D			
Q	**FL**	Y		N	
Y	Y	12	0.857	2	0.143
	N	3	1	0	0
N	Y	12	0.857	2	0.143
	N	2	0.4	3	0.6

Table 3.10 Conditional probabilities of Competitiveness Performance (CP)

Parent node				CP			
C	**Q**	**FL**	**D**	Y		N	
Y	Y	Y	Y	5	0.556	4	0.444
			N	1	1	0	0
		N	Y	0	0	2	1
			N	0	0.5	0	0.5
	N	Y	Y	2	0.4	3	0.6
			N	2	1	0	0
		N	Y	0	0	1	1
			N	2	1	0	0
N	Y	Y	Y	3	1	0	0
			N	1	1	0	0
		N	Y	1	1	0	0
			N	0	0.5	0	0.5
	N	Y	Y	2	0.286	5	0.714
			N	1	0.5	1	0.5
		N	Y	0	0	1	1
			N	0	0	1	1

The Model 2 (Figure 3.8) can be built in a similar way to the above. According to the Question 36 and 37, various conditional probabilities of barriers and innovation performance can be calculated from Table 3.11 to Table 3.17.

Y: the enterprise is facing the X (kind of barriers)

N: the enterprise is not facing the X (kind of barriers)

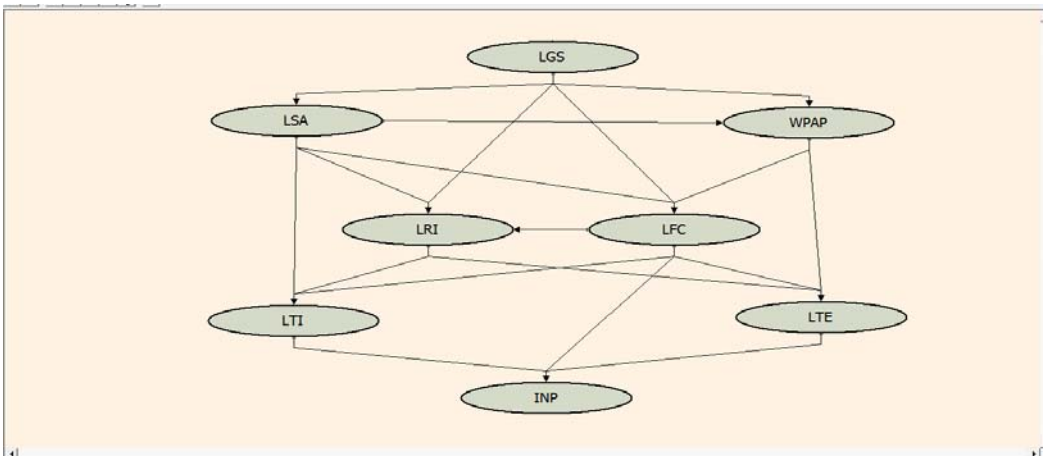


Figure 3.8 Model 2 Barriers and Innovation Performance

LGS: Lack of the government support; LFC: Lack of financial capital; LTE: Lack of technical expert; LRI: Lack of research institutions; LSA: Lack of social innovation atmosphere including culture and environment; LTI: Lack of technical information; WPAP: Weak of awareness Intellectual Property Rights Protection; INP: Innovation performance

These are tables of the conditional probabilities of innovation's barriers:

Table 3.11 Conditional probabilities of LSA

Parent node	LSA			
LGS	Y		N	
Y	5	0.417	7	0.583
N	1	0.042	23	0.958

Table 3.12 Conditional probabilities of LGS

	Y		N	
LGS	6	0.167	30	0.833

Table 3.13 Conditional probabilities of WPAP

Parent node		WPAP			
LGS	LSA	Y		N	
Y	Y	4	0.8	1	0.2
	N	0	0	1	100%
N	Y	1	0.143	6	0.857
	N	5	0.217	18	0.783

Table 3.14 Conditional probabilities of LRI

Parent node			LRI			
LFC	LSA	LGS	Y		N	
Y	Y	Y	3	0.75	1	0.25
		N	1	0.25	3	0.75
	N	Y	0	0	1	1
		N	1	0.1	9	0.9
N	Y	Y	1	1	0	0
		N	2	0.667	1	0.333
	N	Y	0	0.5	0	0.5
		N	4	0.308	9	0.692

Table 3.15 Conditional probabilities of LTI

Parent node			LTI			
LSA	LFC	LRI	Y		N	
Y	Y	Y	3	0.75	1	0.25
		N	0	0	4	1
	N	Y	0	0	3	1
		N	0	0	1	1
N	Y	Y	0	0	1	1
		N	2	0.2	8	0.8
	N	Y	0	0	4	1
		N	3	0.333	6	0.667

Table 3.16 Conditional probabilities of LTE

Parent node			LTE			
LRI	LFC	WPAP	Y		N	
Y	Y	Y	4	1	0	0
		N	0	0	1	1
	N	Y	2	0.667	1	0.333
		N	2	0.5	2	0.5
N	Y	Y	0	0	1	1
		N	7	0.538	6	0.462
	N	Y	2	1	0	0
		N	3	0.375	5	0.625

Table 3.17 Conditional probabilities of INP

Parent node			INP			
LFC	LTI	LTE	Y		N	
Y	Y	Y	4	0.8	1	0.2
		N	0	0.5	0	0.5
	N	Y	4	0.667	2	0.333
		N	4	0.5	4	0.5
N	Y	Y	0	0	2	1
		N	0	0	1	1
	N	Y	6	0.857	1	0.143
		N	3	0.429	4	0.571

Finally, the conditional probability of the innovation performance is populated into the overall competitiveness performance rating. Combination of models 1 and 2 can analyze every variable impact in the final Model I. The conditional probability of the innovation performance is linked to competitive issues (See from Table 3.18 to Table 3.22).

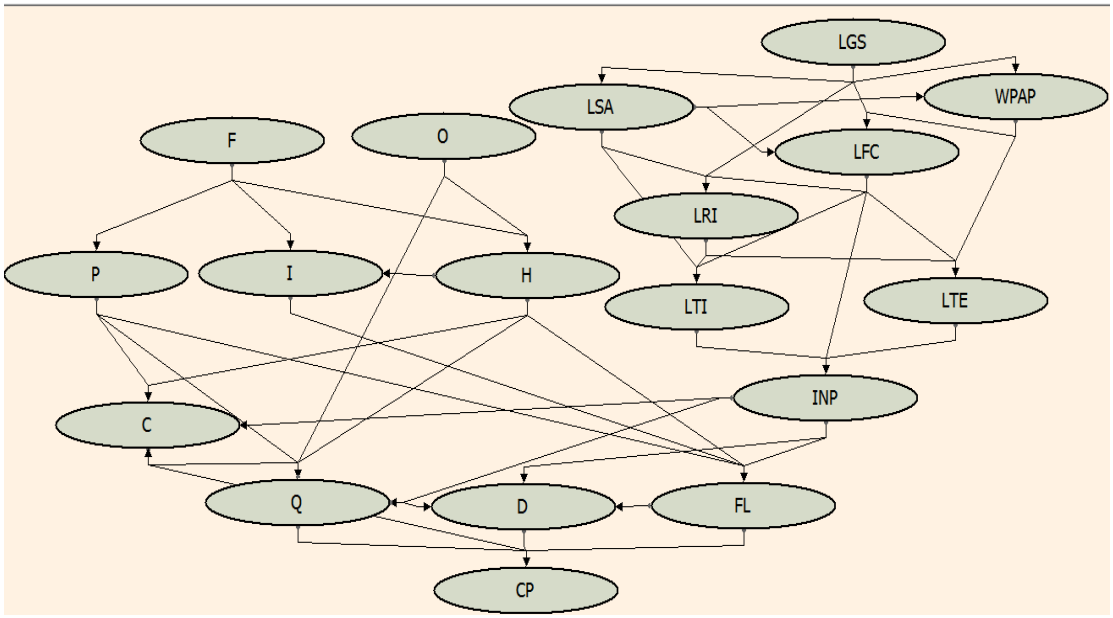


Figure 3.5 Model I General Competitiveness Performance

Table 3.18 Model I Conditional probabilities of Cost

Parent Node(s)				C		
H	P	Q	INP	Yes	No	bar charts
Yes	Yes	Yes	Yes	0.6	0.4	
			No	1.0	0.0	
		No	Yes	0.5	0.5	
			No	0.0	1.0	
	No	Yes	Yes	0.5	0.5	
			No	1.0	0.0	
		No	Yes	0.0	1.0	
			No	0.667	0.333	
No	Yes	Yes	Yes	0.667	0.333	
			No	0.5	0.5	
		No	Yes	0.8	0.2	
			No	0.0	1.0	
	No	Yes	Yes	0.667	0.333	
			No	1.0	0.0	
		No	Yes	0.0	1.0	
			No	0.5	0.5	

Table 3.19 Model I Conditional probabilities of Quality

Parent Node(s)				Q		
O	H	P	INP	Yes	No	bar charts
Yes	Yes	Yes	Yes	0.6	0.4	
			No	0.0	1.0	
		No	Yes	0.5	0.5	
			No	0.0	1.0	
	No	Yes	Yes	0.429	0.571	
			No	1.0	0.0	
		No	Yes	0.667	0.333	
			No	0.333	0.667	
No	Yes	Yes	Yes	1.0	0.0	
			No	1.0	0.0	
		No	Yes	0.0	1.0	
			No	0.5	0.5	
	No	Yes	Yes	0.0	1.0	
			No	0.0	1.0	
		No	Yes	0.5	0.5	
			No	0.5	0.5	

Table 3.20 Model I Conditional probabilities of Dependability

Parent Node(s)			D		
FL	Q	INP	Yes	No	bar charts
Yes	Yes	Yes	0.778	0.222	
		No	1.0	0.0	
	No	Yes	0.875	0.125	
		No	0.833	0.167	
No	Yes	Yes	1.0	0.0	
		No	1.0	0.0	
	No	Yes	0.5	0.5	
		No	0.333	0.667	

Table 3.21 Model I Conditional probabilities of Flexibility

Parent Node(s)				FL		
H	I	INP	P	Yes	No	bar charts
Yes	Yes	Yes	Yes	1.0	0.0	
			No	0.5	0.5	
		No	Yes	1.0	0.0	
			No	0.0	1.0	
	No	Yes	Yes	0.8	0.2	
			No	1.0	0.0	
		No	Yes	1.0	0.0	
			No	0.667	0.333	
No	Yes	Yes	Yes	1.0	0.0	
			No	0.8	0.2	
		No	Yes	1.0	0.0	
			No	1.0	0.0	
	No	Yes	Yes	0.714	0.286	
			No	0.5	0.5	
		No	Yes	0.5	0.5	
			No	0.0	1.0	

Table 3.22 Model I Conditional probabilities of competitiveness performance

Parent Node(s)				CP		
Q	C	FL	D	Yes	No	bar charts
Yes	Yes	Yes	Yes	0.556	0.444	
			No	1.0	0.0	
		No	Yes	0.0	1.0	
			No	0.5	0.5	
	No	Yes	Yes	1.0	0.0	
			No	1.0	0.0	
		No	Yes	1.0	0.0	
			No	0.5	0.5	
No	Yes	Yes	Yes	0.4	0.6	
			No	0.5	0.5	
		No	Yes	0.0	1.0	
			No	1.0	0.0	
	No	Yes	Yes	0.286	0.714	
			No	0.5	0.5	
		No	Yes	0.0	1.0	
			No	0.0	1.0	

3.4.3.4 Step four: Evaluation and Sensitivity Analysis of BBNs Model

The BBN can be evaluated using standard Table 4.26ase method, Causally Independent Assessment (CIA) or asymmetric assessment. The CIA is based on assumptions of the conditional independence amongst the parents of a variable, which can significantly reduce the number of values to be entered. Asymmetric assessment is based on the tree method, which can also reduce the number of values to be inputted. Performing the "sensitivity analysis" (or "what if" analysis) is critical to clarify the each variable's impact on the SMEs' competitiveness performance. The BBN aims to provide a prediction based on tabulated conditional probabilities to improve the overall competitiveness rating. The main analysis will be presented and discussed in the following chapter (Heckerman and Breese, 1996).

3.4.3.5 Sample of Causal Independence Assessment (CIA)

A Causal Independence Assessment (CIA) distribution reduces the number of assessments from 2^{S+M} to M*(S+1), where *S* is the sum of the number of states of the parent nodes and *M* the number of states of the child node. It also speeds up inference substantially if there many parent states (Heckerman and Breese, 1996).

In practice, the BBN model can help save time to calculate the conditional probabilities. The following example shows how to calculate the original conditional probabilities of Human resource (H), Financial resource (F), and Informational resource (I) based on the survey data (Table 3.23, Table 3.24 and Table 3.25). Suppose that there are two variables which could lead to good condition of Informational resource: Financial resource and Human resource. Also, suppose that the condition of financial resource has a direct effect on the condition of the Human resource. Then the situation can be modeled with a BBN model (shown in Figure 3.9).

All three variables have two possible conditions: Y (for good condition) and N (for bad condition).

Table 3.23 Sample Conditional probability of H

	H	
F	Y	N
Y	0.231	0.769
N	0.522	0.478

Table 3.24 Sample Probability of F

	Y	N
F	0.361	0.639

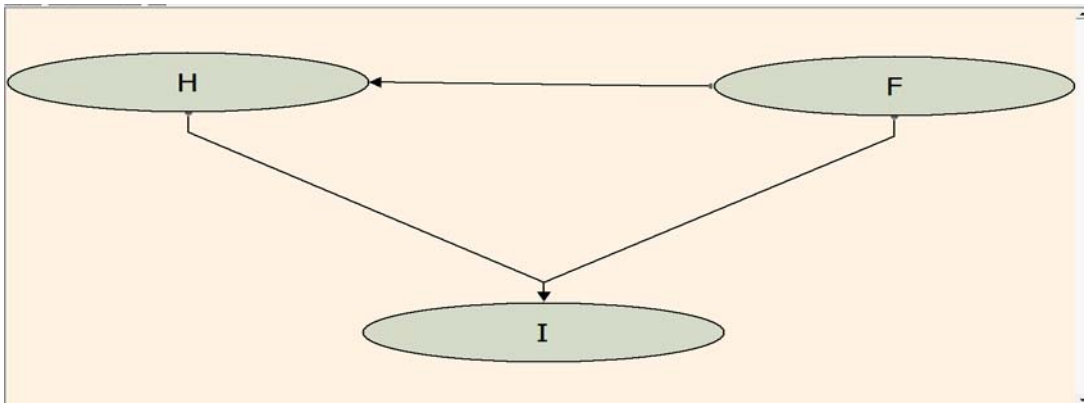


Figure 3.9 Sample BBN relationship of H, F and I

Table 3.25 Sample Conditional probability of I

Parent node		**I**	
H	**F**	Y	N
Y	Y	0.333	0.667
	N	0.25	0.75
N	Y	0.4	0.6
	N	0.636	0.364

H: human resource; F: financial resource; I: informational resource

The joint probability can be calculated as follows:

P (I, H, F) = P (I | H, F) P (H | F) P (F)

Where the names of the variables have been abbreviated to I = condition of the informational resource (Y/N), H = condition of the human resource (Y/N), and F = condition of the financial resource (Y/N) (Y=good, N=bad).

The model can answer questions like "What is the probability that the enterprise have good condition of the financial resource, given the enterprise have good condition of the informational resource?" by using the conditional probability formula and summing over all variables:

$$P(F=Y \mid I=Y) = P(I=Y, F=Y) / P(I=Y)$$

$$= \Sigma H \in \{Y,N\}\ P(I=Y, H, F=Y) / \Sigma H,F \in \{Y,N\}\ P(I=Y, H, F)$$

Appling the joint probability function P (I, H, F) and the conditional probabilities from the conditional probability Tables (Table 3.23, Table 3.24 and Table 3.25) stated in the diagram, one can evaluate each term in the sums in the numerator and denominator:

$$P(I=Y, H=Y, F=Y) = P(I=Y \mid H=Y, F=Y) \times P(H=Y \mid F=Y) \times P(F=Y)$$

$$= 0.333 \times 0.231 \times 0.361 \approx 0.0256$$

$$P(I=Y, H=N, F=Y) = P(I=Y \mid H=N, F=Y) \times P(H=N \mid F=Y) \times P(F=Y)$$

$$= 0.4 \times 0.769 \times 0.361 \approx 0.111$$

$$P(I=Y, H=Y, F=N) = P(I=Y \mid H=Y, F=N)\ P(H=Y \mid F=N) \times P(F=N)$$

$$= 0.25 \times 0.522 \times 0.639 \approx 0.0834$$

$$P(I=Y, H=N, F=N) = P(I=Y \mid H=N, F=N) \times P(H=N \mid F=N) \times P(F=N)$$

$$= 0.636 \times 0.478 \times 0.639 \approx 0.1943$$

Then the numerical results (subscript by the associated variable values) are:

$$P(F=Y \mid I=Y) = P(I=Y, F=Y) / P(I=Y)$$

$$= \Sigma H \in \{Y,N\}\ P(I=Y, H, F=Y) / \Sigma H,F \in \{Y,N\}\ P(I=Y, H, F)$$

$$= [0.0256 + 0.111] / [0.0256 + 0.0834 + 0.111 + 0.1943]$$

$$\approx 33.3\%$$

So, if we know the enterprise has good condition of the informational resource, there is almost 33.3% chance that the enterprise has good condition of the financial resource. However, it can be time consuming when the variables are more complex. The use of MSBNx can save time and is easier to evaluate the conditional probabilities (Fig 3.10).

