Application of Total Innovation Management to Leverage Innovation Capabilities of Chinese Small & Medium Sized Enterprises

Final Technical Report

Submitted to
International Development Research Centre (IDRC)

by
Research Center for Innovation and Development (RCID)

Date of Submission: March, 2010
Grant No.: 104044-001

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Summary

In 2006, China government enforced the innovation strategy on indigenous innovation and innovative country & enterprise. In 2007, the IDRC project, “Application of Total Innovation Management to Leverage Innovation Capabilities of Chinese Small & Medium Sized Enterprises”, was undertaken by Professor XU, who is the director of Research Center of Innovation and Development (RCID), Zhejiang University. As known to all, Zhejiang Province is one of the regions with most plentiful and most active SMEs. The number of SMEs has amounted to about 99.8% of total number of enterprises, which offers the research with rich study resources and makes this study be of great importance. What’s more, the research begun to be conducted, not long after, the sub-prime crisis happened. Sub-prime crisis spreading made SMEs be faced to a harsh surviving environment. Consequently, the importance of innovation has gained high concerning from both academy and practice. Meanwhile, it provided a specific research context for studying SMEs’ innovation, and good opportunities for applying Total Innovation Management (TIM) theory to SMEs as well. Therefore, the IDRC project being conducted by Professor XU with his team of Zhejiang University has enjoyed the situation of the right place, right time, and right people.

The overarching goal of IDRC project is to leverage the innovative capabilities and the competitiveness of SMEs via TIM, and thereby contribute to the social and economical development of Zhejiang and other provinces in China. Of course, the research outcomes are also expected to be useful to instruct SMEs of all the developing countries to develop, since SMEs are the important components in any national economy. By constructing a theoretical and practical TIM paradigm for SMEs, the project will contribute towards the national policy on innovative firms. It is also expected to increase the capability for employment within SMEs, and thereby contribute towards poverty & unemployment reduction and wealth creation.

In order to explore the application pattern of TIM to leverage innovation capabilities of Chinese Small & Medium Sized Enterprises (SMEs), various methods such as a large-scale questionnaire survey and in-depth case studies have been adopted.

Based on discussion with government, enterprises and universities, a questionnaire was developed. 32 enterprises were selected for pilot study. A total of 2068 refined questionnaires were disseminated to SMEs in Zhejiang Province and Shandong Province. 741 questionnaires were received, with the response rate of 35.83%. 401 valid ones were left.

With the supports of governmental agencies of Zhejiang Province, 44 enterprises were selected for in-depth case studies. And the industries cover machinery manufacturing, textiles, electronics, software and services.

A prominent feature of our research method is the cooperation among government, enterprises and university. The government officials who involved (especially Bureau of SMEs, Economic and Information Commission in Zhejiang Province) in our project help us to distribute and collect questionnaires, which was conducive to improve the quality and credibility of data. Enterprises cooperate with us to carry out in-depth case studies, while Zhejiang University of Technology and Fuzhou University provided us with opportunities for academic exchange.

After two and a half years’ study, the research team has achieved some important theoretical and practical outcomes. Simultaneously, by researching activities, the IDRC team members have

been trained and improved. Therefore, IDRC project research has important implications, whether the research itself or the research outcomes. The implications can be summarized as follows.

Firstly, the research has achieved theoretical outcomes, which makes the advances in innovation management theories. The main theoretical outcomes include follows:

(1) The paradigm of TIM applied to SMEs has been explored, which makes total innovation management (TIM) theory improved. From practical perspective, the TIM-SMEs framework may give SMEs the guidelines to implement innovative activities.

(2) The questionnaire for measuring total innovation capabilities (TIC) have been developed and played critical roles in our research. By this questionnaire, the status of TIC in SMEs has been surveyed in Zhejiang Province and Shandong Province. The questionnaire will provide great reference to measure the status of SMEs' total innovation capabilities.

(3) The dimensions of TIC have been identified. And the rules of TIC developing in SMEs have been studied and concluded according to different stages, different level of performance and different scales. Distribution of dimensions of TIC in SMEs will help SMEs diagnose their strength and weakness in TIC. And the rules of TIC developing will guide them to develop or build up their innovative capabilities according to their characteristics.

Secondly, both mechanisms and strategic pathways of leveraging innovative capabilities in SMEs via TIM have been explored, which have practical implications for SMEs to engage in innovative activities. The primary steps identified in the strategic pathway will instruct an SME to implement innovations.

Thirdly, the research outcomes have helped to broaden the horizons of government officials in policy-making and guide the policy-making directions. Based on the research outcomes, some recommendations for policy making have been presented to different levels of government, including central government, relevant bureaus and provincial government.

Finally, innovative methods have been used in project research. By close cooperation among universities, government and industries, the project has been conducted more smoothly. It makes sure that the research outcomes have both the theoretical and practical implications. The cooperative and participative model for project conducting is effective to bridge between academic and practitioners, which is conducive to make management research have an impact on management practice. It is an important innovation in research methods.

However, some questions need further research.

(1) The interactive mechanism of total innovation needs further investigations. The mechanisms of how to obtain synergic effect generated from interactions among total innovation--all-element, all-involvement and all time-space will become the locus problem to be further studied.

(2) Operational mechanisms and regimes of Innovative service system, e.g. platforms serving SMEs, will be one of the important research problems further.

(3) Problems about cluster innovation need further research. Cluster innovation as a collaborative innovation process of specialized SMEs in the same or related industries that cooperate with suppliers, customers, marketing network, government, and other actors in the cluster. While TIM focuses on the synergic effect of all-element, all-involvement and all-time-space, which will provide a new perspective to study cluster innovation. However, how does TIM play a role in cluster innovation will be the further research problem.

(4) The relationships among FIS, RIS and NIS will be another research problem. Innovation

is a complex system. How to make a firm innovation system (FIS) embed into regional innovation system (RIS) and national innovation system (NIS) is a very important research problem.

In sum, by IDRC project, some outcomes have been achieved and some research problems have been identified.

(1) The research has got TIM theory progressed and contributed to innovation management theories as well.

(2) The research outcomes, such as questionnaires developed, rules of TIC developing in SMEs concluded, and the strategic pathway and mechanism for leveraging innovative capabilities, have practical implications in guiding SMEs to engage in total innovation, besides their theoretical implications.

(3) The cooperative and participative model adopted in project research has had our research outcomes diffused more quickly and smoothly, not only in policy-making but also the innovative practice of SMEs.

(4) By the project research, our research team members have acquired well training.

(5) Some new topics have been identified, which will be the further research problems.

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1 Basic Project Information

Innovation is widely recognized as a major source of modern productivity growth. Indeed, it is seen as constituting a central process of economic advancement in industrialized countries. Despite of this, a considerable gap still exists in knowledge and innovation capability between industrialized countries and the more dynamic developing countries such as China. To achieve sustainable competitiveness in the global market in an era of limited resources and energy conservation, the Chinese central government proposed the 11th 5-year Plan in March 2006. Focusing on indigenous innovation and experience, the goal of this Plan was to build a prosperous and productive nation within five years. To this end, Chinese firms must undergo a rapid transition despite several challenges, including lack of good business models and theories.

Given China's extraordinary size and diversity, and the limited knowledge on economic policies, there is a need for research on local innovations in China and other developing countries. Small and medium sized enterprises (SMEs) are a major contributor to the country's economy and in particular the coastal Zhejiang Province where they constitute 99% of all enterprises. However, the absence of specific strategies for their growth has resulted in a number of competitive disadvantages. The overall goal of this project is to create a SME-specific TIM paradigm that can improve the innovative capabilities of SMEs in Zhejiang Province, where their local GDP contribution is more than 90%.

After two and a half year's investigation and study, the project have examined the current status of SMEs in Zhejiang and other provinces, while also assessed the utility of the TIM strategy to leverage their innovation capabilities. The research outputs have led to specific policy recommendations to the provincial government such as Zhejiang, other local authorities, as well as the central government. Apart from enhancing indigenous innovation capabilities of SMEs, the project has advanced existing knowledge on innovation management, technology management, and innovation policy and practices within the SMEs. In addition, the research and implementation capabilities are enhanced through graduate training and other forms of trainings. SMEs are an important component of the national economy. Thus, the development of SMEs is critical for the employment and GDP growth. Focused on the topic of "How to leverage innovation capability of SMEs", the project makes a great contribution to economic restructuring and industry upgrading. What's more, suggestions for "12th 5-year plan" are provided to government by our project team.

2 Research Questions

Despite of tremendous economic growth since the reform programs begun in 1978, there is still a wide gap in innovative and technological capabilities between China and industrialized countries. To compete in a hyper-competitive world, China must transform itself from a labor-intensive to a knowledge-based economy. Encouraging indigenous innovation, promoting innovative capabilities, and building an innovative country are the key planks of China's "11th 5-year Plan" published in March 2006[1]. However, Chinese firms lack the knowledge and experience necessary for the transformation into innovative firms. Project team has collected the secondary data from National Bureau of Statistics of China and target enterprises. Simultaneously, 44 enterprises are taken as typical cases to be studied. A large-scale questionnaire survey was carried out mainly in Zhejiang Province and Shandong Province. After data processing, some research findings can be concluded as follows:

(1) Shortage of resources leading to SMEs' weak capability-base

The R&D intensity of Zhejiang Province is 1.52%, which shows the relatively large disparity to the goal R&D intensity (2%). Meanwhile, the R&D expenditures have not been distributed balanced between large-sized firms and small and medium-sized firms, which makes the problem in SMEs' worse. Consequently, shortage of resources led to SMEs weak capability-base.

(2) Management relied on personal experiences being the bottleneck of innovative capability leveraging

Most SMEs run their business by virtue of the founder's intuition and experiences, which have become the bottleneck of innovation capability enhancement. With the environments develop more dynamic and fiercer, experience-based management can not meet the demand of SMEs' development. Poor management, imperfect institution and lack of systemic thinking have impeded SMEs to leverage their innovative capability.

(3) Old-fashioned ideas and conserve culture being the underlying obstacles for SMEs to leverage their innovative capability

Culture and ideas are the fundamental factors that affect human behaviors. China is an ancient civilized country with a long history and profound culture. Conservation and low tolerance of failure are the root factors of entrepreneurship motivation.

Therefore, research is needed on theoretical and practical models that can be used to improve the innovative capabilities of firms.

SMEs have recently emerged as a critical sector in the country's economy. However, low investments in innovation and weak innovation capability have resulted in competitive disadvantages. This has in turn led to low viability and sustainability in this sector. To advance the country's ongoing economic reforms, it is therefore necessary and urgent that obstacles that may hinder further development and sustainability of SMEs be removed.

[1] Published in March 2006, this Plan calls for China to become an "innovation-oriented society" by the year 2020, and a world leader in S&T by 2050. It also commits China to develop capabilities for "indigenous innovation" and to leapfrog into a leading position in science-based industries by the end of the Plan period. In the Plan, the country will invest 2.5% of its GDP in R&D by 2020; raise the contributions to economic growth from technological advances to more than 60%; and limit its dependence on imported technologies to no more than 30%.

3 Objectives

The project aims to contribute to the social and economical development of Zhejiang and other provinces in China. It is also expected to increase the capability for employment within SMEs, and thereby contribute towards poverty reduction and wealth creation.

(1) Assessing the current status of innovation in Chinese SMEs

- resources and capabilities within SMEs;
- pressures, problems and difficulties in innovation activities.

(2) Identifying the process and mechanism in leveraging innovative capabilities of SMEs via TIM

- interrelationship among the elements of TIM;
- interrelationship between entrepreneurship and innovation performance;
- processes and the mechanism of leveraging innovative capabilities in SMEs via TIM.

(3) Building TIM pattern and application model for SMEs

- generalizing the conceptual framework of TIM for SMEs;
- describing the influences of industry characteristics and growth stages of SMEs on TIM pattern;
- formulating the TIM application model for SMEs;
- developing a strategy for improving innovation capabilities via TIM.

(4) Policy recommendations to local and central government

- policy-making at the firm level for local and central government;
- innovation policy for regional manufacturing clusters under TIM paradigm.

4 Research Methodology

4.1 Research phases

In order to explore the application pattern of Total Innovation Management (TIM) to leverage innovation capability of Chinese Small & Medium Sized Enterprises (SMEs), the project was delivered in four phases as follows.

4.1.1 Literature review

A comprehensive review of relevant literatures was conducted from November 2007 to January 2010, with a specific emphasis on the innovation of SMEs. Taking SMEs, Total Innovation Management and Innovation Capability as the keywords, our project team members have collected and read literatures from the top journals, such as Academy of Management Journal, Administrative Science Quarterly, European Journal of Innovation Management, Harvard Business Review, International Journal of Business Venturing, Management Science, Strategic Management Journal, Research Policy, Technovation, International Journal of Innovation Management and so on.

4.1.2 Pilot study

Semi-structural interviews with senior and middle managers have been taken to collect the data of innovation resources, process and performance of SMEs from March 2008 to August 2009. Based on previous research outcomes of TIM, the contents of interviews were divided into six dimensions: strategy, resource, organizational structure, process, technology and culture. And then the key dimensions and the relationship between these dimensions in the TIM model were identified. 32 pilot studies were from the following industries: 1) Product assembly industries--machinery, household appliances, telecommunications equipment; 2) Non-product assembly industries--textile, chemicals; 3) Knowledge intensive services--software industry, financial industry. In each industry, 2-5 typical cases have been studied. The method similar to SAPPHO proposed by Freeman and Pavitt in 1970s was used to find out the key dimensions by comparing two enterprises that were in the same environment but the operating results were quite different. In addition, more secondary data were collected from documents, magazines, news websites etc. to verify the reliability of data.

4.1.3 Questionnaire survey

Based on preliminary studies, a large-scale questionnaire survey was taken to explore the application model of TIM in SMEs from September 2008 to April 2009. Questionnaires were mainly distributed to SMEs in Zhejiang Province, Shandong Province, and Shanghai. 2068 questionnaires were distributed with the help of Bureau of SMEs, Economic and Information Commission of Zhejiang Province, Professor ZHENG Gang and Ph. D student REN Zongqiang, etc. 741 questionnaires were collected, among which 686 were from Zhejiang, 28 from Shanghai, and the other 27 from Shandong, with the response rate of 35.83%. 504 questionnaires were collected by Economic and Information Commission of Zhejiang Province, 182 ones were collected by Bureau of SMEs, 28 ones by Associate Professor ZHENG Gang, and 27 ones by Ph.D student REN Zongqiang. After excluding the ones that missing data, the number of valid questionnaires was 401. Principal component analysis, variance analysis, regression analysis, confirmatory analysis and structural equation modeling were used to analyze the relationship between various elements and their impact on the performance of SMEs. The main tools include SPSS 16.0, AMOS4.0 and Microsoft Office software suite.

4.1.4 Field study

In order to explore the mechanism of leveraging innovation capabilities, our project team carried out in-depth research on SMEs of Zhejiang Province, Shandong Province and Fujian Province from March 2008 to January 2010. 44 typical SMEs covering the sectors of machinery, textiles, computer services, communications equipment, commercial services, software etc., have been interviewed based on semi-structured outlines. Through in-depth case studies, mechanisms of leveraging innovation capabilities via strategy, culture, technology, market, entrepreneurs have been explored.

4.2 Main research methods

In this project, the large-scale questionnaires survey and case studies are the main methods.

4.2.1 Large-scale questionnaire survey

Contents of questionnaire have been developed as the basic situation of enterprises, strategy capability, culture capability, market capability, technology capability, organization capability, innovation performance, competitive advantages, environment, innovation orientation, policy and entrepreneurship. Seven-point Likert Scale was taken to measure the situations of innovation in enterprises, from totally disagree (1) to totally agree (7). The whole questionnaire, see Appendix A Project Questionnaire.

After the complementation of questionnaire design, 32 enterprises have been selected for pilot study. Explorative Factor Analysis was used to classify different variables and delete or rectify some items that can not be used to measure capabilities. Then the refined questionnaire was distributed to SMEs of Zhejiang Province, Shandong Province and Shanghai.

A total of 2068 questionnaires were disseminated. 741 questionnaires were collected, with the response rate of 35.83%. 401 valid questionnaires were left.

Table 4.1 Sample Distribution

Establishing Time	Before 1990	22.7%
	1990-1999	37.0%
	1999-2009	40.3%
Stage of Development	Start-up	14.1%
	Development	65.6%
	Mature	20.3%
Number of Employees	Less than 500	67.0%
	500-2000	24.2%
	More than 2000	8.8%

Based on the data of large-scale questionnaires, structural equation model, regression equation, and computer stimulation were taken to analyze the relationship between innovation elements, enablers and innovation capabilities.

4.2.2 Case studies

(1) Case selection

According to the “Provisional Regulations on Standards for SMEs” promulgated in February 2003, SMEs must meet the following conditions: the number of employees is less than 2,000, or turnover is less than 300 million, or total asset is less than 400 million. With the supports of government in Zhejiang Province, 44 enterprises (Shown in Appendix B List of case study sample)

have been selected to be investigated. Those enterprises investigated cover machinery manufacturing, textiles, electronics, software and services.