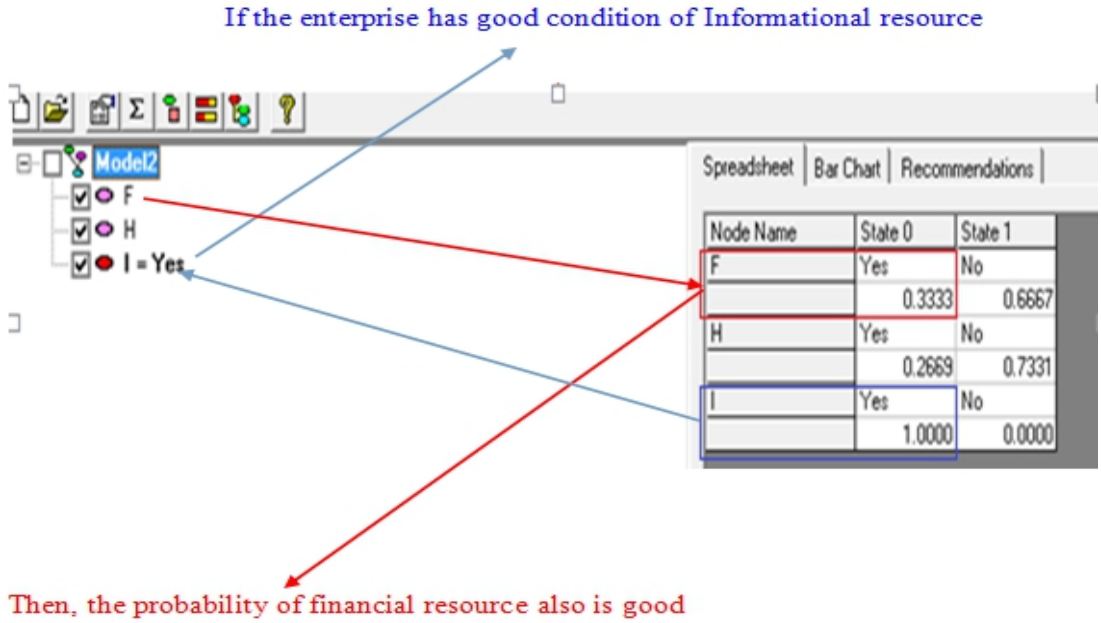


Figure 3.10 Sample Conditional probabilities of F and H If I=good

3.5 Stage four: Factor Analysis

Based on the analysis of Bayesian Belief Network, Quality competitive issue is one of the most significant impacts on the SMEs' competitiveness in Chinese Yangtze River Delta. So it is necessary to help the SMEs better understand the quality management strategies and further identify the weakness of their current practices and future improvement directions, a factor analysis has been performed to characterize the quality management practices in the SMEs in Yangtze River Delta.

The assessment framework used by Malcolm Baldrige Quality Awards (MBNQA) has been widely used to assess the quality management practices and performance in various organizations. For example, Schniederjans (2006) applied MBNQA to comparatively analyze the quality management of India, Mexico, and the United States. MBNQA standard consists of the following categories: Leadership, Strategy Development, Customer Focus, Measure, Analysis and Knowledge Management, Workforce Focus, Quality and Process Management, and Results. They are closely related to the eight quality management principles identified in ISO 9000 series standards. Thus the questionnaire questions for factor analysis of quality management in this research were developed mainly according to the eight quality management principles, which are as follows:

P1 Customer Focus	P2 Leadership
P3 Involvement of people	P4 Process approach
P5 System approach to management	P6 Continual improvement
P7 Factual approach to decision making	P8 Mutually beneficial supplier relations

These eight quality management principles were covered in Q27, with the following six-point levels used, they are: (1) very good; (2) good; (3) medium; (4) weak; (5) very weak and (6) no attention.

3.6 Summary

This chapter has detailed and justified the research methods adopted in this project, including the selection of 36 small and medium manufacturing enterprises' entrepreneurs for questionnaire survey and further interviews, the research hypotheses, the design and development of the questionnaire, the development and analysis of BBNs and the factor analysis of the quality management practices in the SMEs studied.

Next chapter will focus on the quantitative and qualitative data analysis. Quantitative analyses mainly relate to the SMEs' background, information of respondents and some specific information of resources such as human and finance resources, and competitive issues such as quality management, with further discussions and suggestions. Qualitative analyses mainly focus on the BBN modelling and factor analysis of the quality management practices. The core findings of research will be presented in the next chapter.

Chapter 4 Results and Data Analysis

4.1 Quantitative Analysis

The first parts of data are mainly evaluated by the frequency and descriptive analysis of the background of the respondents.

Q1. The age of the enterprise:

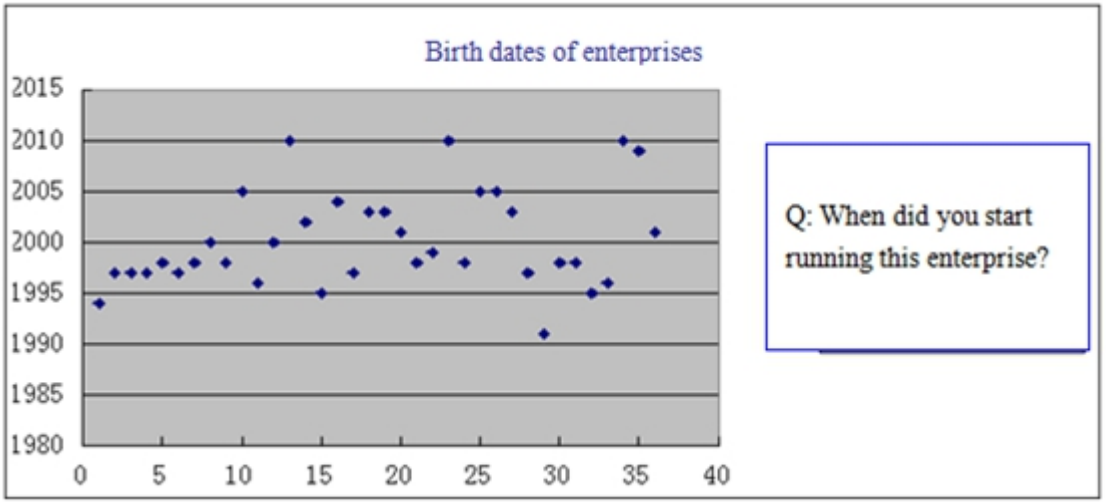


Figure 4.1 Ages of the SMEs

As Figure 4.1 shows, all of the respondents have run their enterprise more than three years. 32 (88.9%) of the enterprises have operated more than 8 years. The highest frequency of the entrepreneurs started their enterprises between 1995 and 2005. The earliest enterprise was launched at 1991.

Q2. The respondent's age range:

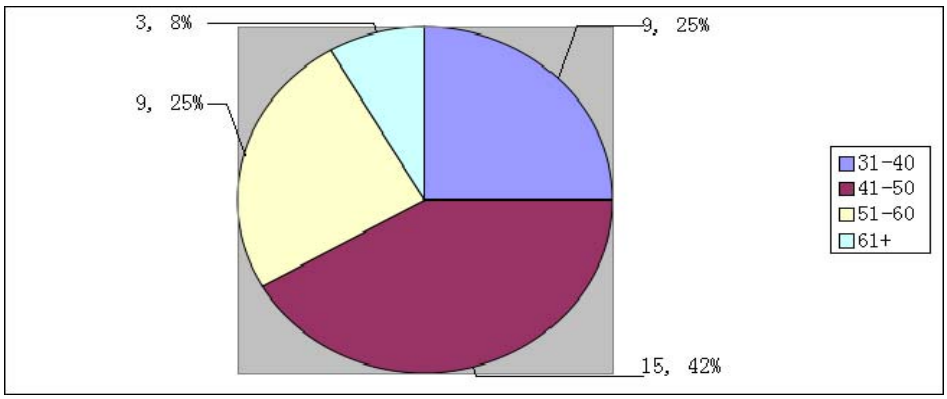


Figure 4.2 Segment of Entrepreneurs' age

As Figure 4.2 shows, 25% of entrepreneurs are in the range of 31-40 and 51-60 years' old, 42% of them are 41-50 years' old, and the remaining 8% of entrepreneurs are older than 61.

Q3. The respondents' education level:

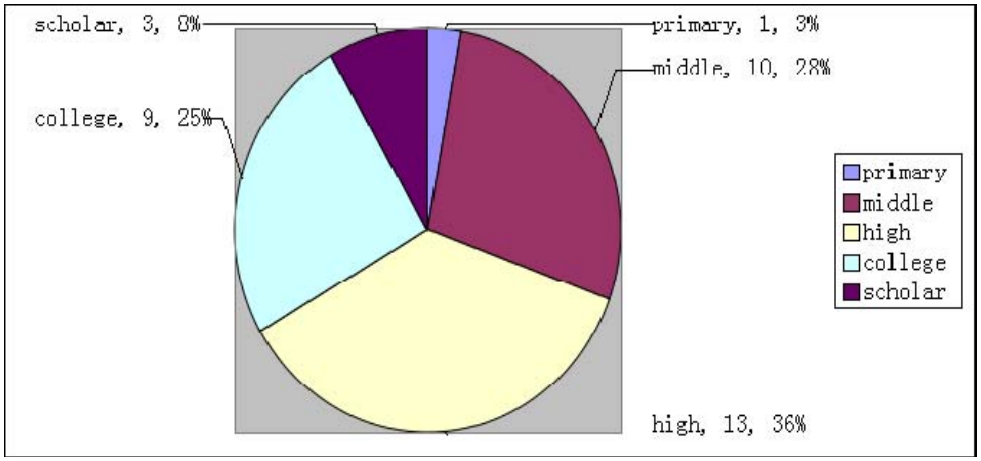


Figure 4.3 Education level

As Figure 4.3 showed, total 30.5% of entrepreneurs are low educated, 36.1% entrepreneurs received high school education. 33.4% entrepreneurs received college diploma and university education.

Q4. The respondent's experience before starting the business:

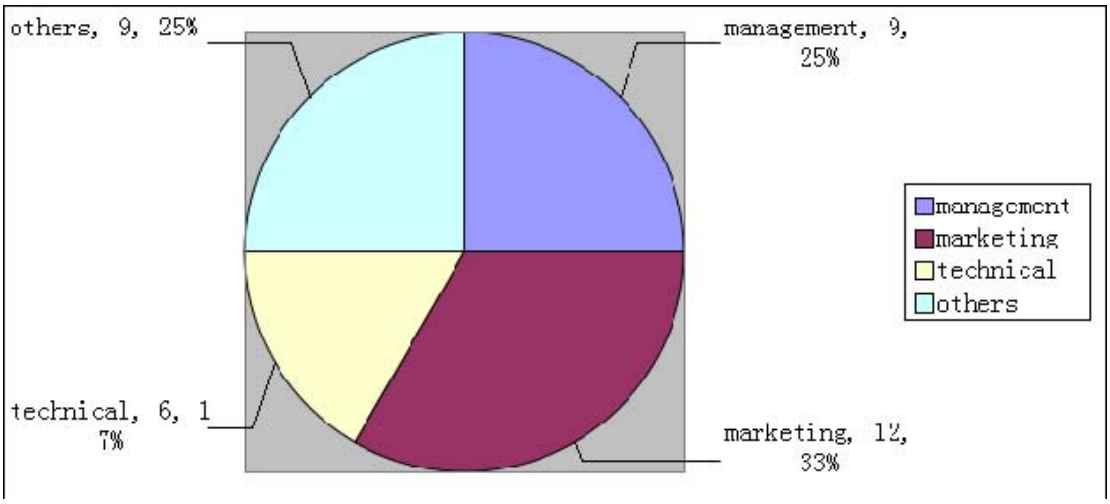


Figure 4.4 Segment of pre experience

As Figure 4.4 shows, 25% responders had the management experiences, 33% of them have marketing experiences and 17% of them have technical experiences before they started running enterprise.

Q5. Number of employees:

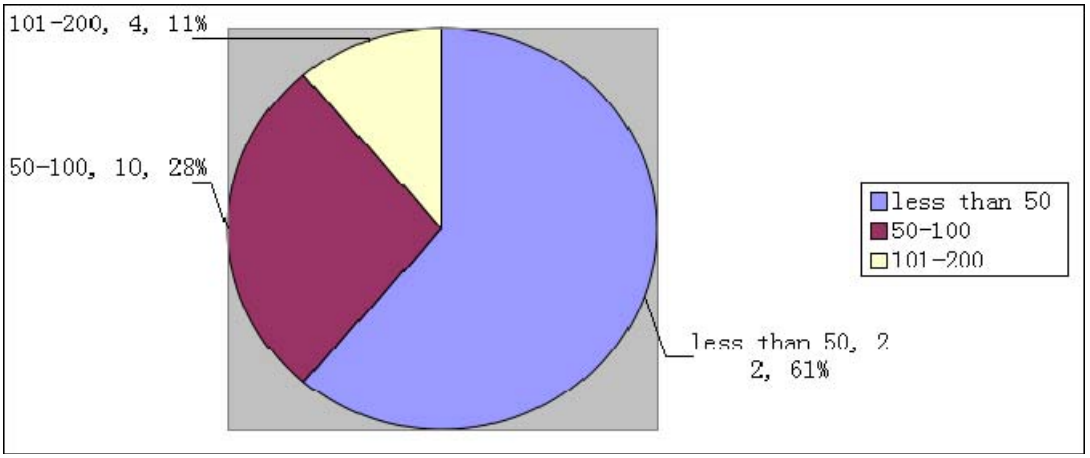


Figure 4.5 Size of enterprises

As Figure 4.5 shows, 61% of the enterprises have fewer than 50 employees, 28% of them have 50-100 employees, and only 11% entrepreneurs employ between 100 and 200 staff.

Q6. Average age of employees:

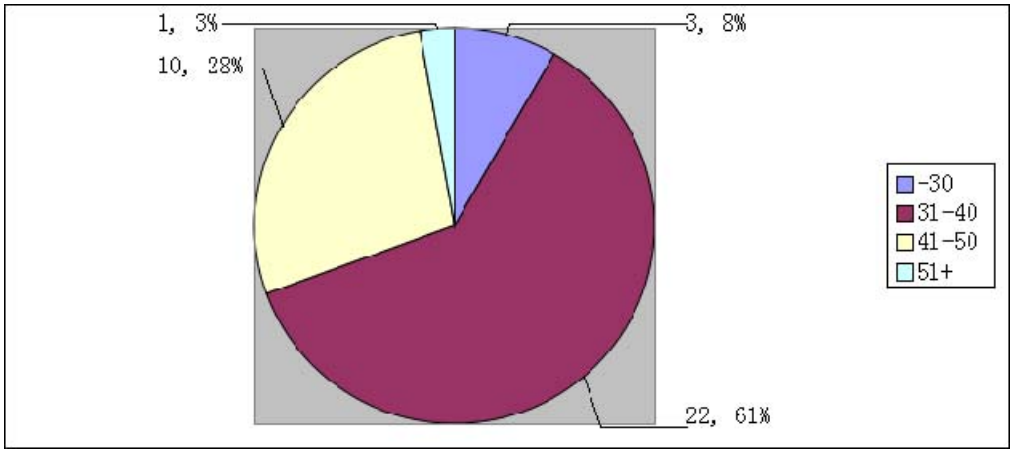


Figure 4.6 Age of employees

As Figure 4.6 shows, there are about 61% of enterprises whose employees' average age range between 31-40 years' old, 28% of SMEs have the average employees' age range of 41-50.

Q7. If the entrepreneurs of SMEs are involved in more than one role such as they are not only in charge of quality control, but also in charge of the marketing sales?

Table 4.1 Role player

Involved more than one role		
Y	24	66.7%
N	12	33.3%

As Table 4.1 shows, almost 66.7% SMEs' entrepreneurs are involved in more than one role in business practice. The rest 33.3% responders are focused on one particular business operational area.

Q8. There are seven main channels to employ people:

A. Recruiting graduates of colleges and universities B. Agent

C. Social career fair D. Traditional paper advertising E. Internet

F. People recommendation G. Others

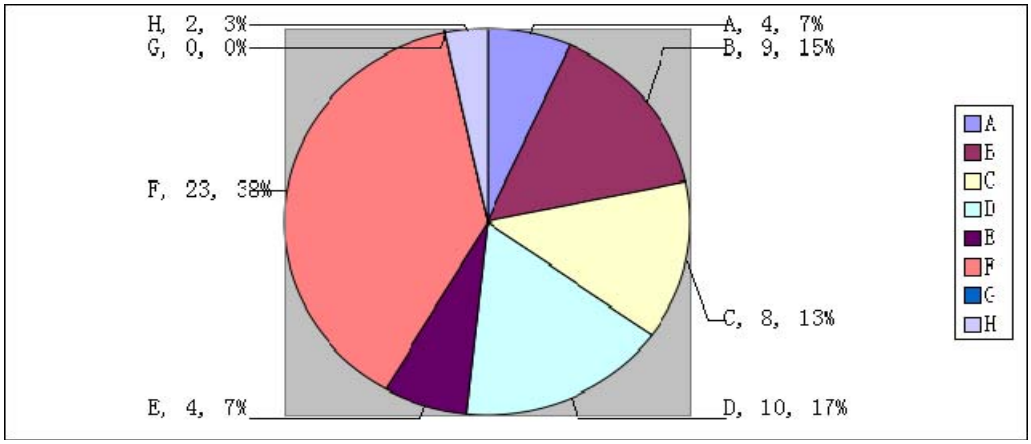


Figure 4.7 Channel of employing people

The main channels (more than 10%) are F (People recommendation 38%), then D (Traditional paper advertising 17%), B (Agent 15%) and C (Social career fair 13%).

Q9. What kind of human resource which the SMEs are lack of?