(2) Data collection

To get rich qualitative data from these enterprises, we collected evidences from four sources within each firm. Firstly, we acquired written material including brochures, annual reports, internal documents, and trade journal articles. Secondly, we used archives such as marketing presentations, organizational records, and project documentation. Thirdly, we used observation through site visits, making observations of meetings, locations of work activities, and normal office communications. These observations were recorded through elaborate field notes, which provided valuable information about organizational practices. Finally, interviews were taken in each enterprise. Before each interview, the interview outline (Shown in Appendix C Semi-structural interview outline) has been ready. Questions in the interview outline were fluid rather than rigid and were open-ended in nature. The whole processes of interviews were recorded, and notes were taken simultaneously. An average of 4 times interviews was taken in each enterprise which lasted for 3 hours or more.

The use of multiple sources of evidence has allowed us to explore the history, the critical experience for successful innovation, and mechanisms of leveraging innovation capabilities in SMEs.

(3) Data analysis

The purpose of data analysis was to offer knowledge regarding the applicability of Total Innovation Management to leverage innovation capabilities of Chinese SMEs.

Based on the TIM theory and the innovation capabilities matrix, the entire analysis was highly iterative and involved moving back and forth among the data, the existing literature, and the concepts that emerged as salient at the research site.

The participation of government in the project facilitates the distribution and collections of questionnaires and improves the information quality. Government also recommended a list of companies for investigation. Meanwhile, our project team participated in the development of industrial policy.

4.3 Contributions to the methodology

(1) In the design process of this project, relevant government officials, business managers and academic experts in related fields were invited to find out problems in the process of innovation and SMEs' requirements of resources, capabilities and policy together. The early involvement mechanism makes our research more suitable to the practical needs.

(2) The participation of government (especially Bureau of SMEs, Economic and Information Commission of Zhejiang Province) in the project has facilitated the distribution and collection of questionnaires and improves the information quality, which is very useful for data analysis.

(3) In order to expand the influence on government decision-making, our project team members have participated in the practices of government agencies, such as the relevant regional and industrial planning, the assessment of innovation centers etc. In the last three years, Professor XU Qingrui, Professor CHEN Jin, and Associate Professor ZHENG Gang, the main team members were invited by government and enterprises. 51 presentations with the focus on TIM theory have been presented.

5 Project Activities

In the two and a half years, project team carried out a series of activities, including activities with government, activities with enterprises and internal activities.

5.1 Activities with government

5.1.1 The incentives of collaboration with government

On one hand, the close relationship with government is conducive to implement the project. Firstly, Government officials have a more macro understanding of SME innovations. It can broaden the vision of IDRC Project. Secondly, with the participation of government officials in our project, the root causes of problems hindering SMEs' innovation have been analyzed and the most valuable research questions have been identified. Thirdly, based on the platform of government, project team is able to access to enterprise data and the opportunities for investigation. Therefore, the cooperation with government can improve the efficiency and effectiveness of project operation.

On the other hand, the close collaboration with government officials can help them to better serve SMEs. Project team has built a platform for cooperating among government, enterprises, universities and institutes, which is helpful to provide different government agencies with the opportunities for exchanging ideas, and broaden the horizon of government officials and influence government policy-making.

5.1.2 Specific activities with government

Based on the two purposes, activities with government have been organized as follows:

Table 5.1 Activities with government

Level	Date	Name	Content	Participant Institute
National level	July 22, 2008	Meeting with Central Government Officials and Experts in Beijing	Discussing the special situation of China, analyzing the problems of innovation in SMEs, and giving suggestions for innovation development and the expected project results.	Western Administration Office of National Development and Reform Commission; Bureau of Science and Technology (BOST) of Ministry of Education; Soft Science Department of Ministry of Science and Technology (MOST); Theory Department of Science and Technology Daily; Intellectual Property Press; 21st Century Agenda Management Center; Zhejiang University
Provincial level (Mainly in Zhejiang Province)	November 5 and 6, 2007	The Convene Planning Meeting for IDRC Project	Introducing research content, method and expected results of the project: How to use TIM to leverage innovation capabilities of Chinese SMEs	Bureau of Science and Technology (BOSMEs); The Centre for Policy Research on Science and Technology, Simon Fraser University, Canada; Zhejiang University; Fudan University; Zhejiang University of Technology; Fuzhou University; etc.
	April 26 and 27, 2008	Training for SMEs' Managers/Government Officers	Emphasizing the importance of Innovation Management and introducing the TIM theory to SMEs.	BOSMEs; Taiwan University; Zhejiang University; Managers etc.
	September 19, 2008	Meeting with Zhejiang Government Officials and Zhejiang Management Association in Hangzhou	Evaluating the project mid-term results and giving suggestions for future research.	BOST; BOSMEs; Economic and Information Commission (EIC) Zhejiang University; Fujian University; Shanghai Jiao Tong University
	June 14, 2009	A Senior Seminar of Department of Personnel, Zhejiang Province	Fully using the opportunities in the Financial Crisis and enhancing the capability of enterprises.	Department of Personnel of Zhejiang Province; BOSMEs, Zhejiang Province and managers from 35 enterprises.
	January 8, 2010	Final Evaluation Meeting	Discussing the policy influence of IDRC project.	BOSMEs; EIC; BOST; Zhejiang Science and Technology Information Institute

(1) July 22, 2008, Central Government Officials and Experts Meeting in Beijing

IDRC project consulting meeting was held on July 22, 2008 in Beijing. The participants mainly came from Ministry of Science and Technology (MOST), Development and Reform Commission, and Ministry of Education. Main participants are shown in the Table 5.2.

Table 5.2 Main participants

Name	Positional Title
ZHAO Ai	Secretary of Western Administration Office, National Development and Reform Commission
CHEN Yinghui	Deputy Director of BOST, Ministry of Education
ZHAO Gang	Deputy Director of Soft Science Department of MOST
HU Yu	Director of Theory Department, Science and Technology Daily
LIU Zhong	Minister of Intellectual Property Press
ZHOU Yuan	Deputy Director of the 21st Century Agenda Management Center
Prof. XU ,CHEN ,WEI	Zhejiang University

In this meeting, Professor XU and CHEN introduced TIM theory and the content of project. Then government officials gave suggestions as follows: Firstly, the special situation of China should be studied and analyzed so that the advanced experiences of foreign countries could be learned based on comparison; secondly, field studies should be carried out in successful firms; thirdly, the definition, characteristics and standard of innovative firms should be explored based on theories and practices; finally, there are three dimensions that need to be focused on during the innovative process, including the macro environment of innovation development, market environment and the situation of enterprises.

Figure 5.1 LIU Zhong, ZHAO Gang, HU Jun, Prof. XU Qingrui, and Prof. CHEN Jin

(2) November 5 and 6, 2007, Meeting with Zhejiang Government Officers & Scholars

The Convene Planning Meeting of IDRC was held on November 5 and 6, 2007 in Room 312 of Building 1, Yuquan Campus of Zhejiang University. The main participants of this meeting are shown in Table 5.3.

Table 5.3 Main participants

Name	Positional Title
CAI Zhangsheng	Senior Officer of BOSMEs
SHEN Huichen	Formal Director of BOSMEs, 1980s-1990s
ZHOU Yimin	R&D Director of Zhejiang Entrepreneur Association
Richard Smith	Professor of Simon Fraser University, Canada
XU, CHEN, GUO, ZHAO, ZHENG	Professors of Zhejiang University
SI Chunlin	Professor of Fudan University
CHI Renyong	Professor of Zhejiang University of Technology
LIN Xing	Lecturer of Fuzhou University

The main topic of the meeting was the introduction of research content, method and expected results of the project: *How to Use Total Innovation Management to Leverage Innovation Capabilities of Chinese Small and Medium Sized Enterprises*.

Professor XU Qingrui clarified the main research contents of this project, analyzed the present condition of SMEs in China, and introduced the framework of TIM in SMEs. CAI Zhangsheng, Senior Officer of BOSMEs of Zhejiang Province, positioned problems and challenges for SMEs in Zhejiang Province, and suggested necessary measures to leverage innovation capability. SHEN Huichen, former director of Bureau of SMEs in Zhejiang Province (1980s-1990s) suggested that project team should do comparative studies between large enterprises and SMEs.

Figure 5.2 Prof. XU Qingrui, Prof. SI Chunlin and Prof. CHI R.Y., Senior Officer CAI Zhangsheng etc.

(3) April 26 and 27, 2008, Training for SME Managers/Government Officials

In order to leverage the capability of SMEs by TIM in Zhejiang Province, a training named *1st IDRC Seminar on Leveraging SME's Capability* was unfolded itself on April 26 and 27, 2008 in the Building 1, Yuquan Campus, Zhejiang University, which was held by Research Center for Innovation and Development (RCID), Zhejiang University and BOSMEs of Zhejiang Province.

58 senior managers from 31 enterprises and 5 government officials of Zhejiang Province took part in this training. The main participants are shown in Table 5.4.

Table 5.4 Main participants

Name	Positional Title
CAI Zhangsheng	Senior Officer of BOSMEs
ZHAO Wei	The officer of Science and Technology of BOSMEs
CHEN Jiasheng	Professor of Taiwan University
XU, CHEN, GUO, ZHAO, ZHENG	Professors of Zhejiang University
58 Senior Managers	Managers of SMEs of Zhejiang Province

CAI Zhangsheng, Senior Officer of BOSMEs, Zhejiang Province, introduced the challenges Zhejiang SMEs facing, highlighted the significance of innovation management, and explained 8 aspects of technological innovation of SMEs.

This training has enhanced the integration between theory and practice, and has broadened the managers' horizon. After grasping the concept of all elements innovation, all-involvement

innovation and all time/space innovation, they consider further to develop for their enterprises' innovation practice and activities, such as integrating their innovation resources etc.

Figure 5.3 Participants in the Training of Leveraging SMEs Capability by TIM

(4) Mid-September 2008, Meeting with Zhejiang Government Officials and Zhejiang Management Association in Hangzhou

The meeting was held on September 19, 2008 in JINXI Hotel of Hangzhou, the participants mainly came from Zhejiang Province. Main participants are shown in Table 5.5.

Table 5.5 Main participants

Name	Positional Title
JIANG Taiwei	Director of BOST of Zhejiang Province
CHEN Hongtao	Senior Officer of BOST of Zhejiang Province
TANG Lilu	Director of EIC of Zhejiang Province
LING Yun	Vice-Director of EIC of Zhejiang Province
LI Jingning	Head of Technological Advances and Equipment Department, EIC of Zhejiang Province
WU Jiaxi	Director of BOSMEs of Zhejiang Province
CAI Zhangsheng	Senior Officer of BOSMEs of Zhejiang Province
LOU Jianren	Director of MOST of Hangzhou
RAO Fangquan	Professor of Shanghai Jiao Tong University
WANG Yi	Professor of Tsinghua University
SI Chunlin	Professor of Fu Dan University
ZHU Bin	Professor of Fuzhou University
XU, CHEN, GUO, ZHAO, ZHENG	Professors of Zhejiang University

Government officials appreciated our research results and gave many suggestions. Firstly, more participation in the process of policy-making is needed in the future. Secondly, more enterprises should be investigated in the future. Thirdly, most successful enterprises have unique external resources, which were hard to be captured by SMEs. Thus, investigations should cover more industries, especially service and software industry.

TANG Lilu, Director of Economic and Information Commission, proposed three problems that further research might focus on the leaders, designers and practitioners of SME's innovation

activity. Firstly, how to improve the internal quality of managers? What were the external constraints of innovation? Secondly, problems enterprises facing, such as shortage of resources and energy, environment issues should be improved by innovation. Thirdly, more researches on unsuccessful enterprises are needed.

Figure 5.4 TANG Lilu, WU Jiaxi, CAI Zhangsheng, Prof. RAO, XU, CHEN etc.

(5) June 14, 2009, Senior Seminar with the Bureau of Human Resource and Social Security of Zhejiang Province

June 14, 2009, seminar with the Bureau of Human Resource and Social Security of Zhejiang Province named "Facing the Financial Crisis, Winning by Technology Innovation", chaired by Professor CHEN Jin, was held at Lingfeng Hotel, Zhejiang University. More than 40 persons attended the seminar, which were mainly from government agencies, enterprise, and universities. The main participants are shown in Table 5.6.

Table 5.6 Main participants

Name	Positional Title
CAI Zhangsheng	Senior Officer of BOSMEs of Zhejiang Province
Dr. WANG Jin	CEO of Manhattan Investment Company
Prof. XU, CHEN, ZHAO, ZHENG, LIU	Professors of Zhejiang University
38 Managers	SMEs of Zhejiang Province

Through this seminar, innovation sense-making, innovation policy-making, crisis management skills of the managers were improved or enhanced, and the participants gave high praise to the seminar.

Figure 5.5 Managers from SMEs were listening to the training course

(6) January 8, 2010, Meeting with BOSMEs, BOST and EIC

The meeting with the BOSMEs, BOST, and EIC, was held on the January 8, 2010, in Yuquan Campus of Zhejiang University. Participants are shown in Table 5.7.

Table 5.7 Main participants

Name	Positional Title
CAI Zhangsheng	Senior Officer of BOSMEs of Zhejiang Province
LI Jingning	Director of Technological Advances and Equipment Section of EIC
YU Fenghua,	Director of Provincial R&D Center, BOST
LIU Wenxian	Vice President of Zhejiang Science and Technology Information Research Institute
Prof. XU, CHEN, ZHAO, ZHENG, LIU	Professors of Zhejiang University

The topic of this meeting was to discuss the policy influence of IDRC project. The major participants were shown as follows:

At the very beginning, Professor XU Qingrui briefly introduced the project's contributions for the theoretical research, SMEs' practice, government policy formulation and other developing countries' development. Then, the participants discussed the policy influence of IDRC project.

LI Jingning, Director of Technological Advances and Equipment Section of Economic and Information Commission, said that, "From one side, IDRC project team leveraged innovation capability in SMEs directly via providing scientific innovation management method. From the other side, IDRC project team leveraged innovation capability of SMEs indirectly via pushing the government to guide enterprises in their innovation activities in better ways. For example, the concept of high involvement innovation was accepted when designing the assessment system of technology center. The number of Innovative proposals from staff was considered to be an important indicator. The importance of entrepreneurship and learning capability was realized by scholars and government officials. The cooperation between government and IDRC project team was broadening policy horizons of policymakers. "

CAI Zhangsheng, Senior Officer of BOSMEs of Zhejiang Province, said, "Firstly, under the economic downturn caused by financial crisis, the government officials paid great attention to IDRC project, and cooperate with IDRC project team in several ways. Secondly, through participating in the IDRC project, government officials have understood the real reasons that blocked the innovation capability leveraging in SMEs. After communicating with IDRC project team members, we found that the in-depth reasons that blocked innovation capability leveraging is the problem generated from the existed mechanism and institution, rather than the capital or technology shortage. Government is responsible for cultivating creative talents by holding training programs. The importance of innovative culture is emphasized by the IDRC project. One of the important dimensions of innovative culture is risk tolerance. However, the risk tolerance culture is weak in China, which is the root cause of shortsighted strategy. Thirdly, the result of IDRC project is quite useful for government. The IDRC project takes advantage of the current crisis to stimulate government to understand the importance of innovation capability leveraging in SMEs. The open innovation theory, which is introduced by Professor CHEN Jin, has a strong practical implication in Zhejiang Province's SMEs. What's more, both the technological factors and the non technological factors are emphasized by IDRC project. The importance of business model innovation, institutional innovation is emphasized. JIN Deshui, the vice governor of Zhejiang Province, has said that the policies formulated for SMEs' development should be differed from

those for large companies. In conclusion, the outcome of IDRC project is meaningful not only in theoretical but in practical side."

YU Fenghua, Director of Provincial R&D Center of BOST, indicated the problem that SMEs are not able to understand the government policy. According to his knowledge, BOST of Zhejiang Province has formulated more than 100 policies. But very few enterprises know these policies. Therefore, the key problem is how to make good use of these policies for SMEs. He also appreciated the importance of Total Innovation Management (TIM) theory to guide the direction of government policy. LIU Wenxian, the Vice-president of Zhejiang Science and Technology Information Research Institute of BOST, stated the reasons why SMEs did not want to innovate and the situation of patent services in SMEs.

Figure 5.6 Prof. XU, CAI Zhangsheng, LI Jingning, YU fenghua, LIU Wenxian

5.2 Activities with Enterprises

Project team carried out series of activities on Total Innovation Management (TIM) with SMEs.

At the early stage, with the help of BOSMEs of Zhejiang Province, project team has provided training to SMEs, through which SMEs can be more aware of TIM theory.

With the help of EIC, BOST and BOSMEs of Zhejiang Province, a number of SMEs were chosen for case studies and questionnaire surveys. Through case studies, on one hand, project team collected the information of enterprises on their development and innovative activities; on the other hand, we introduced TIM theory to enterprises, and discussed how to leverage innovation capabilities via TIM with the top management to promote implementation of TIM in SMEs. Through questionnaire surveys, the status of total innovation capabilities in SMEs has been captured. The questionnaire included the comprehensive situation of various elements of total innovation capabilities, as well as innovation performance. After finishing the questionnaire, they could further understand TIM theory. Questionnaires were distributed and 44 firms were deeply studied.

At the later stage, we applied TIM in the innovation management of SMEs. Four aspects were included: (1) giving books on TIM to SMEs for their reference and learning; (2) selecting

some SMEs as the samples of long-term study, including Honyar, Sunyard, FPI etc; (3) providing trainings to those who wanted to have a better understanding of TIM theory and apply it in their enterprises; (4) conducting long-term cooperationes with enterprises.