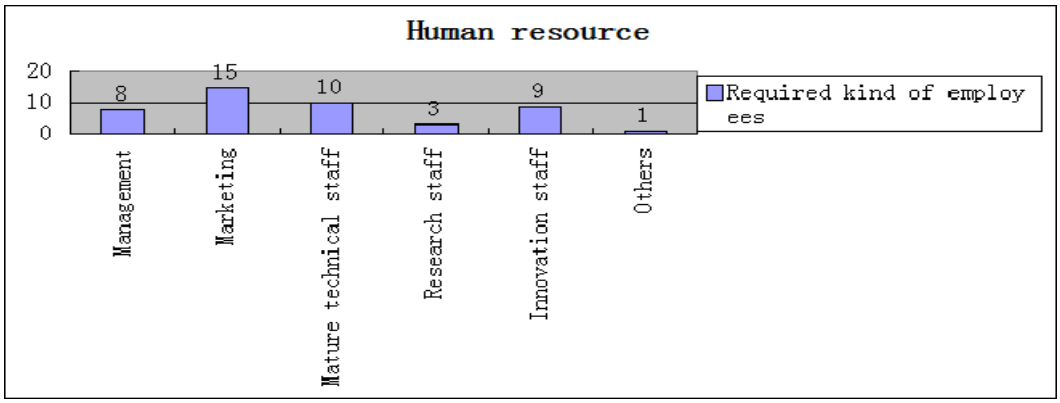


Figure 4.8 Kind of lacking human resource

The results indicate that 15% SMEs lack marketing staff, 10% lack mature technical staff and 9% lack innovation staff.

Q10. Are your employee often trained?

Table 4.2 Frequency of staff training

STAFF OFTEN BE TRAINED		
Y	12	33.3%
N	24	66.7%

Q11. How much do you spend on the training?

Table 4.3 Cost of training

COST OF TRAINING		
VERY BAD (less than 1%)	17	47.2%
BAD (1%-3%)	11	30.5%
GOOD (3%-6%)	6	16.7%
VERY GOOD (more than 6%)	2	5.6%

About a total 77.7% of entrepreneurs spend less than 3% avenue per year on the training. The results in this question will be further analyzed to determine its importance.

Q12. Staff leaving rate per year

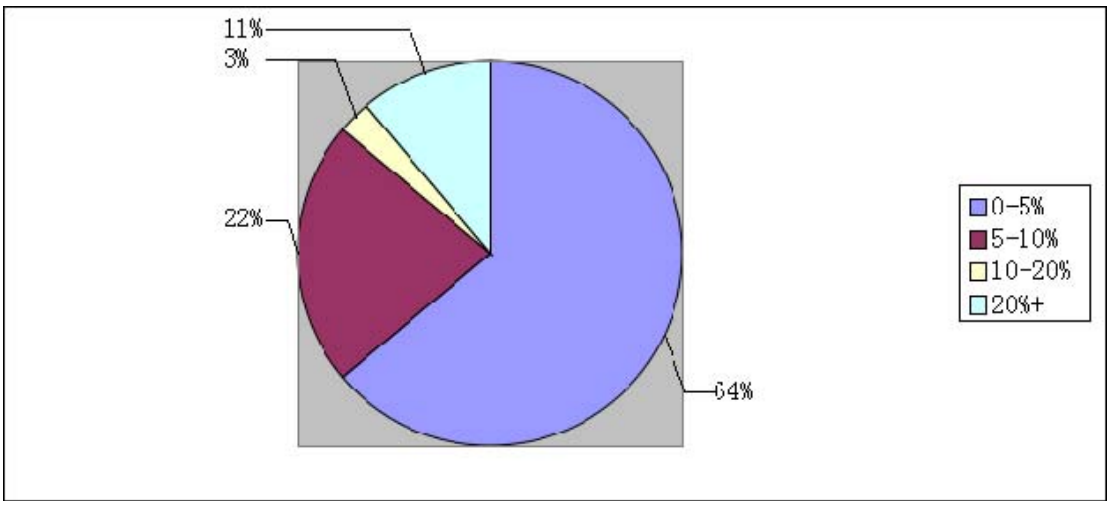


Figure 4.9 Annual staff leaving rate

As Figure 4.9 shows, 64% enterprises have less than 5% of staff leaving per year, 22% enterprise have 5-10% of staff leaving per year and the 11% enterprise have high staff leaving rate which is 10-20%.

Q13. What are the main reasons they left?

A Personal knowledge or skill cannot meet your need B Low salary

C The enterprise culture or regulations cannot be adopted

D Hard workload E Bad habit such as laziness F Others

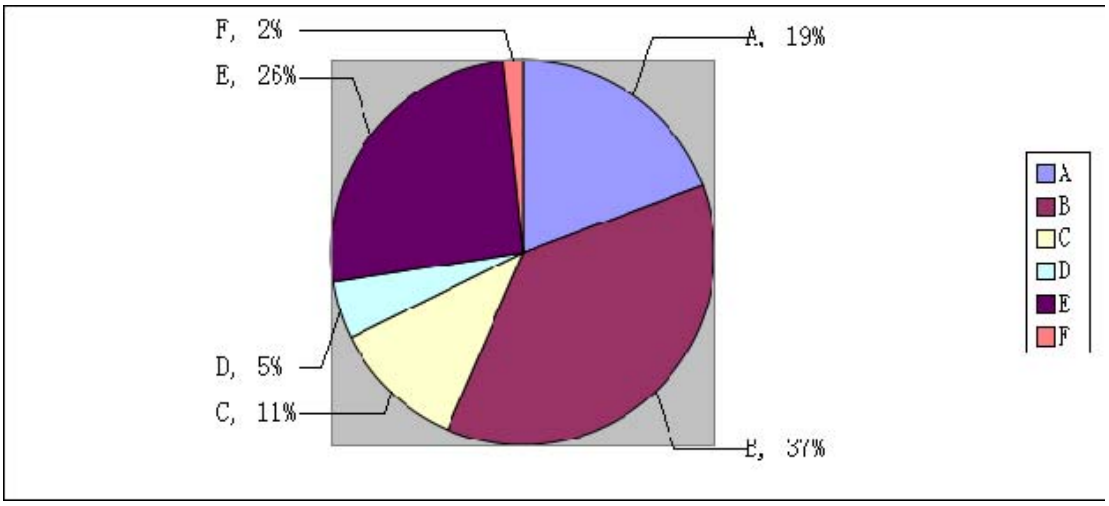


Figure 4.10 The reasons of quitting

As Figure 4.10 shows, Low salary (37%) is the main reason why employees have left.

Q14. Did the entrepreneurs attend formal management training?

This shows that about 30.6% in 36 entrepreneurs have not had formal management training.

Q15. Where enterprise got financial support from?

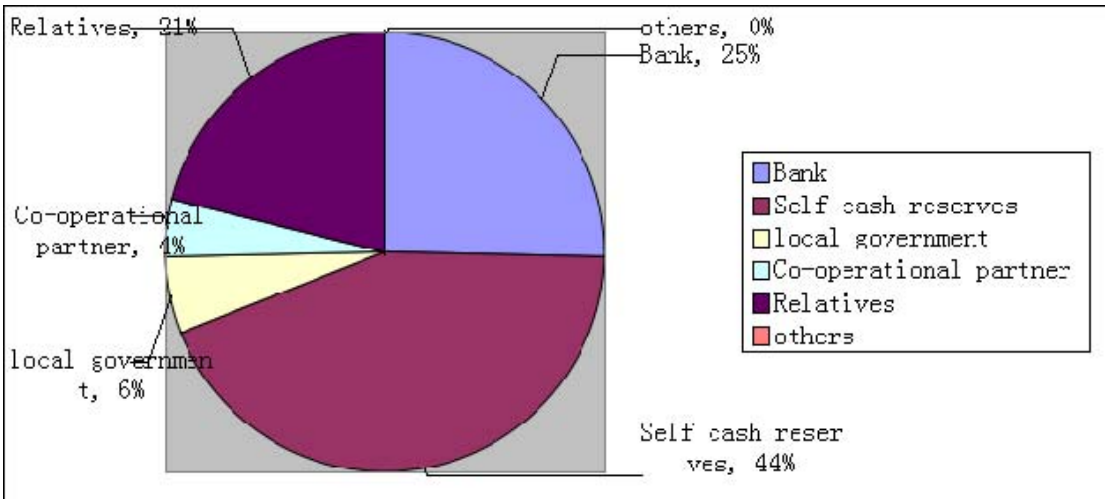


Figure 4.11 Finance origin channel

As Figure 4.11 shows, Self cash reserves (44%) is the main financial resource origin, the other main financial sources are from Bank (25%) and Relatives (21%) when the enterprise faced financial problems.

Q16. What caused financial problems in practice?

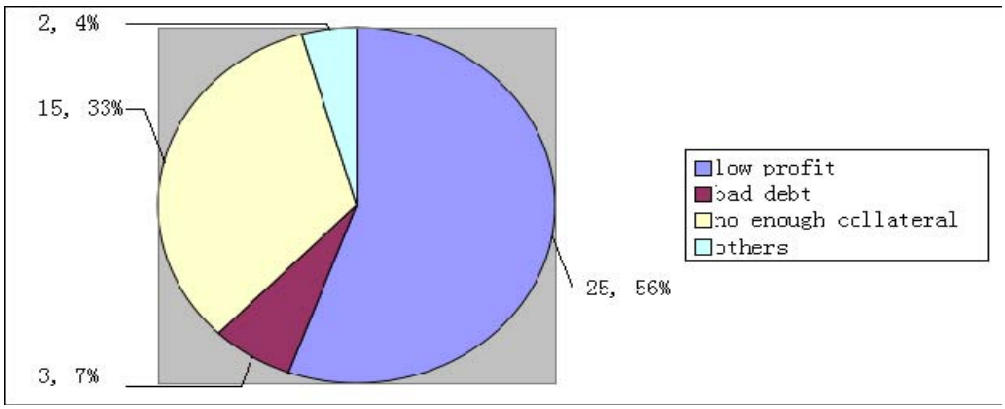


Figure 4.12 Main causes of financial problems

As Figure 4.12 shows, the low profit (56%) is main reason for the financial problem.

Q38. In future, which factor will be considered when you make big decision or changes for the enterprise?

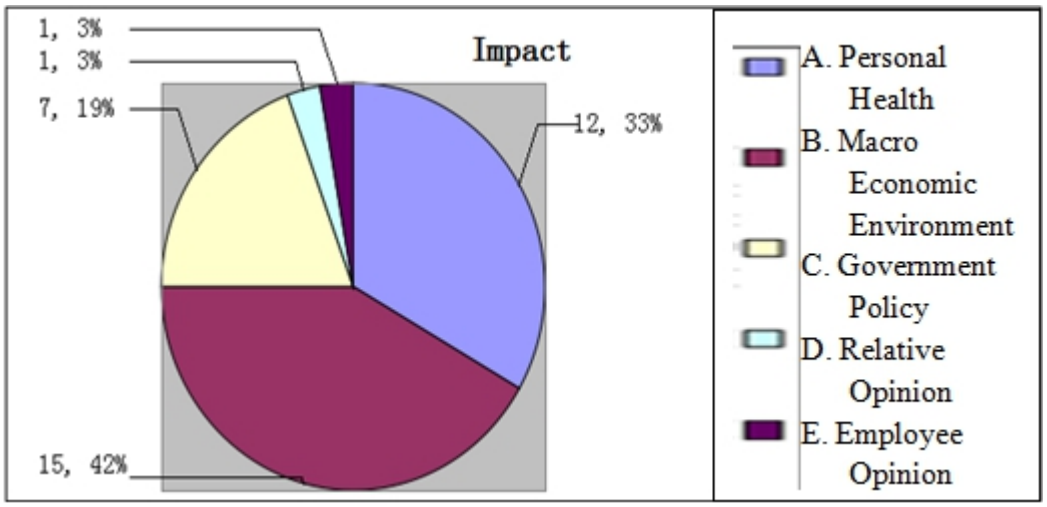


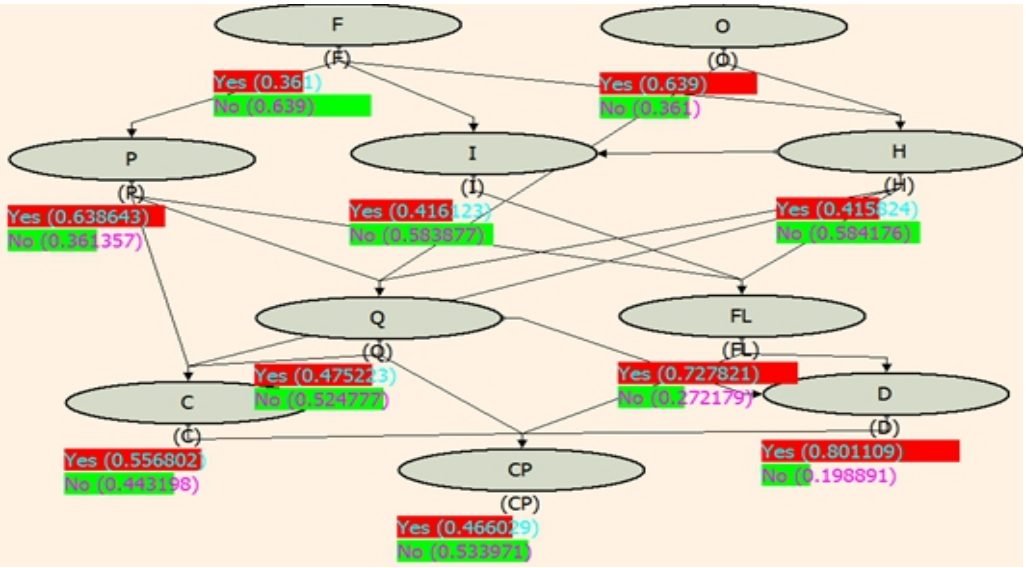
Figure 4.13 Factors of Decision Making

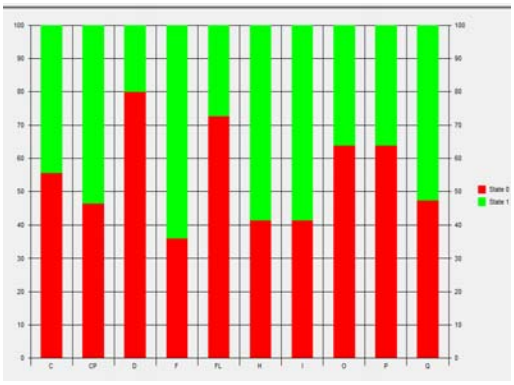
There are three major factors considered by the entrepreneurs in the future when they are facing big business decision making. The most significant factor is the Macroeconomic Environment which is 42%, the second major factor is the Personal Health which has 33%, and there are 75% (9 in 12) entrepreneurs whose age is over 51 choosing this second factor. The third factor is Government Policy.

4.2 Bayesian Belief Networks (BBNs) model

4.2.1 General Results of Model 1

The probabilities of the influencing variables of the Competitiveness Performance excluding innovation performance are showed in Table 4.4.





Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

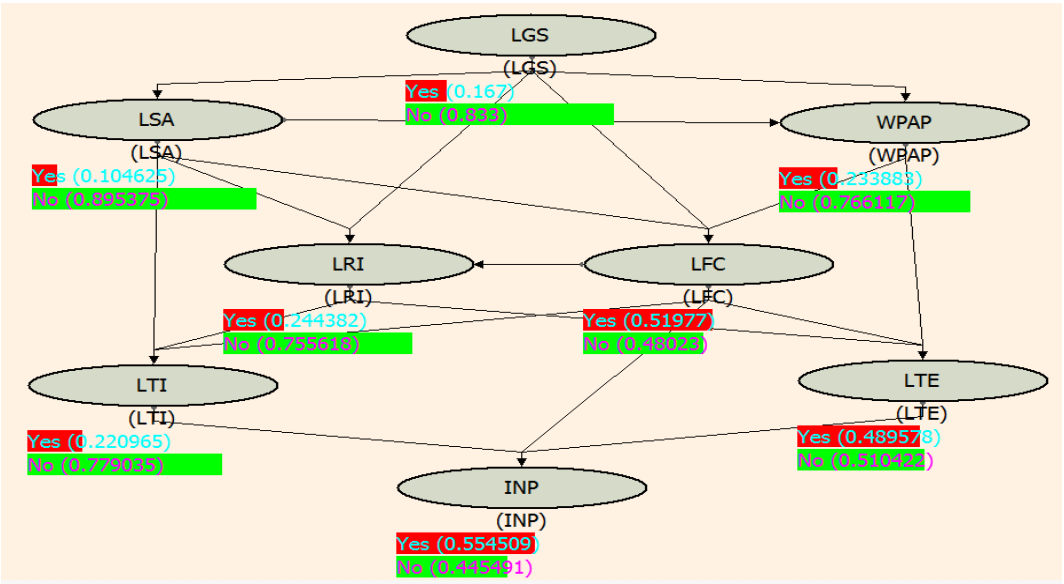
Table 4.4 Model 1 General Variables' probabilities of Competitiveness Performance

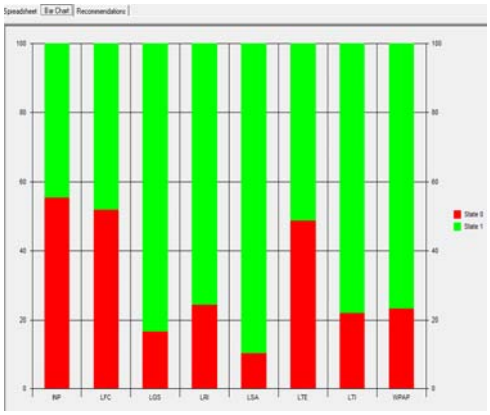
The results have shown the resource based views of SMEs in Yangtze River Delta in the following order: chance of good condition of resource ranking displayed by Organizational (63.90%)> Physical (63.86%)> Informational (41.61%)> Human (41.58%)> Financial (36.10%).