Table 5.8 Activities with enterprises

Stage	Main activities	Basic content
Initial contact with TIM	Providing trainings to SMEs	1st and 2nd IDRC Seminars On Leveraging the Capability of SMEs: introducing the system of TIM and related innovation theory.
Diffusion of the TIM theory	Enterprise investigations	Carrying out investigations of 44 SMEs under the help of government.
	Questionnaire survey	Sending out 2068 questionnaires to SMEs and receiving 741 questionnaires.
The in-depth application of TIM	Sending out books	Sending out books to SMEs, such as TIM, Innovation Horizon etc.
	Interaction	Inviting some SMEs to take part in our research activities: such as ISMOT09, GMC07, Zijin forum ect.
	Long-term survey	Participating in practical activities: such as 4 months in FPI, 8 months in Sunyard, 3 months in Honyar etc.
	Further training	Systematic training about the related theoretical knowledge about TIM.
	Long-term cooperation with enterprises.	Network training Center for TC(Tech Center) Engineers & Managers.

5.2.1Trainging for SMEs

(1) The 1st IDRC Seminar-TIM Training on Leveraging SME's Capability

In order to leverage the capabilities of SMEs by TIM in Zhejiang Province, the training named *1st IDRC Seminar On Leveraging SME's Capability* was held on April 26 and 27, 2008, in Teaching Building 1st, Yuquan Campus, Zhejiang University, which was organized by Research Center for Innovation and Development (RCID), Zhejiang University and Bureau of SMEs in Zhejiang Province(BOSMEs).

Table 5.9 Contents of TIM training

No.	Institute	Speaker	Content
1	RCID (Zhejiang University)	Academician XU Qingrui	• Way of technological innovation in China • Secondary Innovation – Portfolio Innovation – Total Innovation • Background, content and framework of TIM
2	Taiwan University	Prof. CHEN Jiasheng	• Situation of SMEs in Taiwan • Suggestion for SMEs in Zhejiang Province
3	BOSMEs	Senior Officer CAI Zhang sheng	• Challenges of SMEs in Zhejiang Province • Highlighting the significance of innovation management in SMEs • 8 aspects on technological innovation of SMEs, and suggestions for SMEs
4	RCID (Zhejiang University)	Prof. CHEN Jin	• Innovation management model- originality, R&D, marketing and manufacturing • Open innovation
5	RCID (Zhejiang University)	Prof. GUO Bin	• How to conduct product innovation • Design technological strategy
6	RCID (Zhejiang University)	Dr. ZHENG Gang	• How to establish and improve a tech-oriented tech innovation system • How to maintain competitive advantages of SMEs

58 senior managers from 31 enterprises of Zhejiang Province took part in this training, including 10 manufacturing enterprises, 4 service enterprises, 2 textile enterprises, 2 bioengineering enterprises, 3 software enterprises, 5 electrical equipment enterprises, and 5 high-tech enterprises. And, 23 of those 58 participants were top management (including CEO), 26 were managers and engineers, 4 were technical managers, and 5 were officials.

Trainees cherished this chance to learn TIM Theory and exchanged experience with each other. And then in the interactive session of this training, they consulted problems encountered in enterprises to experts; also they shared the experience of successful enterprises. In the session, some subjects about innovation management were put forward: establishment of innovation system; enhancement of innovation capability; improvement of innovative service system; how to keep the confidential information; how to estimate encouragement, and innovation performance; innovation incentive model; standardization and systematization of innovation management; feedback and guidance of development of the enterprises; sustentation of system innovation; significance and impendence of innovation research and innovation case study; innovation orientation and national policy; how to manage well after the development of SMEs; qualification of SMEs; issue on “Hidden Champion”.

After the training, feedback of this training was received from most of the participants, and they showed their satisfaction to this activity. They commented that:

This training enhanced the integration of theory and practice. The participants in this training enlarged the view on innovation and were more conscious of the importance of innovation management in the enterprises. After learning innovation management by everyone, innovation everywhere, innovation at all times, and innovation throughout the process, they considered further to develop of innovation practice and activities. Enterprises gained further information about national, provincial policy on innovation management.

(2) The 2nd IDRC Seminar-TIM Training on Leverage SME’s Capability

In order to leverage the capability of SMEs by TIM in Zhejiang Province, the training named *2nd IDRC Seminar on Leveraging SME’s Capability* was held on June 14, 2009.

52 senior managers and government officials took part in that training, which was taken charge by Professor CHEN Jin. CAI Zhangsheng, Senior Officers of SME Bureau of Zhejiang Province was also present. Many scholars from Zhejiang University (Academician XU Qingrui, Professor CHEN Jin, Associated Professor ZHAO Xiaoqing, Associated Professor Zhuo Jun, Associated Professor Liu Jingjiang and Associated Professor Zheng Gang) attended the training and gave lectures on Innovation of SMEs and TIM.

The main content of this training was introducing the TIM theory, innovation management and exploring the paths of leveraging innovation capabilities.

After the training, some entrepreneurs gave us some kindly suggestions. They hoped that the scholars could give more detailed knowledge about TIM and management skills, the learned style could turn to an exoteric way, and more cases and exchange would be welcomed. ZHANG Shenggen, President of Zhejiang Ruiyuan Machine Tool Company, said that, “Before I attend this forum, I knew nothing about TIM. This time I have got a lot of valuable knowledge and experience, and thank all of you. I suggest that more similar forums will be held, and then I can assign more senior managers to attend.”

(3) Training for Top Management of Shandong Firms

On November 12 and 13, 2008, Professor XU Qingrui was invited to give lectures to the top

management of Shandong firms sponsored by Organization Department of Shandong Commission of CPC (Short for Communist Party of China) in Xixi Campus, Zhejiang University. Participants included top managers coming from ShanDong Iron and Steel Group, Jinan Iron and Steel Group, Shandong Aviation Group, Qilu Security, Xinwen Mining Group etc.

Based on the two themes: "Exploring the path of technological innovation in China" and "the way to build innovative firms", Professor XU gave the excellent lectures. He introduced the development of innovation management in China, and highlighted the outcomes of theoretical research for more than 20 years: Secondary Innovation- Portfolio Innovation- Total Innovation Management. He pointed out that TIM is an essential trend for the development of enterprises. In the interactive session, Professor XU and managers exchanged ideas intensely.

(4) In-home Training for Sample Firms- Honyar

In order to enhance innovation capabilities and cultivate innovative culture, on November 27, 2009, Professor XU was invited to give a lecture to managers and engineers. Based on the previous investigations, the lecture is more targeted. Professor XU analyzed problems encountered in the development and introduced the paths to be an innovative firm. Cases of successful enterprises were shown to Honyar. Professor XU suggested that in order to create new value in market, Honyar should pay more attention to implement innovation and open up new markets. In the training, Dr. ZHENG Gang analyzed the misunderstandings of indigenous innovation.

CEO WANG Micheng said: “Honyar is committed to be an innovative firm. Entrepreneurs are critical enablers to leverage innovation capabilities through strategic planning and organizational structure adjustment”.

Figure 5.7 Top management of Honyar were listening to the lecture

(5) Training Professional Managers of SMEs of Zhejiang Province

On September 22 and 27, 2008, invited by BOSMEs of Zhejiang Province, Dr. ZHENG Gang gave a lecture on leveraging indigenous innovation capabilities on the “Training professional managers of SMEs in Zhejiang Province”. Nearly 100 managers coming from different areas of Zhejiang Province attended this training. Dr. ZHENG Gang’s report was divided into five parts: indigenous innovation and sustainable capability; the system of technological innovation; experience of successful enterprises; the paths of leveraging innovation capabilities; policies supporting technological innovation in SMEs. Dr. ZHENG Gang clarified the definition of indigenous innovation, discussed the problems of innovation faced by SMEs and stressed the urgency to implement innovation in SMEs. Through this training, participants clarified some misunderstandings of indigenous innovation, and realized the importance of innovation for the

development of enterprises.

5.2.2 Field study

Project team has investigated 44 firms in Zhejiang Province, Shandong Province, and Fujian Province. The list of enterprises is shown in Appendix B. A brief review of several major firms is given in the following.

(1) Sunyard (2008.4-2009.8)

Since 1996, Sunyard Co., Ltd. has been established for more than 13 years. It is famous for software R&D, system integration products and operation service, Sunyard System Engineering Co.,Ltd (Sunyard for short) is a software company in China, which is a designer, manufacturer and seller of financial IT software, outsourcing business and environmental protection products. Sunyard has become one of the most excellent developers and manufacturers of financial and securities software. In Sunyard, 30% of employees are managers and 50% are technicians. More than 80% employees have achieved bachelor degree or even higher degree, which has formed a high-qualified specialized team in fields of R&D, manufacturing, integration, technology support and services. Basic conditions of firm investigation in Sunyard are shown in the following table.

Table 5.10 Main activities of firm investigation in Sunyard

Item	Content
Investigation Period	From March 24, 2008 to August 10, 2009
Major Participants	Prof. XU Qingrui, Prof. GUO Bin, Dr. ZHENG Gang, REN Zongqiang, ZHANG Jun, CHEN Litian, ZHANG Suping, CHEN Feng, JIN Lu
Major Interviewee	CHENG Kailin, the general manager of Sunyard system engineering company JI Baiyang, the general manager of technology company in Sunyard JIANG Xiaolin, the project manager of VPN product WU Gengfan, marketing manager of Technology company in Sunyard
Main topics	The development process of Sunyard; the activities of total innovation management; key capabilities and successful experience

Case study in detail is shown in Appendix D.

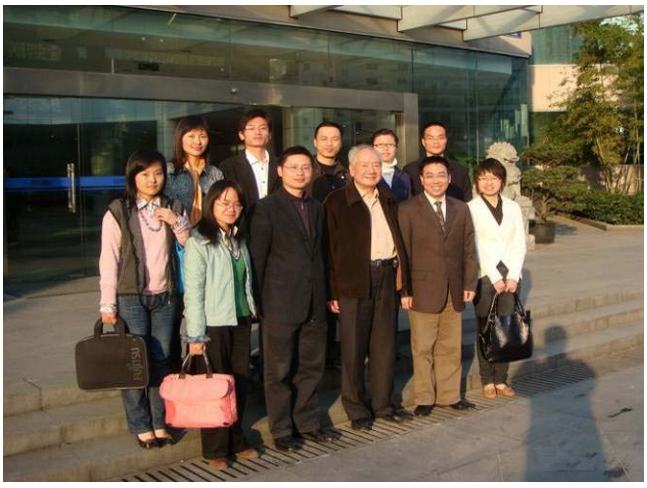


Figure 5.8 Prof. XU & Team, Chairman CHENG Kailin, Vice President WEI Zhishan etc.

(2) Focused Photonics Inc. (2008.11-2009.2)

Focused Photonics Inc. (FPI) is a high-tech enterprise created by returning brains. Company gathers the elites from well-known universities and devotes itself to the research and application development of the new generation of photoelectric measurement technology, process analysis

technology. It develops, produces and sells the analysis measurement instruments which meet the needs of domestic and overseas markets, and provides perfect technical support as well as service. FPI is founded in January, 2002. The registered capital was 12 million dollars. Now, FPI possesses 4 subsidiary companies, 19 offices and customer service terminals, and nearly 1000 employees.

Project team investigated FPI since November, 2008. The main activities of investigation in FPI were shown in the following.

Table 5.11 Main activities of investigation in FPI

Item	Content
Time	November 2008 to May 2009
Participants	Prof. XU Qingrui, Prof. ZHENG Gang, REN Zongqiang, ZHANG Jun, ZHANG Suping, WANG Lin, JIN Lu
Interview object	Chairman WANG Jian; WANG Xin, director of project development; CEO YAO Naxin; ZHANG Zheng (director of marketing) etc.
Main topics	The development of FPI; the activities of TIM; key capabilities and successful experience

Case study in detail is shown in Appendix E.

(3) Honyar (2008.9-2009.12)

Hangzhou Honyar Electrical Co., Ltd., established in 1984, has produced various kinds of building electrical appliances products for more than 20 years and is well-known domestic electrical appliances production, operating enterprise. It is also the national 863 plan CIMS application engineering business model, national demonstration enterprises of intellectual property, the high-tech enterprises and demonstration enterprise of patent in Zhejiang Province. In new era, Honyar is committed to be the provider of the electrical connection with the construction of electrical control systems integration and promote Chinese electric industry into the era of intelligent one. Accordingly it is focusing on the innovation capability based on total innovation management with the comprehensive information management and a strong marketing network to enhance its core competitiveness.

Project team investigated Honyar from September 22, 2008. The main activities of investigations were shown in the following table.

Table 5.12 Main activities of investigation in Honyar

Time	Participants	Respondent
September 22, 2008	Prof. ZHENG Gang, student LI Wenting, WANG Lin	Tech- center, CEO Office
April 21, 2009	Prof. ZHENG Gang, Prof. LIU Jingjiang, PhD Student REN Zongqiang,WANG Shu	Tech- center (manager LI Lixin, WANG Haiping)
May 22, 2009	Prof. XU Qingrui, Prof. ZHENG Gang, PhD Student REN Zongqiang,	CEO(WANG Micheng), Tech- center managers (LiLixin, WANG Haiping)
June 3 to 5, 2009	Prof. XU Qingrui, Prof. LiuJingjiang, Dr.ZHU Jianzhong, Secretary DING Xiao, PhD Student REN Zongqiang, ZHANG Jun, ZHANG Suping, Student WANG Lin, JIN Lu	CEO(WANG Micheng), Central-academe managers (LI Lixin, WANG Haiping) Human-resources department manager(ZHU Wei), Information center manager, CEO Senior Officer of Market Department (ZHANG Yuan)
November 2,2009	Prof. XU Qingrui, Prof. ZHENG Gang, PhD Student REN Zongqiang	Senior managers (56)

Case study in detail is shown in Appendix F.

(4) SUPCON Group (2008-2009)

SUPCON Group Co., Ltd. (SUPCON in short), established in 1993, is one of the leading high-tech enterprises in China with focus on research & development, manufacturing, marketing, engineering services and system integration for industrial total solutions with innovative industrial control and information technologies.

Since January 11, 2008, as a part of the Canadian International Development Research Center (IDRC) project “Application of Total Innovation Management to Leverage Innovation Capabilities of Chinese Small & Medium Sized Enterprises”, Professor XU Qingrui and Professor CHEN Jin conducted an in-depth research to SUPCON Group.

Vice-president Shi Yiming introduced the Group's development process, technical qualifications and honor echelon personnel, etc., in particular, highlight the Group's independent innovation system, that is, relying on Zhejiang University's research, technical achievements of independent innovation, cooperation and Project development cooperation and exchange and high quality products and services.

The CEO CHU Jian suggested RCID research team to cooperate further with Supcon, namely, conducting an in-depth study on the strategy innovation for the development of Supcon.

Case study in detail is shown in Appendix G.

Figure 5.9 Prof. XU & Team was listening to the introduction of new product

(5) Futong Group (2008.6-2008.11)

Futong is established in 1987. Optical Fibers and Communication Cables are the major parts of Futong’s business. In terms of Optical Fibers Futong was focused on the domestic market in the past. Here they are ranking 2nd in China. Futong has started to develop overseas market. They delivered their products to Europe and into Asian countries. In Europe Futong is the biggest Chinese Supplier of high quality Optical Fibers,in Germany even the biggest foreign Supplier. Here they compete with all international global Players. In a worldwide consideration Futong is positioned around the TOP 10.

From June, 2008, Professor XU and his team have conducted a research to FUTONG GROUP on indigenous innovation. Director of Technology Center LI Guochang introduced detailed information on the Group's current situation and showed us the process of synthesizing technology to master optical fiber. Another several investigations were taken to analyze the experience of successful innovation and the problems of innovation managements.

(6) Fuchunjiang Group (2008.6-2008.9)

Fuchunjiang Group is established in 1985. Optical fibers and communication cables are the main products. It is the Top Hundred Firms of National Electronic Information, and the Top Five

Firms of National Wire & Cable. From June 18, 2008, Professor XU and his team have conducted a field study to Fuchunjiang Group.

Deputy Chief LU Chunxiao introduced the industrial development characteristics and the development of their firm. Then Professor XU introduced the TIM theory and showed the experience of successful enterprises. Professor XU also emphasizing that enterprise should pay attention to total innovation elements instead of the single technological innovation.

Figure 5.10 Prof. XU & Team interview with Deputy Chief LU Chunxiao

(7) Uni-power Group (2008.12-2009.5)

Uni-Power Guaranty in Zhejiang Province founded on May 18th 2004, with registered capital 284.98 million RMB, is the largest Sino-foreign joint financial company in Zhejiang Province. UPG position is “A financial services company serving the growth of SMEs in an integrated approach”;Core values: "Responsibility, Honesty, and Mutualism"; UPG commits to be "the most trustworthy and the most valuable integrated financial services company.

Since April 2, 2009, Professor XU and his team conducted the field study to Zhejiang Uni-Power Guarantee Group, Communicated with the Chairman CHEN Hangsheng and Vice President, Yang Sheng and President Zhou Ji.

CHEN Hangsheng talked about the current status of the security development of the industry, and introduced “Qiaosui Mode” and “Luqu Mode” created by Chairman CHEN. Vice president Yang Sheng introduced the company's development situation and the construction of organizational culture.