General competitive issues are characterized by the following results: chance of better condition of competitive issues ranking display by Dependability (80.11%)> Flexibility (72.78%)> Cost (55.68%)> Quality (47.52%). The general good competitiveness performance is 46.60%.

4.2.2 General Results of Model 2

The probabilities of the influencing variables (barriers) of Innovation Performance are shown in Table 4.5:



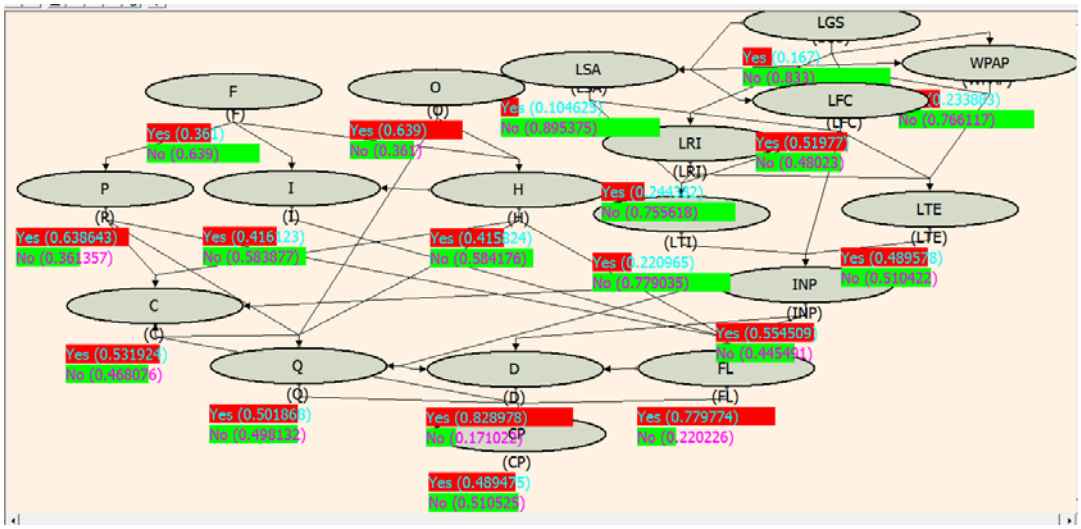


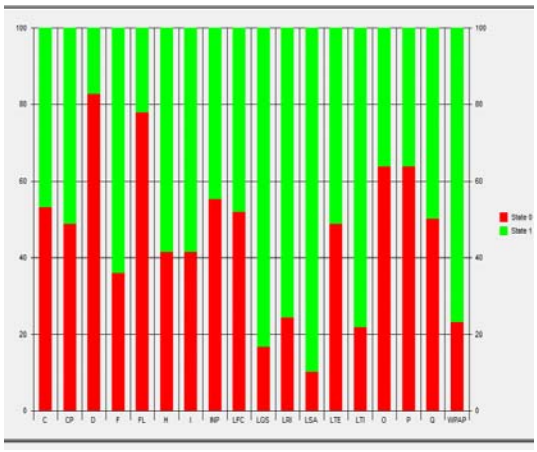
Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

Table 4.5 Model 2 General Barriers' probabilities of Innovation Performance

The results have shown the likelihoods of general barriers of innovation in these SMEs, with the main barriers of innovation ranking display by LFC (51.98%)> LTE (48.96%)> LRI (24.44%)> WPAP (23.39%)> LTI (22.10%)> LGS (16.70%)> LSA (10.46%). The general innovation performance is 55.45% (the probability of the enterprise is focusing on the innovation activities currently).

4.2.3 General Results of Model I





Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

Table 4.6 Model I General Competitive issues and INP's probabilities of CP

The general competitive issues combined with innovation performance (Table 4.6) have shown the following results: the chance of better condition of competitive issues ranking display by Dependability (82.90%)> Flexibility (77.98%)> Cost (53.19%)>

Quality (50.19%). The general good competitiveness performance is 48.95%. Compared with the findings in section 4.2.1, the general competitive issues after the consideration of innovation have generally given better results.

4.3 Causal Independence Assessment (CIA) of BBNs

4.3.1 CIA of Model 1

1) Financial resource in model 1:

If the company has good condition of Financial resource, the conditional probabilities of other variables (nodes) are shown in Table 4.7, compared with the general probability overview in Table 4.4 (repeated for convenience, the same in the following discussions) :

Table 4.7 CI if F=Good

Node Name	State 0	State 1
C	Yes	No
	0.5485	0.4515
CP	Yes	No
	0.4417	0.5583
D	Yes	No
	0.7919	0.2081
F	Yes	No
	1.0000	0.0000
FL	Yes	No
	0.6521	0.3479
H	Yes	No
	0.2243	0.7757
I	Yes	No
	0.3850	0.6150
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6150	0.3850
Q	Yes	No
	0.4724	0.5276

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The changes in the node probabilities can be shown in the following Table:

Table 4.7.1 Differences of Impact if F=Good compared with General view

	H (S0=Y)	P (S0=Y)	I (S0=Y)	O (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP
F (S0=Y)	22.43%	61.50%	38.50%	63.90%	54.85%	47.24%	65.21%	79.19%	44.17%
General(S0=Y)	41.58%	63.86%	41.61%	63.90%	55.68%	47.52%	72.78%	80.11%	46.60%
Difference	-19.15%	-2.36%	-3.11%	0	-0.83%	-0.28%	-7.57%	-0.92%	-2.43%

2) Human resource in Model 1:

If the company has good condition of Human resource, the conditional probabilities of other variables (nodes) are given in Table 4.8, in comparison with the general probability overview in Table 4.4.

Table 4.8 CIA if H=Good

Node Name	State 0	State 1
C	Yes	No
	0.6010	0.3990
CP	Yes	No
	0.4996	0.5004
D	Yes	No
	0.7981	0.2019
F	Yes	No
	0.1947	0.8053
FL	Yes	No
	0.7722	0.2278
H	Yes	No
	1.0000	0.0000
I	Yes	No
	0.2662	0.7338
O	Yes	No
	0.5279	0.4721
P	Yes	No
	0.6448	0.3552
Q	Yes	No
	0.5302	0.4698

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.8 and Table 4.4 is as follows:

Table 4.8.1 Differences of Impact if H=Good compared with General view

	F (S0=Y)	P (S0=Y)	I (S0=Y)	O (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP(S0=Y)
H (S0=Y)	**19.47%**	**64.48%**	**26.62%**	**52.79%**	**60.10%**	**53.02%**	**77.22%**	**79.81%**	**49.96%**
General (S0=Y)	**36.10%**	**63.86%**	**41.61%**	**63.90%**	**55.68%**	**47.52%**	**72.78%**	**80.11%**	**46.60%**
Difference	**-16.63%**	**0.62%**	**-14.99**	**-11.11**	**4.42%**	**5.50%**	**4.44%**	**-0.30%**	**3.36%**

3) Organizational resource in model 1:

If the company has good condition of Organizational resource, the conditional probabilities of other variables (nodes) are shown in Table 4.9, compared with the general probability overview in Table 4.4

Table 4.9 CIA if O=Good

Node Name	State 0	State 1
C	Yes	No
	0.5284	0.4716
CP	Yes	No
	0.4671	0.5329
D	Yes	No
	0.7995	0.2005
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7228	0.2772
H	Yes	No
	0.3435	0.6565
I	Yes	No
	0.4326	0.5674
O	Yes	No
	1.0000	0.0000
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4627	0.5373

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.9 and Table 4.4 is as follows:

Table 4.9.1 Differences of Impact if O=Good compared with General view

	F (S0=Y)	P (S0=Y)	I (S0=Y)	H (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP (S0=Y)
O (S0=Y)	36.10%	63.86%	43.26%	34.35%	52.84%	46.27%	72.28%	79.95%	46.71%
General(S0=Y)	36.10%	63.86%	41.61%	41.58%	55.68%	47.52%	72.78%	80.11%	46.60%
Difference	0	0	1.65%	-7.23%	-2.84%	-1.25%	-0.5%	-0.16%	0.11%

4) Physical resource in model 1:

If the company has good condition of Physical resource, the conditional probabilities of other variables (nodes) are given in Table 5.5, compared with the general probability overview in Table 4.4.

Table 4.10 CIA if P=Good

Node Name	State 0	State 1
C	Yes	No
	0.5706	0.4294
CP	Yes	No
	0.5365	0.4635
D	Yes	No
	0.8364	0.1636
F	Yes	No
	0.3476	0.6524
FL	Yes	No
	0.8644	0.1356
H	Yes	No
	0.4198	0.5802
I	Yes	No
	0.4168	0.5832
O	Yes	No
	0.6390	0.3610
P	Yes	No
	1.0000	0.0000
Q	Yes	No
	0.5402	0.4598

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.10 and Table 4.4 is as follows:

Table 4.10.1 Differences of Impact if P=Good compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP(S0=Y)
P (S0=Y)	34.76%	63.90%	41.68%	41.98%	57.06%	54.02%	86.44%	83.64%	53.65%
General(S0=Y)	36.10%	63.90%	41.61%	41.58%	55.68%	47.52%	72.78%	80.11%	46.60%
Difference	-1.34%	0	0.05%	0.40%	1.38%	6.50%	13.66%	3.53%	7.05%

5) Informational resource in model 1:

If the company has good condition of Informational resource, the conditional probabilities of other variables (nodes) are listed in Table 5.6, compared with the general probability overview in Table 4.4.

Table 4.11 CIA if I=Good

Node Name	State 0	State 1
C	Yes	No
	0.5461	0.4539
CP	Yes	No
	0.5064	0.4936
D	Yes	No
	0.8169	0.1831
F	Yes	No
	0.3340	0.6660
FL	Yes	No
	0.8671	0.1329
H	Yes	No
	0.2660	0.7340
I	Yes	No
	1.0000	0.0000
O	Yes	No
	0.6643	0.3357
P	Yes	No
	0.6396	0.3604
Q	Yes	No
	0.4616	0.5384

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.11 and Table 4.4 is as follows:

Table 4.11.1 Differences of Impact if I=Good compared with General view

	F(S0=Y)	O (S0=Y)	P (S0=Y)	H (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP(S0=Y)
I (S0=Y)	33.40%	66.43%	63.96%	26.60%	54.61%	46.16%	86.71%	81.69%	50.64%
General(S0=Y)	36.10%	63.90%	63.86%	41.58%	55.68%	47.52%	72.78%	80.11%	46.60%
Difference	-2.7%	2.53%	0.10%	-14.98%	-1.07%	-1.36%	13.93%	1.58%	4.04%

6) Cost issue in model 1:

If the company has cost competitive advantage than competitors, the other variables' probabilities are showed in Table 4.12.

Table 4.12 CIA if C=better

Node Name	State 0	State 1
C	Yes	No
	1.0000	0.0000
CP	Yes	No
	0.4645	0.5355
D	Yes	No
	0.8270	0.1730
F	Yes	No
	0.3556	0.6444
FL	Yes	No
	0.7361	0.2639
H	Yes	No
	0.4489	0.5511
I	Yes	No
	0.4081	0.5919
O	Yes	No
	0.6064	0.3936
P	Yes	No
	0.6545	0.3455
Q	Yes	No
	0.5980	0.4020

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.12 and Table 4.4 is as follows:

Table 4.12.1 Differences of Impact if Cost is better compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	P (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)	CP (S0=Y)
C (S0=Y)	**35.56%**	**60.64%**	**40.81%**	**44.89%**	**65.45%**	**59.80%**	**73.61%**	**82.70%**	**46.45%**
General(S0=Y)	**36.10%**	**63.90%**	**41.61%**	**41.58%**	**63.86%**	**47.52%**	**72.78%**	**80.11%**	**46.60%**
Difference	**-0.54%**	**-3.26%**	**-0.8%**	**3.31%**	**1.59%**	**12.28%**	**0.83%**	**2.59%**	**-0.15%**

7) Quality issue in model 1:

If the company has the quality competitive advantage than the competitors, we have:

Table 4.13 CIA if Q=better

Node Name	State 0	State 1
C	Yes	No
	0.7007	0.2993
CP	Yes	No
	0.6238	0.3762
D	Yes	No
	0.8914	0.1086
F	Yes	No
	0.3589	0.6411
FL	Yes	No
	0.7598	0.2402
H	Yes	No
	0.4640	0.5360
I	Yes	No
	0.4042	0.5958
O	Yes	No
	0.6222	0.3778
P	Yes	No
	0.7260	0.2740
Q	Yes	No
	1.0000	0.0000

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.13 and Table 4.4 is as follows:

Table 4.13.1 Differences of Impact if Quality is better compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	P (S0=Y)	C (S0=Y)	FL (S0=Y)	D (S0=Y)	CP (S0=Y)
Q (S0=Y)	35.89%	62.22%	40.42%	46.40%	72.60%	70.07%	75.98%	89.14%	62.38%
General(S0=Y)	36.10%	63.90%	41.61%	41.58%	63.86%	55.68%	72.78%	80.11%	46.60%
Difference	-0.21%	-1.68%	-1.19%	4.82%	8.74%	14.39%	3.20%	9.03%	15.78%

8) Flexibility issue in model 1:

If the company has the flexibility competitive advantage than the competitors, then:

Table 4.14 CIA if FL=better

Node Name	State 0	State 1
C	Yes	No
	0.5632	0.4368
CP	Yes	No
	0.5471	0.4529
D	Yes	No
	0.8570	0.1430
F	Yes	No
	0.3234	0.6766
FL	Yes	No
	1.0000	0.0000
H	Yes	No
	0.4412	0.5588
I	Yes	No
	0.4958	0.5042
O	Yes	No
	0.6346	0.3654
P	Yes	No
	0.7585	0.2415
Q	Yes	No
	0.4961	0.5039

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.14 and Table 4.4 is as follows:

Table 4.14.1 Differences of Impact if Flexibility is better compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	P (S0=Y)	C (S0=Y)	Q (S0=Y)	D (S0=Y)	CP (S0=Y)
FL (S0=Y)	32.34%	63.46%	49.58%	44.12%	75.85%	56.32%	49.61%	85.70%	54.71%
General(S0=Y)	36.10%	63.90%	41.61%	41.58%	63.86%	55.68%	47.52%	80.11%	46.60%
Difference	-3.76%	-0.44%	7.97%	2.54%	11.99%	0.64%	2.09%	5.59%	8.11%

9) Dependability in model 1:

If the company has better the dependability competitive issue, we have:

Table 4.15 CIA if D=better

Node Name	State 0	State 1
C	Yes	No
	0.5748	0.4252
CP	Yes	No
	0.4375	0.5625
D	Yes	No
	1.0000	0.0000
F	Yes	No
	0.3568	0.6432
FL	Yes	No
	0.7786	0.2214
H	Yes	No
	0.4142	0.5858
I	Yes	No
	0.4243	0.5757
O	Yes	No
	0.6377	0.3623
P	Yes	No
	0.6667	0.3333
Q	Yes	No
	0.5288	0.4712

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.15 and Table 4.4 is as follows:

Table 4.15.1 Differences of Impact if dependability is better compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	P (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	CP (S0=Y)
D (S0=Y)	**35.68%**	**63.77%**	**42.43%**	**41.42%**	**66.67%**	**57.48%**	**52.88%**	**77.86%**	**43.75%**
General(S0=Y)	**36.10%**	**63.90%**	**41.61%**	**41.58%**	**63.86%**	**55.68%**	**47.52%**	**72.78%**	**46.60%**
Difference	**-0.42%**	**-0.13%**	**0.85%**	**-0.16%**	**2.81%**	**1.8%**	**5.36%**	**5.08%**	**-2.85%**

10) Competitiveness performance in model 1:

If the company has better competitiveness performance, we have the following data:

Table 4.16 CIA if CP=Good

Node Name	State 0	State 1
C	Yes	No
	0.5550	0.4450
CP	Yes	No
	1.0000	0.0000
D	Yes	No
	0.7520	0.2480
F	Yes	No
	0.3421	0.6579
FL	Yes	No
	0.8544	0.1456
H	Yes	No
	0.4458	0.5542
I	Yes	No
	0.4522	0.5478
O	Yes	No
	0.6405	0.3595
P	Yes	No
	0.7352	0.2648
Q	Yes	No
	0.6361	0.3639

Table 4.4

Node Name	State 0	State 1
C	Yes	No
	0.5568	0.4432
CP	Yes	No
	0.4660	0.5340
D	Yes	No
	0.8011	0.1989
F	Yes	No
	0.3610	0.6390
FL	Yes	No
	0.7278	0.2722
H	Yes	No
	0.4158	0.5842
I	Yes	No
	0.4161	0.5839
O	Yes	No
	0.6390	0.3610
P	Yes	No
	0.6386	0.3614
Q	Yes	No
	0.4752	0.5248

The comparison between Table 4.16 and Table 4.4 is as follows:

Table 4.16.1 Differences of Impact if competitiveness performance is good compared with General view

	F (S0=Y)	O (S0=Y)	I (S0=Y)	H (S0=Y)	P (S0=Y)	C (S0=Y)	Q (S0=Y)	FL (S0=Y)	D (S0=Y)
CP (S0=Y)	**34.21%**	**64.05%**	**45.22%**	**44.58%**	**73.52%**	**55.50%**	**63.61%**	**85.44%**	**75.20%**
General(S0=Y)	**36.10%**	**63.90%**	**41.61%**	**41.58%**	**63.86%**	**55.68%**	**47.52%**	**72.78%**	**80.11%**
Difference	**-1.89%**	**0.15%**	**3.61%**	**3.00%**	**9.66%**	**-0.18%**	**16.09%**	**12.66%**	**-4.91%**

4.3.1.1 Summary of the analysis results of Model 1

Combination of the data from Table 4.7.1, Table 4.8.1, Table 4.9.1, Table4.10.1, Table4.11.1, Table 4.12.1, Table 4.13.1, Table 4.14.1, Table 4.15.1 and Table 4.16.1, this research have built a Variable Value Table 4.17 of conditional Causal Independence Assessment of resources and competitive issues.