Team members ZHANG Suping and CHEN Feng have taken more than 5 months in-depth study on the mechanisms of leveraging innovation capabilities in UPG.

(8) R&D Design Company (2009.4--2009.12)

Hangzhou R&D Design Co., Ltd. featured as integration of industry design, brand planning, commercial display, marketing integration, strategy operation and innovation promotion. Now it has got more than 80 employees including world-class senior market consulting specialists, style designers, structural engineers, graphic designers, planners, trade show designers and artists.

Since April 8, 2009, Professor XU and his team conduct field study to Hangzhou R&D Design Ltd, Communicated with general manager LI Qi, director of Integrated Management Center, QIAN Peihua and Assistant Manager of Human Resources Yang Fan.

General manager LI Qi introduced the 10th anniversary of the establishment of the development process as well as planning for the next 10 years. Professor XU thought highly of the past 10 years achievements in innovation management, especially "Daily ideas", reading groups to full innovative activities expressed concern.

CHEN Feng and ZHANG Suping have made in-depth study on the High Involvement Innovation, especially the organizational learning in R&D Design.

(9) Zhejiang Institute of Modern Textile Industry (2009.4-2009.9)

Zhejiang Institute of Modern Textile Industry is founded by Zhejiang University, Zhejiang S&T University, and other universities and research institutions. It formally establishes in October 2006, serving textile enterprises. At present, there are about 300 employees, of which 80% have bachelor degree or above.

Since April 26, 2009, the Chinese Academy of Engineering, director of Innovation and Development Research Center of Zhejiang University, Professor XU Qingrui and his team conducted a study to Zhejiang Institute of Modern Textile. 9 service centers and 4 research institutes were investigated for 14 times.

ZHANG Jun, ZHANG Suping, WANG Jie, WU Lubing, LI Qing etc. have made in-depth study in Zhejiang Institute of Modern Textile Industry

(10) Fujian Haiyuan Automatic Equipments CO., LTD

Fujian Haiyuan Automatic Equipments CO., LTD set up in 1998, is a private enterprise about building materials machinery manufacturing. It is a high-tech enterprise in Fujian, as well as one of the key enterprises of electromechanical equipment enterprise in China and vested in the key state-supported equipment manufacturing industry during "Eleventh Five-Year" period.

Figure 5.11 Prof. ZHU & Chairman LI Liangguang of Haiyuan

Haiyuan's Chairman LI Liangguang listened to the elaborate of TIM theory by training course from ZHU Bin, Professor of Fujian University and project leader of Fujian Sub team of the IDRC Project titled "Application of TIM on Leveraging the Innovation Capability of SMEs (TIM-SMEs briefly hereafter)", that then leading Haiyuan's managers to joint in learning and deeply understanding TIM theory. Under the guidance of TIM theory, Haiyuan conducted a comprehensive research to itself, systematic scanned and empirical summarized Haiyuan 21 years' development course. Haiyuan following the guidance of TIM theory, explore and analyze the principle contradiction and problems in each stage; conclude each stage's innovation characteristics and element-oriented innovation shape; and find out their own unique features in innovation: project-oriented innovation model, element-oriented innovation shape upgrading path,

product-oriented technology innovation teams cultivation path, consulting “win-win” marketing mode and 5S service system, matrix organization structure, unique quality management system, green “harmony” culture system, the unique TIM platform which is able to generate Hi-tech SMEs upgrade to innovative SMEs. To sum up, TIM theory offers an important theoretical guidance for Haiyuan’s development course review and summary.

5.3 Internal activities

In order to enhance the abilities of team members, several internal trainings and seminars of team learning were organized.

5.3.1 Trainings

In the two and half years, a series of training has been organized. The main trainings are shown in the following table.

Table 5.13 List of main internal training

Time	Lecturer	Major Content
March 11,2008	Prof. CHEN Jin	Open innovation, and management innovation
April 6, 2008	Prof. WEI Jiang	Industrial cluster innovation
May, 30 2008	Prof. GUO Bin	Explaining the contents of questionnaire and introducing some statistical methods.
June 10, 2008	Prof. GUO Bin	Explaining the use of statistical software of SPSS.
June 17, 2008	Prof. GUO Bin	Introducing problems that may be encountered in questionnaire survey.
July 14, 2008	Prof. XU Qingrui	Internal training of writing the investigation reports
November 28, 2008	Prof. XU Qingrui	Training on case study
April 1,2009	Prof. CHEN Jin & Prof. WEI Jiang	The law and policy of indigenous innovation. Massive economy to the industrial cluster- the experience of HaiNing Leather industry upgrading.
April 15,2009	Prof. CHEN Jin	Regional Innovation System in Zhejiang Province.

5.3.2 Team learning

Team learning is important to cultivate and enhance abilities of team members. The list of main team learning activities is shown as follows.

Table 5.14 List of team learning activities

Data	Major Speakers	Major content
March 4, 2008	Prof. XU Qingrui	Literature review of *Successful Innovation*
March 7,2008	Master Student JIN Lu	Innovation strategies and performance in small firms
March 13,2008	Ph. D Student CHEN Litian	Innovation capability leveraging via interaction of innovation elements in SMEs
April 1, 2008	Ph. D SHUI Changqing	Innovation process of SMEs
May 13, 2008	Ph. D CHEN Litian	Technological span, technology leapfrogging and enterprise strategies
June 30, 2008	Prof. XU Qingrui	Literature review on the essay *Dynamic Capabilities in Small Software Firms: A Sense-and-Respond Approach*
September 17, 2008	Prof. XU Qingrui	The source of innovation: practice and theory
October 20, 2008	Ph. D Student CHEN Litian	Evaluation indexes of innovative firms
December 9, 2008	Master Student CHEN Feng	Cultural Management
January 2, 2009	Ph. D Student ZHANG Suping	The relationship between entrepreneur and innovation
January 2, 2009	Ph. D Student ZHANG Jun	Dynamic capabilities: theories and practice

Table 5.14 List of team learning activities (continuted)

Data	Major Speakers	Major content
February 23, 2009	Ph. D Student ZHANG Jun, ZHANG Suping, WANG Shu, Master Student CHEN Feng	Organizational capability, entrepreneurship, cultural capability, enterprise clusters
March 13,2009	Master Student CHEN Feng	Cluster Culture
March 23,2009	Ph. D Student ZHANG Suping	Innovation capability and entrepreneurship
March 27,2009	Ph. D Student ZHANG Jun	Organizational mechanism and dynamic capabilities
April 22, 2009	Dr. Wang Liangjun	Networking and outsourcing
May 8, 2009	Master Student CHEN Feng	Organizational culture as a knowledge repository to leverage innovation capability
May 22, 2009	Ph. D Student ZHANG Jun	Building theoretical and empirical bridges across
June 24, 2009	Ph. D Student CHEN Litian	The types of innovation strategy, and their influence on innovation capability
July 6, 2009	Ph. D Student CHEN Litian	The mechanism of innovation capability leveraging via strategic resonance
August 11, 2009	Ph. D Student REN Zongqiang	Self-organizing innovation networks: external-internal networks co-evolution
September 23, 2009	Ph. D Student ZHANG Suping	Literature review on the essay of A Process Model of Capability Development: Lessons from the Electronic Commerce Strategy at Bolsa de Valores de Guayaquil
September 23, 2009	Ph. D Student CHEN Litian	Innovation and enhancement of enterprise capabilities: A survey of assessment approaches
October 24, 2009	Master Student CHEN Feng	Cooperate culture and innovation capability
November 13, 2009	Ph. D Student ZHANG Jun	The source of competitiveness
December 29, 2009	Master Student CHEN Feng	Literature review on Innovation to the Core

6 Project Outputs

Through continuous efforts in two and a half years, some achievements have got, including analytical outputs, theoretical outputs and practical outputs. Theoretical outputs include the articles, books, case reports as well as academic conferences hosted and attended by project team. Practical outputs focus on the policy briefs presented to the government, trainings for SMEs managers and government officials, and the capabilities improvement of project team members, managers and government officials.

6.1 Analytical outputs: The status of innovation in SMEs

6.1.1 The status of innovation resources invested into SMEs of Zhejiang Province

In 2007, the ratio of R&D expenditure to GDP of Zhejiang Province is 1.52% (the indicator is 1.50% adjusted according to the national standards), which is about equal to the national level (1.49%) but much lower than Jiangsu Province (1.67%) and Shanghai (2.52%). Overall R&D intensity of the nation has increased to 1.52% in 2008. The level of R&D intensity in Zhejiang Province is far below 2.0%, the goal indicator of relatively strong indigenous innovation capabilities. Meanwhile, most of those expenditures are invested into those firms above designated size rather than SMEs. That is to say, most SMEs can not get financial support from government. The loan discrimination from commercial banks and/or financial institute has impeded SMEs to finance enough capital to develop. Consequently, the lack of development resources, especially, monetary resources is still serious in the development of SMEs.