Table 4.17 Variable Value of conditional Causal Independence Assessment of Resources and competitive issues

	F	H	O	I	P	C	Q	FL	D	CP
F		-19.15%	0	-3.11%	-2.36%	-0.83%	-0.28%	-7.53%	-0.92	-2.43%
H	-16.63%		-11.11%	-14.99%	0.62%	4.42%	5.50%	4.44%	-0.30%	3.36%
O	0	-7.23%		1.65%	0	-2.84%	1.25%	-0.50%	-0.16%	0.11%
I	-2.7%	-14.98%	2.53%		0.10%	-1.07%	-1.36%	13.93%	1.58%	4.04%
P	0.40%	-1.34%	0	0.05%		1.38%	6.50%	13.66%	3.53%	7.05%
C	-0.54%	3.31%	-3.26%	-0.80%	1.59%		12.28%	0.83%	2.59%	-0.15%
Q	-0.21%	4.82%	-1.68%	-1.19%	8.74%	14.39%		3.20%	9.03%	15.78%
FL	-3.76%	2.54%	-0.44%	7.97%	11.99%	0.64%	2.09%		5.59%	8.11%
D	0.42%	-0.16%	-0.13%	0.85%	2.81%	1.80%	5.36%	5.08		-2.85%
CP	-1.89%	3.00%	0.15	3.61%	9.66%	-0.18%	16.09%	12.66%	-4.91%	

Currently the importance of SMEs' resources related competitiveness performance (CP) in Yangtze River Delta is ranked by: P (7.05%)> I (4.04%)>H (3.36%)>O (0.11%)>F (-2.43%).

Currently the importance of SMEs' competitive issues related competitiveness performance in Yangtze River Delta has the following ranking: Q (15.78%)> FL (8.11%)>C (-0.15%)>D (-2.85%).

In addition:

1) Table 4.17 showed that if the enterprises have good condition of financial resource, there is no positive impact on any other variables including other conditions of resource and competitive issues. When the enterprises have good condition of financial resource, the worst performance is good condition of Human resource which 19.15% smaller than the result in general views. It means that even the financial resource is good, the entrepreneurs did not use or use well. According to Q11 and Q13, about 77.7% SMEs spend less than 3% avenue per year on employee training and the main reason of employee quitting (37%) is low salary.

2) Table 4.17 indicates that if the enterprises have good condition of Human resource, the resource with the largest decrease in condition is the finance (-16.43%). However, the good condition of human resource has a general positive impact on the competitive issues and competitiveness performance (3.36%).

3) Table 4.17 also showed the main differences occur with variables H and C. The probability for CP is higher by 0.11% than general performance. Compared with

Table 4.4, the organizational resource is the best condition resource but it is not important variable for improving competitiveness performance of SMEs.

4) Table 4.17 suggested that good condition of physical resource is the most positive variable for competitive issues and improving the competitiveness performance (7.05%) in the all five kinds of resources.

5) According to Table 4.17, good condition of informational resource is the second positive impact on improving the competitiveness performance (4.04%) in five kinds of resources with the highest positive impact on the Flexibility competitive issue (13.93%).

6) It can be seen that if the enterprises have better condition of Quality, then the good condition of competitiveness performance increased to 62.38%. Compared with general good competitiveness performance (46.60%), it has huge 15.78% improvement. Compared with other variables, the Quality competitive issue is the most significant positive impact on improving the competitiveness performance. Better condition of Quality not only has the most positive impact on the competitiveness performance, but also has the most positive impact on better performance of Cost (14.45%) and Dependability (7.3%).

7) Table 4.17 showed that the Dependability in SMEs is a weak negative variable for the competitiveness and the Dependability competitive advantage is quite weak to other variables in current SMEs in Yangtze River Delta. The branding of SMEs may not cause big improvement for the general competitiveness. Currently, if the

competitiveness performance is good, the best positive impact comes from the Quality and Flexibility competitive issue rather than Physical resource.

8) Table 4.17 indicated that Cost competitive issue did not bring any positive impact on the performance of competitiveness currently. It probably means the enterprise has to pay more attention to focus on the other competitive issues such as Quality and Flexibility.

9) Table 4.17 also showed that the Flexibility is the second positive impact on improving the competitiveness performance (8.11%). The better performance of Flexibility also required the good condition of Physical (11.99%) and Informational resource (7.97%).

4.3.2 CIA of Model 2

1) Variable LFC in model 2:

If the company is lack of the financial capital (LFC), then we have the following compared with Table 4.5 (repeated for convenience) :

Table 4.18 CIA if LFC=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.5910	0.4090
LFC	Yes	No
	1.0000	0.0000
LGS	Yes	No
	0.2945	0.7055
Lack of research ins	Yes	No
	0.1567	0.8433
LSA	Yes	No
	0.1457	0.8543
LTE	Yes	No
	0.4520	0.5480
LTI	Yes	No
	0.2250	0.7750
WPAP	Yes	No
	0.2137	0.7863

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.18 and Table 4.5 is as follows:

Table 4.18.1 Differences of Impact if LFC=Main Barrier compared with General view

	LGS (S0=Y)	LRI (S0=Y)	LSA (S0=Y)	LTE (S0=Y)	LTI (S0=Y)	WPAP (S0=Y)	INP (S0=Y)
LFC (S0=Y)	29.45%	15.67%	14.57%	45.20%	22.50%	21.37%	59.10%
General(S0=Y)	16.70%	24.44%	10.46%	48.96%	22.10%	23.39%	55.45%
Difference	12.75%	-8.77%	4.11%	-3.76%	0.40%	-2.02%	3.65%

2) Variable LGS in model 2:

If the company is lack of the government support (LGS), then:

Table 4.19 CIA if LGS=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.6305	0.3695
LFC	Yes	No
	0.9166	0.0834
LGS	Yes	No
	1.0000	0.0000
Lack of research ins	Yes	No
	0.3336	0.6664
LSA	Yes	No
	0.4170	0.5830
LTE	Yes	No
	0.5681	0.4319
LTI	Yes	No
	0.3043	0.6958
WPAP	Yes	No
	0.3336	0.6664

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.19 and Table 4.5 is as follows:

Table 4.19.1 Differences of Impact if LGS=Main Barrier compared with General view

	LFC(S0=Y)	LRI(S0=Y)	LSA(S0=Y)	LTE(S0=Y)	LTI(S0=Y)	WPAP(S0=Y)	INP(S0=Y)
LGS (S0=Y)	91.66%	33.36%	41.70%	56.81%	30.43%	33.36%	63.05%
General(S0=Y)	51.98%	24.44%	10.46%	48.96%	22.10%	23.39%	55.45%
Difference	39.68%	8.92%	31.24%	7.85%	8.33%	9.97%	7.60%

3) Variable LRI in model 2:

If the company is lack of the research institution, we have:

Table 4.20 CIA if LRI=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.6487	0.3513
LFC	Yes	No
	0.3333	0.6667
LGS	Yes	No
	0.2280	0.7720
Lack of research ins	Yes	No
	1.0000	0.0000
LSA	Yes	No
	0.2893	0.7107
LTE	Yes	No
	0.5236	0.4764
LTI	Yes	No
	0.1436	0.8564
WPAP	Yes	No
	0.3582	0.6418

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.20 and Table 4.5 is as follows:

Table 4.20.1 Differences of Impact if LRI=Main Barrier compared with General view

	LFC(S0=Y)	LGS (S0=Y)	LSA (S0=Y)	LTE (S0=Y)	LTI (S0=Y)	WPAP (S0=Y)	INP (S0=Y)
LRI (S0=Y)	33.33%	22.80%	28.93%	52.36%	14.36%	35.82%	64.87%
General(S0=Y)	51.98%	16.70%	10.46%	48.96%	22.10%	23.39%	55.45%
Difference	-18.65%	6.10%	18.47%	3.40%	-7.74%	12.43%	9.42%

4) Variable LSA in model 2:

If the company is lack of the social innovation atmosphere including culture and environment, then:

Table 4.21 CIA if LSA=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.6488	0.3512
LFC	Yes	No
	0.7236	0.2764
LGS	Yes	No
	0.6656	0.3344
Lack of research ins	Yes	No
	0.6758	0.3242
LSA	Yes	No
	1.0000	0.0000
LTE	Yes	No
	0.5643	0.4357
LTI	Yes	No
	0.3354	0.6646
WPAP	Yes	No
	0.5803	0.4197

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.21 and Table 4.5 is as follows:

Table 4.21.1 Differences of Impact if LSA=Main Barrier compared with General view

	LFC	LGS	LRI	LTE	LTI	WPAP	INP
LSA (S0=Y)	72.36%	66.56%	67.58%	56.43%	33.54%	58.03%	64.88%
General (S0=Y)	51.98%	16.70%	24.44%	48.96%	22.10%	23.39%	55.45%
Difference	20.38%	49.86%	43.14%	7.47%	11.44%	34.60%	9.43%

5) Variable LTE in model 2:

If the company is lack of the technical or research expert, we have:

Table 4.22 CIA if LTE=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.6879	0.3121
LFC	Yes	No
	0.4798	0.5202
LGS	Yes	No
	0.1938	0.8062
Lack of research ins	Yes	No
	0.2614	0.7386
LSA	Yes	No
	0.1206	0.8794
LTE	Yes	No
	1.0000	0.0000
LTI	Yes	No
	0.2345	0.7655
WPAP	Yes	No
	0.2955	0.7045

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.22 and Table 4.5 is as follows:

Table 4.22.1 Differences of Impact if LTE=Main Barrier compared with General view

	LFC (S0=Y)	LGS (S0=Y)	LRI (S0=Y)	LSA (S0=Y)	LTI (S0=Y)	WPAP(S0=Y)	INP (S0=Y)
LTE (S0=Y)	47.98%	19.38%	26.14%	12.06%	23.45%	29.55%	68.79%
General(S0=Y)	51.98%	16.70%	24.44%	10.46%	22.10%	23.39%	55.45%
Difference	-4.00%	2.68%	1.70%	1.60%	1.35%	6.16%	13.34%

6) Variable LTI in model 2:

If the company is lack of the technological information, then:

Table 4.23 CIA if LTI=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.3473	0.6527
LFC	Yes	No
	0.5293	0.4707
LGS	Yes	No
	0.2299	0.7701
Lack of research ins	Yes	No
	0.1588	0.8412
LSA	Yes	No
	0.1588	0.8412
LTE	Yes	No
	0.5196	0.4804
LTI	Yes	No
	1.0000	0.0000
WPAP	Yes	No
	0.2711	0.7289

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.23 and Table 4.5 is as follows:

Table 4.23.1 Differences of Impact if LTI=Main Barrier compared with General view

	LFC (S0=Y)	LGS (S0=Y)	LRI (S0=Y)	LSA (S0=Y)	LTE (S0=Y)	WPAP (S0=Y)	INP (S0=Y)
LTI (S0=Y)	52.93%	22.99%	15.88%	15.88%	51.96%	27.11%	34.73%
General(S0=Y)	51.98%	16.70%	24.44%	10.46%	48.96%	23.39%	55.45%
Difference	0.95%	6.29%	-8.56%	5.42%	3.00%	3.72%	-20.72%

7) Variable WPAP in model 2:

If the company is Weak of IPR protection (WPAP), we have:

Table 4.24 CIA if WPAP=Main Barrier

Node Name	State 0	State 1
INP	Yes	No
	0.6104	0.3896
LFC	Yes	No
	0.4748	0.5252
LGS	Yes	No
	0.2382	0.7618
Lack of research ins	Yes	No
	0.3742	0.6258
LSA	Yes	No
	0.2596	0.7404
LTE	Yes	No
	0.6186	0.3814
LTI	Yes	No
	0.2562	0.7438
WPAP	Yes	No
	1.0000	0.0000

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.24 and Table 4.5 is as follows:

Table 4.24.1 Differences of Impact if WPAP=Main Barrier compared with General view

	LFC (S0=Y)	LGS (S0=Y)	LRI (S0=Y)	LSA (S0=Y)	LTE (S0=Y)	LTI (S0=Y)	INP (S0=Y)
WPAP (S0=Y)	47.48%	23.82%	37.42%	25.96%	61.86%	25.62%	61.04%
General(S0=Y)	51.98%	16.70%	24.44%	10.46%	48.96%	22.10%	55.45%
Difference	-4.50%	7.12%	12.98%	15.50%	12.90%	3.52%	5.59%

8) Variable LFC in model 2:

If the company is focusing on innovation, the results are:

Table 4.25 CIA if INP=Yes

Node Name	State 0	State 1
INP	Yes	No
	1.0000	0.0000
LFC	Yes	No
	0.5540	0.4460
LGS	Yes	No
	0.1899	0.8101
Lack of research ins	Yes	No
	0.2859	0.7141
LSA	Yes	No
	0.1224	0.8776
LTE	Yes	No
	0.6073	0.3927
LTI	Yes	No
	0.1384	0.8616
WPAP	Yes	No
	0.2575	0.7425

Table 4.5

Node Name	State 0	State 1
INP	Yes	No
	0.5545	0.4455
LFC	Yes	No
	0.5198	0.4802
LGS	Yes	No
	0.1670	0.8330
Lack of research ins	Yes	No
	0.2444	0.7556
LSA	Yes	No
	0.1046	0.8954
LTE	Yes	No
	0.4896	0.5104
LTI	Yes	No
	0.2210	0.7790
WPAP	Yes	No
	0.2339	0.7661

The comparison between Table 4.25 and Table 4.5 is as follows:

Table 4.25.1 Differences of Impact if INP=Yes compared with General view

	LFC (S0=Y)	LGS (S0=Y)	LRI (S0=Y)	LSA (S0=Y)	LTE (S0=Y)	LTI (S0=Y)	WPAP(S0=Y)
INP (S0=Y)	55.40%	18.99%	28.59%	12.24%	60.73%	13.84%	25.75%
General(S0=Y)	51.98%	16.70%	24.44%	10.46%	48.96%	22.10%	23.39%
Difference	3.42%	2.29%	4.15%	1.78%	11.77%	-8.26%	2.36%

4.3.2.1Summary of the analysis results of Model 2

Combining the data from Table 4.18.1, Table 4.19.1, Table4.20.1, Table4.21.1, Table 4.22.1, Table 4.23.1, Table 4.24.1 and Table 4.25.1, this research have generated a Variable Value Table 4.26 of conditional Causal Independence Assessment of Barriers and Innovation.

Table 4.26 Variable Value of conditional Causal Independence Assessment of Barriers

	LGS	LFC	LTI	LTE	LSA	WPAP	LRI	INP
LGS		39.68%	8.33%	7.85%	31.24%	9.97%	8.92%	7.60%
LFC	12.75%		0.40%	-3.76%	4.11%	-2.02%	-8.77%	3.65%
LTI	6.29%	0.95%		3.00%	5.42%	3.72%	-8.56%	-20.72%
LTE	2.68%	-4.00%	1.35%		1.60%	6.16%	1.70%	13.34%
LSA	49.86%	20.38%	11.44%	7.47%		34.60%	43.14%	9.43%
WPAP	7.12%	-4.50%	3.52%	12.90%	15.50%		12.98%	5.59%
LRI	6.10%	-18.65%	-7.74%	3.40%	18.47%	12.43%		9.42%
INP	2.29%	3.42%	-8.26%	11.77%	1.78%	2.36%	4.15%	

Currently, the harmful and serious barriers of real SMEs' Innovation activity in Yangtze River Delta has the following ranking: LTE (11.77%)> LRI (4.15%)>LFC (3.42%)>WPAP (2.36%)>LGS (2.29%)> LSA (1.78%)>LTI (-8.26%).

In addition, the following conclusions can be drawn from Table 4.26:

1) WPAP has a huge impact on the barrier of LRI, LTE and LSA. When the main barrier of the SMEs in Yangtze River Delta is weakness in IPR protection, the barriers of LSA, LRI and LTE also increase to the main barrier of more innovative enterprises.

2) Lack of the technology information has medium impact on the barrier of LRI and LGS. When the main barrier of the SMEs is lack of the technical information, the barriers of LGS and LRI also increase their chances to be the main barrier of the least innovative enterprises.

3) Lack of the technical or research expert is medium impact on the barrier of LFC and WPAP. When the main barrier of the SMEs is lack of the technical or research expert, the barriers of LGS and LRI also become the main barrier of more innovative enterprises.

4) Lack of social innovation atmosphere has huge impact on the barrier of LGS and LRI. When the main barrier of the SMEs is lack of social innovation atmosphere, the barriers of LGS and LRI are likely to be the main barrier of more innovative enterprises.

5) Lack of research institution has huge impact on the barrier of Lack of financial capital, Lack of social innovation atmosphere and Weak of intellectual property right protection. When the main barrier of the SMEs is lack of Research institution, the barriers of LSA and WPAP also are likely to be the main barrier of more innovative enterprises.

6) Lack of government support has huge impact on the barrier of Lack of financial capital and Lack of social innovation atmosphere. When the main barrier of the SMEs is lack of Government support, the enterprises may also have a big barrier of Lack of financial capital and social innovation atmosphere.

7) Lack of the technology information has medium impact on the barrier of LRI and LGS. When the main barrier of the SMEs is lack of the technical information, the barriers of LGS and LRI also increase their chances to be the main barrier of the least innovative enterprises.

4.3.3 CIA of Model I (Only Pick competitive issues and innovation performance)

1) Variable C in model I

If the company has cost competitive advantage together with the innovation activity in model I, then we have the following compared with Table 4.6 (repeated for convenience):

Table 4.27 CIA if C=better

Node Name	State 0	State 1
C	Yes	No
	1.0000	0.0000
CP	Yes	No
	0.4705	0.5295
D	Yes	No
	0.8503	0.1497
FL	Yes	No
	0.7688	0.2312
INP	Yes	No
	0.5672	0.4328
Q	Yes	No
	0.6382	0.3618

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.27 and Table 4.6 can be shown in the following table:

Table 4.27.1 Differences of Impact if C= better compared with General view

	Q(S0=Y)	**D(S0=Y)**	**FL(S0=Y)**	**INP(S0=Y)**	**CP (S0=Y)**
C **(S0=Y)**	63.82%	85.03%	76.88%	56.72%	47.05%
General**(S0=Y)**	50.19%	82.90%	77.98%	55.45%	48.98%
Difference	13.63%	2.13%	-1.10%	1.27%	-1.93%

2) Variable Q in model I

If the company has quality competitive advantage together with the innovation activity in model I, then:

Table 4.28 CIA if Q=better

Node Name	State 0	State 1
C	Yes	No
	0.6764	0.3236
CP	Yes	No
	0.6449	0.3551
D	Yes	No
	0.9020	0.0980
FL	Yes	No
	0.7857	0.2143
INP	Yes	No
	0.5487	0.4513
Q	Yes	No
	1.0000	0.0000

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.28 and Table 4.6 can be shown in the following table:

Table 4.28.1 Differences of Impact if Q= better compared with General view

	C(S0=Y)	**D(S0=Y)**	**FL(S0=Y)**	**INP(S0=Y)**	**CP (S0=Y)**
Q (S0=Y)	67.64%	90.20%	78.57%	54.87%	64.49%
General**(S0=Y)**	53.19%	82.90%	77.98%	55.45%	48.98%
Difference	14.45%	7.30%	0.59%	-0.58%	15.51%

3) Variable FL in model I:

If the company has flexibility competitive advantage together with the innovation activity in model I, we have:

Table 4.29 CIA if FL=better

Node Name	State 0	State 1
C	Yes	No
	0.5244	0.4756
CP	Yes	No
	0.5464	0.4536
D	Yes	No
	0.8669	0.1331
FL	Yes	No
	1.0000	0.0000
INP	Yes	No
	0.5810	0.4190
Q	Yes	No
	0.5057	0.4943

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.29 and Table 4.6 can be shown in the following table:

Table 4.29.1 Differences of Impact if FL= better compared with General view

	C(S0=Y)	**D(S0=Y)**	**Q(S0=Y)**	**INP(S0=Y)**	**CP (S0=Y)**
FL (S0=Y)	52.44%	86.69%	50.57%	58.10%	54.64%
General**(S0=Y)**	53.19%	82.90%	50.19%	55.45%	48.98%
Difference	-0.75%	3.79%	0.38%	2.65%	5.66%

4) Variable D in model I

If the company has dependability competitive advantage together with the innovation activity in model I, then:

Table 4.30 CIA if D=better

Node Name	State 0	State 1
C	Yes	No
	0.5456	0.4544
CP	Yes	No
	0.4623	0.5377
D	Yes	No
	1.0000	0.0000
FL	Yes	No
	0.8154	0.1846
INP	Yes	No
	0.5460	0.4540
Q	Yes	No
	0.5461	0.4539

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.30 and Table 4.6 can be shown in the following table:

Table 4.30.1 Differences of Impact if D= better compared with General view

	C(S0=Y)	**FL(S0=Y)**	**Q(S0=Y)**	**INP(S0=Y)**	**CP (S0=Y)**
D (S0=Y)	54.56%	81.54%	54.61%	54.60%	46.23%
General**(S0=Y)**	53.19%	77.98%	50.19%	55.45%	48.98%
Difference	1.37%	3.56%	4.42%	-0.85%	-2.75%

5) Variable INP in model I

If the company is focusing on innovation together with the innovation activity in model I, we have:

Table 4.31 CIA if INP=Yes

Node Name	State 0	State 1
C	Yes	No
	0.5441	0.4559
CP	Yes	No
	0.5155	0.4845
D	Yes	No
	0.8162	0.1838
FL	Yes	No
	0.8170	0.1830
INP	Yes	No
	1.0000	0.0000
Q	Yes	No
	0.4966	0.5034

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.31 and Table 4.6 can be shown in the following table:

Table 4.31.1 Differences of Impact if INP=Yes compared with General view

	C(S0=Y)	**FL(S0=Y)**	**Q(S0=Y)**	**D(S0=Y)**	**CP (S0=Y)**
INP (S0=Y)	54.41%	81.70%	49.66%	81.62%	51.55%
General**(S0=Y)**	53.19%	77.98%	50.19%	82.90%	48.98%
Difference	1.22%	3.72%	-0.53%	-1.28%	2.57%

6) Variable CP in model I:

If the company has better competitiveness performance together with the innovation activity in model I, the results are:

Table 4.32 CIA if CP=Good

Node Name	State 0	State 1
C	Yes	No
	0.5113	0.4887
CP	Yes	No
	1.0000	0.0000
D	Yes	No
	0.7829	0.2171
FL	Yes	No
	0.8705	0.1295
INP	Yes	No
	0.5840	0.4160
Q	Yes	No
	0.6612	0.3388

Table 4.6

Node Name	State 0	State 1
C	Yes	No
	0.5319	0.4681
CP	Yes	No
	0.4895	0.5105
D	Yes	No
	0.8290	0.1710
FL	Yes	No
	0.7798	0.2202
INP	Yes	No
	0.5545	0.4455
Q	Yes	No
	0.5019	0.4981

The comparison between Table 4.32 and Table 4.6 can be shown in the following table:

Table 4.32.1 Differences of Impact if CP=Good compared with General view

	C(S0=Y)	**FL(S0=Y)**	**Q(S0=Y)**	**D(S0=Y)**	**INP (S0=Y)**
CP (S0=Y)	51.13%	87.05%	66.12%	78.29%	58.40%
General**(S0=Y)**	53.19%	77.98%	50.19%	82.90%	55.45%
Difference	-2.06%	9.07%	15.93%	-4.61%	2.95%

4.3.3.1 Summary of the analysis results of model I

By combining the results from Tables 4.27.1, 4.28.1, 4.29.1, 4.30.1, 2.31.1 and 4.32.1, we can generate a Variable Value Table 4.33 of conditional Causal Independence Assessment of Competitive issues and Innovation.

Table 4.33 Variable Value of conditional Causal Independence Assessment of Competitive issues and Innovation

	C	Q	D	FL	INP	CP
C		13.63	2.13	-1.10	1.27	-1.93
Q	14.45		7.30	0.59	-0.58	15.51
D	1.37	4.42		3.56	-0.85	-2.75
FL	-0.75	0.38	3.79		2.65	5.66
INP	1.22	-0.53	-1.28	3.72		2.57
CP	-2.06	15.93	-4.61	9.07	2.95	

Currently, the importance of competitive issues and innovation for SMEs' competitiveness performance in Yangtze River Delta are ranked by: Q(15.93%) > FL(9.07%) > INP(2.95%) > C(-2.06%) > D(-4.61%).

In addition, the following conclusions can be drawn from Table 4.33:

1) If the enterprise is focusing on the innovation activity, this brings little positive improvement on Cost (1.22%), Flexibility (3.72%) and Competitiveness Performance (2.57%) and a little negative impact on Quality (-0.53%) and Dependability (-1.28%).

4.4 Factor Analysis

The summary statistics are showed in Table 4.34. There are a total of 36 SMEs covered in the factor analysis of quality management practices.

Table 4.34 Summary statistics

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
P1	36	0	36	1.000	3.000	1.694	0.577
P2	36	0	36	1.000	3.000	1.528	0.609
P3	36	0	36	1.000	6.000	2.250	1.052
P4	36	0	36	1.000	6.000	2.611	1.202
P5	36	0	36	1.000	6.000	2.556	1.027
P6	36	0	36	1.000	6.000	2.333	1.171
P7	36	0	36	1.000	5.000	2.000	0.793
P8	36	0	36	1.000	6.000	1.861	0.990

The mean scores of each quality principle factor:

P1 Customer Focus = 1.694 P2 Leadership = 1.528

P3 Involvement of people = 2.250 P4 Process approach = 2.611

P5 System approach to management = 2.556 P6 Continual improvement = 2.333

P7 Factual approach to decision making = 2.000

P8 Mutually beneficial supplier relations = 1.861

So, importance ranking of quality principle factor from very strong to very weak by the mean scores is: P2> P1> P8> P7> P3> P6> P5> P4.

According to the mean score, Customer Focus (P1) and Leadership (P2) are the best performance of quality management of the SMEs in Yangtze River Delta.

Table 4.35 Correlation matrix

Variables	P1	P2	P3	P4	P5	P6	P7	P8
P1	**1**	**0.391**	-0.012	-0.176	-0.139	-0.226	0.187	-0.026
P2		**1**	0.323	0.093	0.203	-0.013	**0.474**	0.267
P3			**1**	0.282	-0.132	**0.487**	0.103	**0.693**
P4				**1**	**0.435**	0.257	0.030	**0.458**
P5					**1**	-0.206	0.105	-0.034
P6						**1**	**0.369**	**0.509**
P7							**1**	0.073
P8								**1**

A correlation matrix is normally used to initially screen for clustering between sets of variables. A correlation coefficient of >0.90 suggests there is clear clustering present. In the event of a presence of redundant (highly correlated) variables, they can be replaced with a smaller number of uncorrelated variables (Kakkar and Narag 2007).

According to Table 4.35, the highest correlation coefficient of P1 correlates with the P2 (0.39); the highest correlation coefficient of P2 correlates with the P7 (0.474); the highest correlation coefficient of P3 correlates with the P6 (0.487) and P8 (0.693); the highest correlation coefficient of P4 correlates with the P5 (0.435) and P8 (0.458); the highest correlation coefficient of P6 correlates with the P7 (0.369) and P8 (0.509).

Principal component analysis (PCA) has been utilised to reduce the dimensionality and to assit the interpretation of the results of the survey. PCA uses an optimal linear

dimension reducing technique as it extracts the maximum of the variability of the original variables, and (as per section on correlation analysis above) they are uncorrelated. Eigenvalues were used to extract the number of principal components for this study.

Table 4.36 Eigenvalues

	F1	F2	F3	F4	F5	F6	F7	F8
Eigen value	2.571	1.659	1.454	0.992	0.555	0.296	0.272	0.200
Variability (%)	32.142	20.738	18.179	12.402	6.936	3.698	3.401	2.505
Cumulative %	32.142	52.879	71.058	83.460	90.396	94.094	97.495	100.000

Eigenvalues illustrate the variance on the new factors that are successively extracted by PCA. The analysis also provided the proportion of total variance in all the variables accounted for by each factor. It is evident from the data that the Eigenvalues decrease quickly from the first value. The first component accounts for 32.142% of the variance of the original eight factors, but subsequent components account for much less. According to Kaiser (1960), only factors with Eigenvalues >1.0 will be retained. Thus, using the Eigenvalue selection for this study, it can be assumed that only three factors will be retained. As the Table 4.36 showed, they are F1 (2.571), F2 (1.659) and F3 (1.454). The Eigenvalue (Blue) and Cumulative variability (Red) by the Scree plot is showed as below (Figure 4.14).

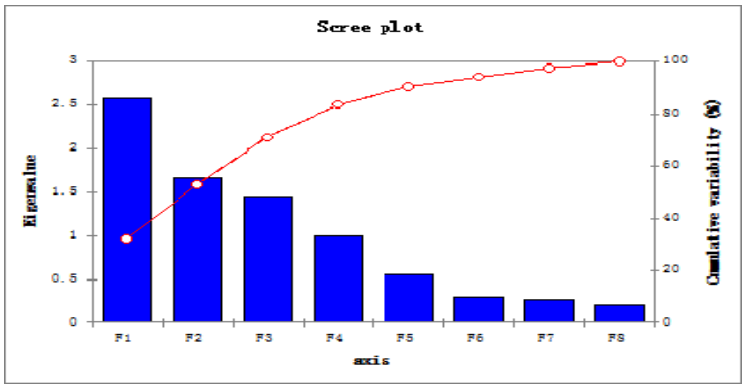


Figure 4.14 Scree plot

According to the analysis of Eigenvalues, two or three factors can be retained in Table 4.37 and Table 4.38.

Table 4.37 Factor pattern (No. of factor=2)

	F1	F2	Initial communality	Final communality	Specific variance
P1	-0.026	**-0.764**	1.000	0.584	0.416
P2	0.463	**-0.747**	1.000	0.772	0.228
P3	**0.809**	0.082	1.000	0.661	0.339
P4	**0.564**	0.274	1.000	0.393	0.607
P5	0.067	**-0.092**	1.000	0.013	0.987
P6	**0.704**	0.285	1.000	0.578	0.422
P7	0.409	**-0.565**	1.000	0.487	0.513
P8	**0.846**	0.167	1.000	0.743	0.257

Table 4.38 Factor pattern (No. of factor=3)

	F1	F2	F3	Initial communality	Final communality	Specific variance
P1	-0.026	**-0.764**	0.214	1.000	0.629	0.371
P2	0.463	**-0.747**	-0.156	1.000	0.796	0.204
P3	**0.809**	0.082	0.237	1.000	0.717	0.283
P4	0.564	0.274	**-0.600**	1.000	0.753	0.247
P5	0.067	-0.092	**-0.929**	1.000	0.875	0.125
P6	**0.704**	0.285	0.316	1.000	0.678	0.322
P7	0.409	**-0.565**	-0.006	1.000	0.487	0.513
P8	**0.846**	0.167	0.077	1.000	0.749	0.251

Values in bold correspond for each variable to the factor for which the cosine-squared is the largest. Thus, based on Table 4.36 quality management principles can be compressed into two or three main factors as Table 4.39 and Table 4.40 showed:

Table 4.39 QM principles compressed into two main factors

Factor 1	Factor 2
P3, P4, P6, P8	P1, P2, P5, P7
P3: Involvement of people P4: Process approach P6: Continual improvement P8: Mutually beneficial supplier relations	P1: Customer Focus P2: Leadership P5: System approach to management P7: Factual approach to decision making

Table 4.40 QM principles compressed into three main factors

Factor 1	Factor 2	Factor 3
P3, P6, P8	P1, P2, P7	P4, P5
P3: Involvement of people P6: Continual improvement P8: Mutually beneficial supplier relations	P1: Customer Focus P2: Leadership P7: Factual approach to decision making	P4: Process approach P5: System approach to management

By a process of rotation, a clear pattern of loadings is found, which is clearly showed by high and low loadings for Variables. The intention of this analysis is to illustrate the common loading of factors, where they did not load together, and to understand the reasons for it. Figure 4.15 illustrates the loading of all the variables against the various factors. The factor loadings (or component loadings in PCA) are the correlation coefficients between the variables (i.e. rows) and factors (i.e. columns).

Factor loadings indicate how much each factor can explain a variable. Loadings above 0.6 are usually considered “high” and those below 0.4 are “low” (Kakkar and Narag, 2007).

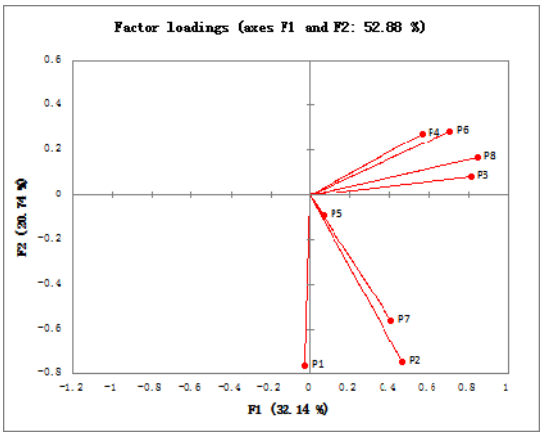


Figure 4.15 The factor loading (Factor=2)

Thus, the results in Figure 4.15 have shown:
P3, P4, P6 and P8 are considered “high” of F1 (i.e. well explained by F1), “low” of F2.
P1, P2 and P7 are considered “high” of F2; P2 and P7 are considered “middle” of F1; P1 is considered very “low” of F1; P5 is considered “low” of both F1 and F2

Finally, Figure 4.16 showed each individual observation located by factor scores (Number of Factor=2).

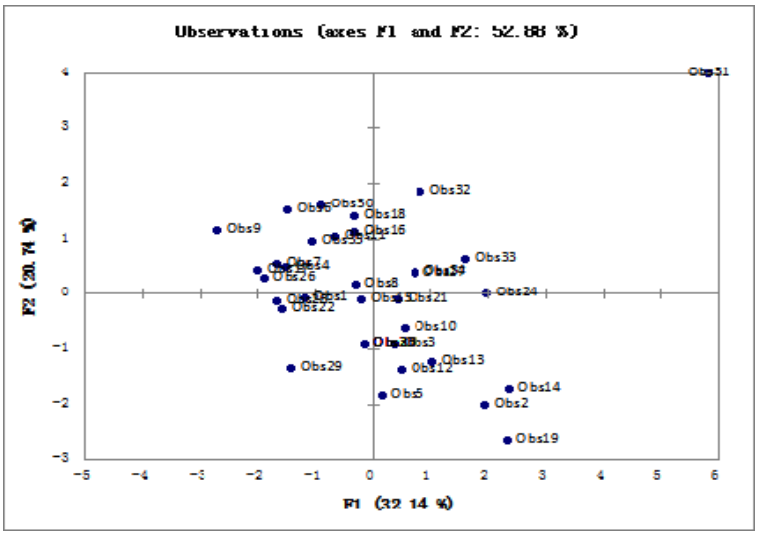


Figure 4.16 Factor loading of each observation

4.5 Summary

This chapter analyzed and presented the results and discussions concerning all 36 small and medium manufacturing enterprises, including quantitative and qualitative analyses. The first part is the quantitative statistics about the basic background information, resource and competitive issues. The second part of results is mainly the outcomes from the analyses of BBNs by the general views, “what-if” analyses, and Conditional Independent Assessment. The final part of results mainly comes from factor analysis of quality management practices, including summary statistics, correlation matrix, Eigenvalues and factor pattern.

Next chapter will focus on the findings, the hypothesis test and further discussions. Firstly, the findings will mainly be derived from the data analysis of BBNs by the general views and Conditional Independent Assessments from this chapter. Secondly, hypotheses will be tested if they are supported or not. Finally, the further discussions of the finding will be presented.

Chapter 5 Findings, Hypotheses Results and Discussions

5.1 Findings

According to the analyses using BBNs and quality management factor analysis, this research has concluded nine major findings about current general conditions and importance of resources, competitive issues and barriers to innovations for improving the competitiveness performance of SMEs in Yangtze River Delta.

Finding I (Table 4.4):

General resource based views of SMEs in Yangtze River Delta: good condition of resource has a ranking displayed by Organizational resource (63.90%)> Physical resource (63.86%)> Informational resource (41.61%)> Human resource (41.58%)> Financial resource (36.10%).

Finding II (Table 4.4):

General competitive issues: good condition of competitive issues has a ranking display by Dependability (80.11%)> Flexibility (72.78%)> Cost (55.68%)> Quality (47.52%). General good competitiveness performance is 46.60%.

Finding III (Table 4.5):

General barriers of innovation views: the main barriers of innovation has a ranking display by LFC (51.98%)> LTE (48.96%)> LRI (24.44%)> WPAP (23.39%)> LTI (22.10%)> LGS (16.70%)> LSA (10.46%). General Innovation performance is 55.45% (the probability of the enterprise is focusing on the innovation activities currently).

Finding IV (Table 4.6):

General competitive issues if involved into innovation performance (Table 4.6): good condition of competitive issues has a ranking display by Dependability (82.90%) > Flexibility (77.98%) > Innovation (55.45%) > Cost (53.19%) > Quality (50.19%). General good competitiveness performance is 48.95%. Compared with Finding II, the general competitive issues together with innovation generally give better results.

Finding V (Table 4.17):

Currently the importance of SMEs' resources related competitiveness performance (CP) in Yangtze River Delta is ranked by: Physical resource (7.05%) > Informational resource (4.04%)> Human resource (3.36%) > Organizational resource (0.11%) > Financial resource (-2.43%).

Finding VI (Table 4.17):

Currently the importance of SMEs' competitive issues related competitiveness performance in Yangtze River Delta is ranked by: Quality (15.78%) > Flexibility (8.11%) > Cost (-0.15%) > Dependability (-2.85%).

Finding VII (Table 4.26):

Currently, the harmful and serious barriers of SMEs' Innovation in Yangtze River Delta is ranked by: LTE (11.77%) > LRI (4.15%) > LFC (3.42%) > WPAP (2.36%) > LGS (2.29%) > LSA (1.78%) > LTI (-8.26%).

Finding VIII (Table 4.33):

Currently, the importance of competitive issues with innovation activity for SMEs' competitiveness performance in Yangtze River Delta is ranked by: Quality (15.93%) > Flexibility (9.07%) > Innovation Performance (2.95%) > Cost (-2.06%) > Dependability (-4.61%).

Finding IX (Table 4.39)

Currently, the quality management practices by the SMEs in Yangtze River Delta can be grouped into two factors, 1) Customer Focus, Leadership, System approach to management and Factual approach to decision making; 2) Involvement of people, Process approach, Continual improvement and Mutually beneficial supplier relations.

5.2 Hypotheses Results

According to Finding I, this research found common general advantages and disadvantages of resources from SMEs in Yangtze River Delta which support the findings from the Günerergin *et al.* (2012) empirical research of SMEs in Turkish.

H1: The condition of Financial resource in Yangtze River Delta SMEs is worse than other conditions of resources. The condition of Organizational resource in Yangtze River Delta SMEs is better than other conditions of resources. **Supported**

According to Finding VI and VIII, this research found and ranked the importance of competitive issues of SMEs in Yangtze River Delta which support the findings from Li *et al.* (2008) in their empirical research of SMEs in China.

H2: Quality is the most important competitive issue to improve the competitiveness performance of SMEs in Yangtze River Delta. **Supported**

According to Finding VII, this research found and ranked the harmful and serious barriers of SMEs' Innovation real activity in Yangtze River Delta which supports the findings from Xie *et al.* (2010) in their empirical research of SMEs in Shanghai.

H3: The most serious barrier of innovation is Lack of technical/research experts in real innovation activities of SMEs in Yangtze River Delta. **Supported**

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5.3 Discussions

This research has mainly analyzed the competitiveness performance of SMEs through resource based views, competitive issues and innovation related the barriers. Accordingly, discussions here can also be grouped in three categories. In addition, the first eight research findings can be divided into two parts, which are the general condition performance and importance for competitiveness performance.

5.3.1 Discussions of Resource based on Findings

According to Finding I, the SMEs have the best condition in Organizational (63.90%) and Physical (63.86%) resource in general views. However, Organizational resource is an almost ignored variable for improving competitiveness after comparison with Finding V. Physical resource is the most important variable for improving the competitiveness. Financial resource is the weakest variable in both general views and importance impacts.

5.3.2 Discussions of Competitive Issues based on Findings

According to Finding II, Dependability has the best performance in competitive issues in general view. However, Dependability is the least important variable for improving competitiveness in Finding VI. Particularly, Quality has the lowest weighting of performance in the competitive issues in general views. However, Finding VI showed Quality is the most important competitive issue for improving competiveness.

5.3.3 Discussions of Innovation based on Findings

According to Finding III, Lack of finance capital is the first serious barrier for innovation in general view. However, when the SMEs are really focusing on the innovation activities, Lack of technical expert is the first serious barrier for innovation in Finding VII.

5.4 Summary

This chapter summarized the first eight major findings based the outcomes from the BBNs and ninth finding based on the outcomes from the factor analysis of quality management practices. Based on the findings, the three research hypotheses have been tested and they are all supported by the results. Finally, the research findings are further discussed through main differences and similarities between general views and importance for competitiveness.

Next chapter will focus on the recommendations for those who are willing to improve the competitiveness performance of SMEs in Yangtze River Delta, such as the entrepreneurs and local government. These suggestions will mainly be argued based on the findings and decision process theory.

Chapter 6 Recommendations and Contributions to Knowledge

6.1 Recommendations

Competitive issues of cost, quality, dependability and flexibility are important areas for development and improvement of competitiveness performance. The distribution of the resources can improve the capacity and performance of competitiveness. The innovation activity can directly and potentially improve the performance of competitive issues, and general competitiveness can be achieved by avoiding and overcoming the barriers. As the SMEs have less resource than large enterprises, they have to focus on the efficiency and effectiveness. Which factor or variable is the most impact and how to achieve the better efficiency and effectiveness is strategically important for the SMEs.

There is no doubt that the Quality issue is the most positive, efficiency and effectiveness variable for improving the competitiveness performance of SMEs in Yangtze River Delta according to the results of analysis. However, the other variables and their impacts also are important and dynamic, as far as the competitiveness is concerned. The research aims to provide the generally important variables for improving enterprises' competitiveness. Thus, the research will provide three tables of impacts to help the entrepreneurs make more efficient and effective decisions.

According to Tables 4.17, 4.26 and 4.33, this research has generated correspondent CIA impact Tables 6.1, 6.2 and 6.3 for the decision maker to find better efficiency and effective solution to improve the competitiveness and innovation performance.

Table 6.1 CIA Impacts of Each Variable in Model 1

	F	H	O	I	P	C	Q	FL	D	CP
F		---		-	-			--		-
H	---		---	---		+	++	+		+
O		--		+		-	-			
I	-	---	+			-	-	+++	+	+
P	-					+	++	+++	+	++
C		+	-		+		+++		+	
Q		+	-	-	++	+++		+	+	++
FL	-	+		++	+++		+		++	++
D					+	+	++	++		-
CP	-	+		+	++		+++	+++	-	

"-" Stand for negative impact; "-": 1-5%; "--":5-10%; "---": more than 10%

"+" Stand for the positive impact; "+": 1-5%; "++":5-10%; "+++": more than 10%

The blank means an impact of less than 1%.

Table 6.2 CIA Impacts of Each Variable in Model 2

	LGS	LFC	LTI	LTE	LSA	WPAP	LRI	INP
LGS		+++	++	++	+++	++	++	++
LFC	+++			-	+	-	--	+
LTI	++			+	++	+	---	---
LTE	+	-	+		+	++	+	+++
LSA	+++	+++	+++	++		+++	+++	++
WPAP	++	-	+	+++	+++		+++	++
LRI	++	---	--	+	+++	+++		++
INP	+	+	--	+++	+	+	+	

"-" Stand for the probability of barrier decreased: "-": 1-5%; "--":5-10%; "---": more than 10%

"+" Stand for the probability of barrier increased: "+": 1-5%; "++":5-10%; "+++": more than 10%

The blank means an impact of less than 1%.

Table 6.3 CIA Impact of Each Variable in Model I

	C	Q	D	FL	INP	CP
C		+++	+	-	+	-
Q	+++		++			+++
D	+	+		+		-
FL			+		+	++
INP	+		-	+		+
CP	-	+++	-	++	+	

"-" Stand for negative impact; "-": 1-5%; "--":5-10%; "---": more than 10%

"+" Stand for the positive impact; "+": 1-5%; "++":5-10%; "+++": more than 10%

The blank means an impact of less than 1%.

The decision making process can be presented in Figure 6.1 through study of Baker et al. (2001).

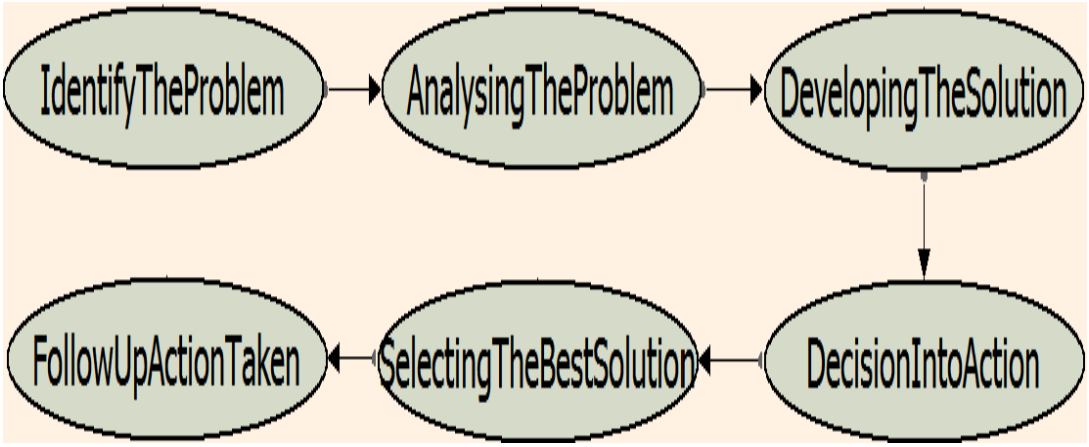

Figure 6.1 General Decision Making Process

Distribution of the resources is important for the organizations, especially the SMEs. Inefficient and ineffective distribution of resource means higher risks for the enterprise, especially SMEs because they have limited resource than large ones. Figure 6.1 showed the process of decision making and Table 6.1 presents a very clear

and simple positive and negative impact diagram for current decision makers who are willing to improve the competitiveness of SMEs such as the entrepreneurs, local government, and local social organizations in Yangtze River Delta.

Table 6.1 can help the decision maker to

1) More easily identify the main condition of resources and competitive issues;

2) More efficiently analyze the problems;

3) Find the best and more effective solutions.

The basic recommendations for decision maker who may be entrepreneurs of SMEs or Local Yangtze River Delta Government are:

1) To improve the current competitiveness of SME, there are two best positive variables which are Quality (+++) and Flexibility (+++) as Table 4.17 shows.

2) Local government can encourage and support the entrepreneurs to attend the quality management training and reduce the unnecessary and over elaborated formalities for the SMEs, giving them more flexibility.

Similarly, Table 6.2 and 6.3 also can help the decision maker. Table 6.2 presents a very clear and simple impact diagram for current barriers of innovation to help decision makers such as the entrepreneurs, local government, and social organizations who are willing to improve the innovation performance of SMEs in Yangtze River Delta.

Table 6.2 makes it possible for the decision maker:

1) To more easily identify the main barrier of innovation in real action;

2) To more efficiently analyze the barrier;

3) To find the best and effective solutions to avoid the barriers.

The basic recommendations here for decision maker who is entrepreneurs of SMEs in Yangtze River Delta are:

1)The main barrier is Lack of technical/research expert for innovation of the SMEs.

2)To more efficiently and effectively avoid or solve the barrier, the SMEs should focus on finding the research expert required by the enterprise.

If the decision makers who have more resource or capacity such as the local government, these decision makers have to focus on the more impact barriers such as the LSA which is one of the serious barrier. It depends on how much capacity and resource of the decision maker can control or input. For the entrepreneurs of SMEs, more effective and efficient solution of improving the performance of innovation is focusing on the LTE.

In particular, the entrepreneur is always the pilot of the enterprise, especially in SMEs. The personal background, knowledge and experience play significant roles in decision making. As Question 38 has shown, when entrepreneurs in SMEs make a big decision, they always play a dictator role and merely consider personal health, macroeconomic environment and government, and only two persons would consult and discuss with their employees or other persons. A high proportion of the responders started the enterprises around 1995-2005. This period was the fastest developing or changing time in China, and they have made big contributions to the country. These entrepreneurs were the first generation of private business owners in China. Their experiences and knowledge are very different from those of the younger generations who are the main labour force now. This difference or gap will significantly affect the decision making, communication, and management, resource distribution, competitive

factors, the innovation and competitiveness performance. The huge gap or difference of perspectives is the big challenge for the entrepreneurs.

During last three decades the products made in China have rapidly occupied the global markets due to their huge cost advantages. With more than 30 years' high speed growth, the SMEs in the good economic areas such as the Yangtze River Delta are challenged in a similar way to the previous one in which they have emerged as the winner due to their cost advantage. The entrepreneurs now have to throw the old rust weapon to find the new sword as advantage like quality or innovations for the enterprises.

Whilst the SMEs are the driving forces in this future development, there are some serious barriers which the SMEs cannot handle with limited resources and capacities, To overcome these barriers, SMEs have to seek assistance externally from those who have huge capacities and resources such as the government and banks, and these assistances should also implement favorable conditions, policies and environment to encourage, facilitate and support SMEs in their continual improvement of quality management, innovation and business competitiveness.

Fortunately, Chinese new leaders have implemented SMEs Tax support policies, small meager-profit businesses have been the target to be supported by the government's tax policies. More than 1.20 million small enterprises are now enjoying preferential income tax policies for small meager-profit businesses. Approved by the State Council, the Ministry of Finance (MOF) and State Administration of Taxation (SAT) issued a circular in 2013, stating that the small-sized enterprises with monthly sales below RMB 20,000 (around 3200 US dollar) is exempted from paying VAT and

business tax (State Administration of Taxation of The people's Republic of China, 2014).

6.2 Contributions to Knowledge

The research has led to a number of contributions to the knowledge which can be summarized as follows:

1) Through study of resource-based views, competitive issues and innovation performance by barriers, this thesis has established a framework of competitiveness performance of SMEs. The framework helps simply understand how the enterprises perform their competition by the variables from resources, competitive issues and innovation. The framework also provides a base to build the Bayesian Belief Network modelling.

2) Dynamical models of the SMEs' competitiveness performance (Model I) by Bayesian Belief Networks have been developed. In order to evaluate and assess the variables of Model I more clearly, the Model I has been split into sub-model 1 and sub-model 2. The analyses of these models have established various variables on the probability to find the general positive and negative impact on SMEs' competitiveness performance.

3) Based on the Bayesian Belief Network models, detailed "what if" analyses have been performed to evaluate the efficiency and importance of various strategies on the improvement of SMEs' business competitiveness performance. A decision Table has further been developed to assist the entrepreneurs of SMEs and social organizations in their decision making.

4) Since quality management plays a central role in the SMEs' competitiveness performance, factor analysis has been performed to characterize the use of quality management strategies in the SMEs in the Yangtze River Delta, based on the eight quality management principles. The analyses have identified the key independent factors explaining the quality management practices in these SMEs and have further shown their current performance scores and the direction of improvements.

6.3 Summary

This chapter has made a series of recommendations for the entrepreneurs and local government to achieve possible more effective and efficient performance, based on the variables impact Table 4.17nd decision make process to improve the competitiveness performance of SMEs in Yangtze River Delta. Moreover, the research has summarized the main contributions of the research.

Next chapter will conclude what research has found and learned and present the future extent work to enrich the research BBNs' model better.

Chapter 7 Conclusions and Future work

7.1 Conclusions

SMEs in Yangtze River Delta have been significant contributor to economic growth in China. Whilst they share many characteristics similar to other SMEs in other regions of China, e.g. limited human, financial, informational and organizational resources compared with large companies, the average costs of Yangtze River Delta such as the labour cost are higher than enterprises in middle and west of China. On the other hand, the enterprises in Yangtze River Delta tend to have benefited more from infrastructure, transportation and China's open door policy.

This thesis has focused on the current and future potential competitiveness performance of SMEs in Yangtze River Delta, and examined the competitive issues, using resource based view, and innovation performance by questionnaire survey and interviews. The data were further modeled and studied using Bayesian Belief Networks and factor analysis of quality management practices.

Specifically, this research have found and learned:

1) According to the analysis of the current main background in Yangtze River Delta and China in the broader context of the world business environment, the research area is located in one of the fastest developing zone in China as a world manufacturing base with the well developed infrastructures. On one hand, SMEs are growing faster and have benefited a lot in this region. On the other hand, they also face the increasing challenges such as rising labour cost. Thus, how to improve the competitiveness of SMEs has very significant importance and impacts.

2) According to this study, the research has learned and understood what the enterprises' competitiveness is, mainly through resource based-views, competitive issues and innovations related barriers. Meanwhile, research also found the specifics and differences between SMEs and Large enterprises. Moreover, the research has learned the key important variables for the entrepreneurs of the SMEs to gain the complete information for general competitiveness.

3) Through further identification and study of resource based-views, competitiveness issues and barriers of innovation, we found these elements can be defined as variables of competitiveness performance. Thus, in order to analyze the dynamic and uncertain variables, the research found the Bayesian Belief Networks particularly suitable this study as well as many other empirical studies. Based on the established method and procedure, the research has built BBN models to determine the key variables and identify the effective and efficient solutions for improving the competitiveness performance, with the eight main research findings derived from the outputs of BBNs' assessments.

4) Based on the outcomes of BBNs, the research found the Quality competitive issue is the most important variable for improving the competitiveness in SMEs. Thus, Quality management practices in the SMEs have been analyzed by factor analysis,, with the ninth research finding identified for the SMEs in Yangtze River Delta.

5) According to the research findings, the research has formulated variables' impact tables combined with decision make process to help the individual entrepreneur of SMEs and local government find the best effective and efficient solutions.

7.2 Future work

To extend the current studies and facilitate the actual implementations of the findings and strategies, the following tasks have been identified as the future research works:

1) To carry out further survey, targeting more SMEs and including the SMEs from other economic zones in China, and preferably also compared with one developed country, e.g. in the Europe.

2) To further improve Bayesian Belief Networks in terms of the number of variables and analysis.

3) To further compare the differences of different studies, i.e. orthogonal experiments, Bayesian belief networks and factor analysis.

4) To develop a more integrated framework to help SMEs for problem solving, maximizing the use of the limited resources, continual improvement of quality and the competitiveness performance of the SMEs in Yangtze River Delta.

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Appendix A Questionnaire (Translate from Chinese Questionnaire)

My name is Wenlong Chen, studying PhD Engineering Management at Brunel University London. I would like to invite any voluntary to compete this questionnaire below. Your participant is voluntary and you may withdraw at any stage. Your personal information will not be recorded throughout this survey. The questionnaire will be used for the sole purpose of my academic study. Thank you for your time and participation.

1.When did you start running this enterprise?

_____

2.How old are you?

A 20-30 B 31-40 C 41-50 D51-60 E 61+

3. What's your education level?

A primary B middle school

C high school D college E scholar

4. What was your previous occupation before you operate enterprise?

A manager section B marketing section C technical section

D others_____

5. How many employees are there in your enterprise?

A less than 10 B 11-50 C51-100 D101-200 E200+

6. What is the average age of your employees?

A 51+ B 41-50 C 31-40 D less than 30

7.As the entrepreneur, do you play more than one role (such as manager, marketing)?

YES NO

8. How do you employ staff?

A Recruiting graduates of colleges and universities

B Agent C Social career fair

D Traditional paper advertising E Internet

F People recommendation G Others

9. What's kind of human resource is your enterprise lack?

A Innovation B Management C Marketing D Researching

E Mature technical workers F Others

10. Are your staffs often trained?

A Y (frequently) B N (few)

11.How about do you spend on the training?

A very bad B bad C good D very good

12. What's the percentage of staff leaving per year?

A 0-5% B 5%-10% C 10%-20% D 20%+

13. What are the main reasons they left?

A Personal knowledge or skill cannot achieve you need

B Low salary

C The enterprise culture or regulations cannot be adapted

D Hard workload E Others

14. As the entrepreneur, have you attended the formal management training?

Y N

15. Where do you gain the financial resource?

A Bank B Self cash reserves

C Local government D Cooperation Partner

E Relatives and Friends F Others

16. What is the main financial problem you are facing?

A Low profit B Bad debt C No enough collateral D Others

17. Do you think Bank is the most significant issue you hope to gain financial resource support?

Y N

18. Generally, what is the situation in the list of resources? (please tick)

HUMAN	GOOD	BAD
FINANCIAL	GOOD	BAD
PHYSICAL	GOOD	BAD
INFORMATIONAL	GOOD	BAD
ORGANIZATIONAL	GOOD	BAD

19. Is the increasing cost significant problem for your enterprise?

Y N

20. In your experience, which costs increased fast?

A Material B Labour cost C Machines D Marketing

E Plant rent F Transportation cost G Customer service

H Energy cost I New product development J Others

21. Which ways do you apply to control and reduce the cost?

A Reduce the waste of inferior quality product

B Increase the workload

C Extent the life of the machine

D Change to cheap plant

E Change to less cost ways of marketing

F Reduce the training cost

G Reduce the new product development

H looking for low cost transportation channel

I Others

22.The seven producing wastes are argued widely, which kind of waste does your enterprise have?

A Defects B Waiting C Overproduction

D Transportation E Inventory G Motion F Processing

23.Is the quality significant issue for your enterprise?

Y N

24. Do you have any quality certification (such as ISO9001)?

Y N

25. Do you think the quality certification is important?

Y N

26. In your experience, which steps for you to control the quality?

A material purchasing B producing process

C finished product checking D packaging

E storage F transportation

G the producing machine I others

27. There are eight approved quality management principles, what is the condition of them? (please tick)

	Very good	Good	Normal	Weak	Very weak	No attention
A Customer focus						
B Leadership						
C Involvement of people						
D Process approach						
E System approach to management						
F Continual improvement						
G Factual approach to decision making						
H Mutually beneficial supplier relations						

28. Do you think the speed issue is important for the competitiveness of enterprise?

Y N

29. Do you think the flexibility of product is important to satisfy the customer need which related the competitiveness of enterprise?

Y N

30. Do you think the dependability of enterprise is important to the competitiveness?

Y N

31. How is the cost of your product compared with competitors?

Y better N worse

32. How is the quality of product compared with competitors?

Y better N worse

33.How is the speed compared with competitors?

Y better N worse

34. How is the flexibility compared with competitors?

Y better N worse

35. How is the dependability compared with competitors?

Y better N worse

36. Which barriers mainly affect innovation? (please tick)

A Lack of financial capital

B Lack of research expert

C Lack of research institutions

D Lack of social innovation atmosphere including culture and environment

E Lack of technical information

F Weak awareness of IPR protection

G Lack of the government support

37. In practice, are you focusing on innovation or are you going to innovate for improving the competitiveness of enterprise?

Y N

38. In future, which elements will be mainly considered when you make big decision and movement?

A Personal condition (health, age)

B Macro economy C Government policy

D Relatives' opinions E Employees' opinions

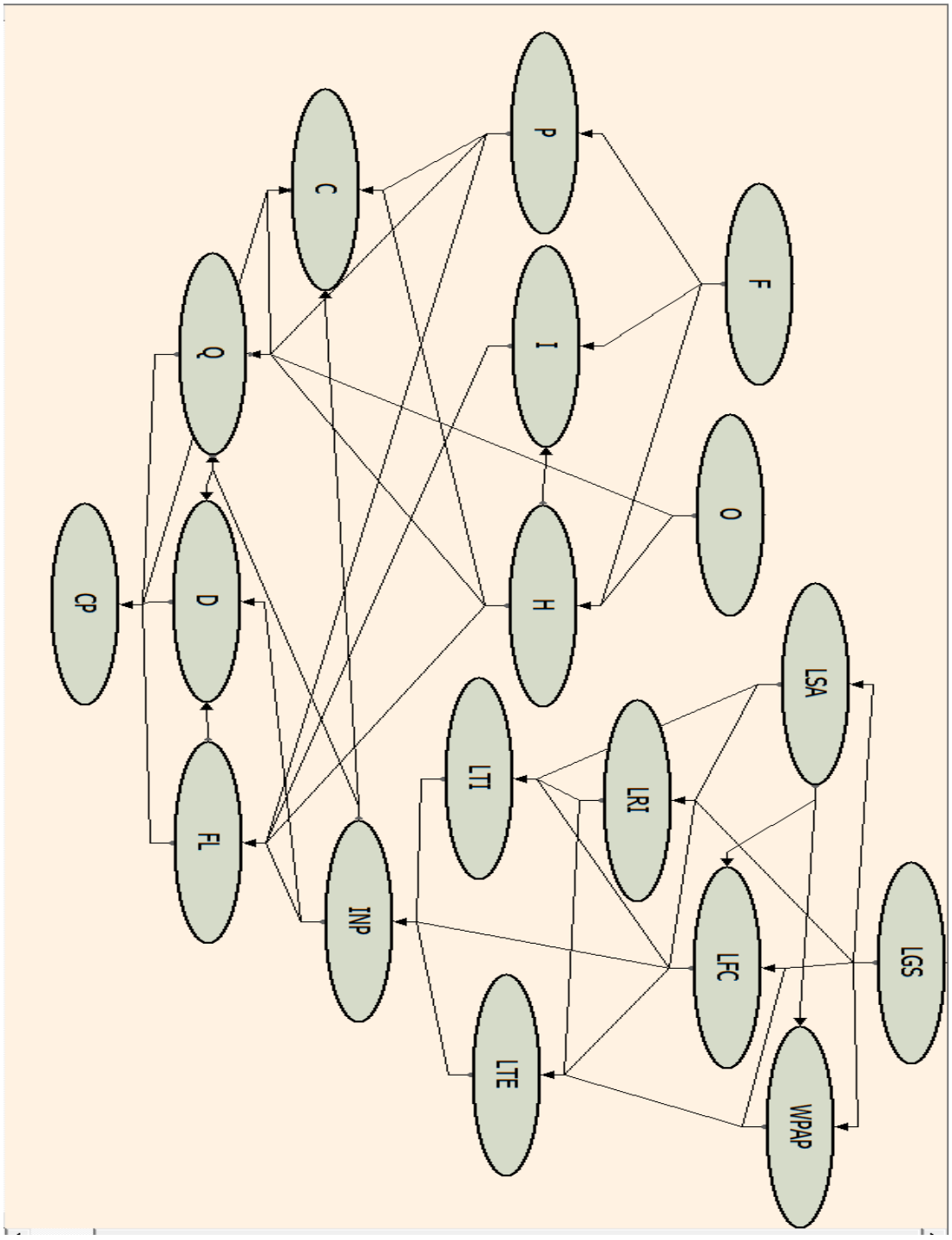
F Others

39.Generally, please make a score for the competitiveness of your enterprise? (1-10)

_____

THANK YOU VERY MUCH

Appendix B: Competitiveness Performance of BBN in model I



Appendix C: Design Orthogonal Experiment

In order to determine the most important factor influencing the SME competitiveness, several experiments were designed in the survey to study the impacts of various control factors. A control factor for a particular product or process is one that affects the output and is easy or less costly to control, e.g.

1) Design parameters that influence the performance.
2) Input variables can be controlled.
3) Included the purpose of determining their influence and control upon the most desirable performance.

DOE 1

In this experimental design, there are four main control variables/factors, which are condition of Human Resource (Q18), Cost (Q31), Quality (Q32) and Innovation performance (Q37) based on current competitiveness performance (Q39) of SMEs. See Table C.1

Table C.1 Representative of the Variables (H, C, Q, INP)

FACTOR	Description of variable	Level 0	Level 1
HUMAN	The condition of human resource	H0:good condition of human resource (Y)	H1:bad condition of human resource (N)
COST	The condition of cost issue	C0:have cost advantage (Y)	C1:no cost advantage (N)
QUALITY	the condition of the quality issue	Q0:have quality advantages (Y)	Q1:no quality advantage (N)
INP	the condition of innovation	INP0:focusing on innovation (Y)	INP1:no innovation activity (N)

L8 orthogonal array is used and the four factors are assigned to the array as follows

Table C.2:

Table C.2 L8 test (H, C, Q, INP, CP)

FACTOR	H	C	Q	INP	CP (mean)
1	0	0	0	0	8
2	0	0	0	1	7
3	0	1	1	0	5.5
4	0	1	1	1	7.5
5	1	0	1	0	7
6	1	0	1	1	7
7	1	1	0	0	8
8	1	1	0	1	8

Data analysis of DOE 1

To find the best level for variable H (human resource), we add the scores of competitiveness performance at H0 and compare with the sum of scores of competitiveness performance at H1.

From the first column for factor H:

H0 = 8 + 7 + 5.5 + 7.5 = 28 (meanH0=28/4=7)

H1 = 7 + 7 + 8 + 8 = 30 (mean H1=30/4=7.5)

From the second column for factor C:

C0 = 8 + 7 + 7 + 7 = 29 (mean C0=29/4=7.25)

C1 = 5.5 + 7.5 + 8 + 8 = 29 (mean C1=29/4=7.25)

From the third column for factor Q:

Q0= 8 + 7 + 8 + 8 = 31 (mean Q0=31/4=7.75)

Q1= 5.5 + 7.5 + 7 + 7 = 27 (mean Q1=27/4=6.75)

From the last column for factor INP:

INP0= 8 + 5.5 + 7 +8 =28.5 (mean INP0=28.5/4=7.125)

INP1= 7 + 7.5 + 7 + 8 = 29.5 (mean INP1=29.5/4=7.375)

Then we can get the effect differences and the solutions see Table C.3:

Table C.3 Results of Difference and Solution

Factor and level	Mean Value		Difference	Solution
H0 H1	7	7.5	0.5	H1
C0 C1	7.25	7.25	0	C0/C1
Q0 Q1	7.75	6.75	1	Q0
INP0 INP1	7.125	7.375	0.25	INP1

Results of DOE 1

According Table 4.33.3, we can conclude the following from the DOE results:

−The relative significance of the factors in descending order as follows: Q, H, INP and C.

−The optimum factor levels corresponding to the best competitiveness performance of SMEs for each variable are as follows: H1, CO/C1, Q0 and INP1.

This means that with regard to the current SMEs' competitiveness performance in Yangtze River Delta, Quality is the most significant factor; Human resource is the second important factors; Innovation performance is the third factor which has not played an important role; Cost issue is the last one which is comparatively insignificant.

Moreover, the SMEs with the best competitiveness performance tend to be lack of human resource, have quality competitive advantage, and not focusing on the innovation activities. On the other hand, the SMEs with weak competitiveness performance are looking for the innovation in the hope to improve their competitive advantages. There is no difference in cost issues. The fastest increasing cost factors are material and labour cost which every local enterprise has to accept.

DOE 2

This experiment studied the effects of another four main control variables/factors, including Frequency of training (Q10), Cost of training (Q11), Training of management (Q14) and Quality certification (Q24) based on current reliable performance of quality (Q27) in SMEs (See Table C.4).

Table C.4 Representatives of the Variables

FACTOR	Level 0	Level 1
Frequency of training	rarely	often
Cost of training	More than 3% of revenue	Less than 3% of revenue
Training of management	The entrepreneur was not trained formal management course	The entrepreneur was trained formal management course
Quality certification	Have quality certification	No quality certification

Table C.5 L8 Test of Good Quality Performance

FACTOR	Frequency of training	Cost of training	Training of management	Quality certification	Good Quality performance
1	0	0	0	0	36
2	0	0	1	1	24.5
3	0	1	1	1	14
4	0	1	0	0	18
5	1	0	0	1	25
6	1	0	1	0	29
7	1	1	1	0	32.2
8	1	1	0	1	24.7

Data analysis of DOE2

To find the best level for variable Frequency of training as Table C.5 showed, we add the scores of quality performance at Level 0 of Frequency of training and compare with the sum of scores of quality performance at Level 1 of Frequency of training.

From the first column from the Frequency of training:

Frequency of training (0) = 92.5 (mean=23.125)

Frequency of training (1) = 110.9 (mean=27.725)

From the second column from the Cost of training:

Cost of training (0) = 114.5 (mean =28.625)

Cost of training (1) = 88.9(mean=22.225)

From the third column from the Training of Management:

Training of management (0) = 103.7(mean=25.925)

Training of management (1) = 99.7 (mean=24.925)

From the fourth column from the Quality certification:

Quality certification (0) = 115.2 (mean=28.8)

Quality certification (1) = 88.2 (mean=22.05)

Then we can get the differences and solutions:

Table C.6 Results of differences and solutions

Factor and level	Result		Difference	Solution
Frequency of training(0,1)	23.125	27.725	4.6	1
Cost of training(0,1)	28.625	22.225	6.4	0
Training of management(0,1)	25.925	24.925	1	0
Quality certification(0,1)	28.8	22.05	6.75	0

Result of DOE 2

The results of the DOE 2 are shown Table C.6:

−The relative significance of the factors in descending order is: Quality certification, Cost of training, Frequency of training, Training of Management.

−The optimum levels corresponding to the best quality performance of SMEs for each variable are as follows: Quality certification (0), Cost of training (0), Frequency of training (1) and Training of management (0).

Followed by Table C.6, for the best quality performance, the most significant factor is the enterprise have the quality certification, then the second significant factor is that enterprise spend more than 3% of revenue per year on training, then the employees are frequency of training and the least important issue is entrepreneur received the formal management training course.