6.1.2 The status of total innovation capabilities of SMEs in Zhejiang Province

Large-scale questionnaires survey has been taken mainly in SMEs of Zhejiang Province and Shandong Province with the help of relevant bureaus of Zhejiang Province, such as Bureau of SMEs, Economic and Information Commission, Bureau of Science and Technology, and so on. There are 741 questionnaires received. And 401 are valid. The results of statistical analysis are shown as follows:

(1) Total innovation capabilities (TIC) have been identified, including market capability, technology capability, organization capability, strategy capability, and culture capability. The TIC can be divided into core capabilities and supplementary capabilities. And the core capabilities are weak while the supplementary capabilities are relatively strong, which may be one of main causes leading SMEs to lack of sustainable competitiveness. For example, most SMEs are relatively strong in such capabilities as response to long-term market (which refers to high concerning the long-term relationship with clients and suppliers), learning and innovative climate, but weak in such capabilities as technology, manufacturing and organizational processes.

(2) In total innovation capabilities (TIC), market capability is relatively strong, while the technology capability is weak. The development of most SMEs has been relied on the opportunities generated in economy transformation. The developmental experience has led most SMEs to pay more attention to make sense of market and follow demand rapidly. Capability-accumulating has been ignored by most SMEs.

(3) Analysis based on the categorizing according to enterprises' scale shows that capability of strategy and that of organizational processes in those enterprises above the average scale are relatively stronger than those below the average scale. The underlying reason may be that management and/or coordination will become more and more complicated with the development

of an enterprise. Consequently, it becomes more and more necessary to improve the effectiveness and efficiency by the means of strategy management and organization arrangement. It is interesting that there are almost no differences in technology capability between the two categories, namely, weak technology capability is not only in the enterprises below the average scale, but in those above the average scale.

(4) Analysis based on the categorizing according to innovation performance shows innovation performance is positively related to core capabilities. The results of statistical analysis show that all the dimensions of total innovation capabilities (TIC) are stronger in firms above the average performance than those below the average performance, especially the capability of organizational processes, technology, manufacturing and the capability of response to short-term market are significantly stronger. It means that innovation performance is positively related to the core capabilities.

(5) Analysis based on the categorizing according to developmental stages shows that higher attention will be paid to technology capability and manufacturing capability with the development of SMEs. That is to say, it is difficult for an enterprise to form its core capabilities at stages of start-up and growing. The closer to the core the capabilities are,the more difficult for them to form. The statistical results show the core capabilities score the lowest, e.g. technology capability, manufacturing capability and capability of response to short-term market, while the supplementary capabilities score the highest, such as capability of response to long-term market, capability of innovative climate and that of learning climate, at the start-up stage. While, at the maturity stage, such dimensions score the highest as capability of response to long-term market, technological capability, capability of learning climate and that of manufacturing. T-test shows that there are significant differences in 9 dimensions mentioned above between the firms at the stage of start-up and that of developing. And all dimensions of TIC are better shown in firms in developing stage than those in start-up stage. The most significant difference is in capability of manufacturing, strategy, organizational processes and technology. When comparing between the firms at developing stage and those at maturity, only capability of manufacturing and that of technology show the significant difference. Firms at maturity stage are better than those at developing stage in the two dimensions mentioned above. Maybe more resources such as capital and R&D staff can be invested into R&D activities with firms growing.

6.2 Theoretical outputs

6.2.1 Articles

The project team has published 19 articles, five of which are indexed by EI, and three of which are accepted by the domestic top journals. And another 23 articles will be published. On the other hand, the number of peer-reviewed articles is 22, non-peer-reviewed 20. The topics involve theory and application of TIM, model and pathways of indigenous innovation, characteristic and pathways of innovative firms, mechanism of leveraging innovation capabilities, theory and application of disruptive innovation, and so on. The list of the peer-reviewed articles is shown in Appendix H and the list of the non-peer-reviewed is listed in Appendix I.

Table 6.1 The main articles

No.	Title	Author(s)	Publication	Type
1	From Secondary Innovation to Total Innovation Management – with the Case of Small and Medium Enterprises	XU Qingrui, CHEN Jin, GUO Bin and CHEN Litian	International Journal of Chinese Culture and Management,2009,2(1): 83-103	Journal
2	The Evolution of Industrial Cluster: Second Innovation and Organization Learning	GUO Jingjing, WU Xiaobo	Study in Science of Science, 2008,26(6)	Journal
3	Entrepreneurial Orientation of New Entrepreneurial Firms: Dimensions, Measurement and Validation	LIU Jingjiang	Journal of Dialectics of Nature, 2009,4	Journal
5	Comparing Research on the Indigenous Innovation Model	ZHAO Xiaoqing, XU Qingrui,	Journal of Zhejiang University (Humanities and Social Sciences), July of 2009	Journal
6	Total Innovation Management Capability and Innovation Performance in SMEs: An Empirical Study Based on SME Survey in Zhejiang Province	XU Qingrui,, CHEN Jin, CHEN Litian, JIN Lu, LOU Dong	IEEM2008, December 8-11,2008,Singapore	Conference
7	The Mechanism of Innovation Capability Leveraging via Strategy in SMEs	CHEN Litian	IEEM2009,December 8 -11,Hong Kong, China	Conference
8	A Research on the Mechanism of Leveraging Innovation Capabilities via Entrepreneurs in SMEs	ZHANG Suping	IEEM2009,December 8 -11,Hong Kong, China	Conference

6.2.2 Special issue and book

A special issue of *Journal of Industrial Engineering and Engineering Management* has been published, on leveraging innovation capability of SMEs by applying TIM Theory. The main contents of the special issue includes “how to apply TIM”, “the model and framework of TIM in SMEs”, “the mechanism of leveraging innovation capabilities via TIM”, “the analysis of the application of TIM and the improvement of innovation capabilities in SMEs on the industry and firm level”. The book *Leverage Innovation Capability—Application of Total Innovation Management (TIM) in China SMEs’ Study* will be published by Singapore World Scientific Press and Zhejiang University Press. It systematically introduces the influence of SME innovation capability leveraging by TIM, which strengthens the TIM theory’s influence at home and abroad. Special issue and books are the core outputs of this Project. The detailed contents of special issue are shown in Appendix I. The outline of the English book is shown in Appendix J.

6.2.3 Case reports

Totally, we have investigated 44 SMEs, and 21 complete case reports have been finished, including the report of SUPCON Group, Sunyard System Engineering Co.,Ltd, Hangzhou Honyar Electric Co., Ltd., Zhejiang Uni-Power Guarantee, Focused Photonics Inc. and so on. The main contents of case reports include: (1) firm development process; (2) the platform of TIM; (3) benefit analysis and mechanism of leveraging innovation capability; (4) the main successful experience and problems of firms. The detailed case reports are shown in Appendix (D-G).

6.2.4 Academic Conference and Workshop hosted by the project team

The RCID with IDRC project team jointly organized the 6th International Symposium on Management of Technology （ISMOT2009）with NIIM & School of Management of Zhejiang University, which was held in Hangzhou, P. R. China, 23-25 October 2009. The theme of this conference is Open Network and Total Innovation toward Innovative Country. ISMOT2009

attracted participants from academics, industries and government from all over the world. She continues her tradition which strongly links academic, industry and government, brilliant scholars, CEOs, CTOs have been invited as keynote speakers. Professor XU gave a presentation titled "Toward Innovative Firm via Application of TIM to Leverage Innovation Capabilities of SMEs". REN Zongqiang, a PhD student in IDRC project team, gave a presentation based on the paper titled "Based on TIM to Leverage the Technological Innovation Capability with the Case of SMEs". ZHANG Jun, a PhD student in IDRC project team, gave a presentation based on the paper titled "Organizational Structures Changing with Capabilities Dynamization in SMEs: a Case Study in JGST". FANG Jincheng, the team member in Fuzhou University, which located in Fujian province, gave a presentation based on the paper titled "Research on Applying TIM Theory to Improve the Innovation Capability of SMEs in Fujian Province". CHEN Feng, a Master candidate in IDRC project team, gave a presentation based on the paper titled "Leveraging Innovation Capability via Culture".

Figure 6.1 The key members of IDRC project team and some famous professors in the IDRC-workshop

The ISMOT workshop was held by IDRC project team on Oct.24, 2009. The aim of this workshop is to introduce the activities and main research findings of IDRC project team and ask suggestions from scholars. Hot discussions about the research findings were conducted. What's more, scholars also gave suggestions for our further study. The importance of industries-universities-institutes cooperation was emphasized by many scholars. ASHEIM Bjorn, a professor of Lund University in Sweden, said, "We need to look at SMEs' innovation policy. Generally SMEs are not very innovative, which don't make them really safe, don't see the problem, don't see the potentials and do not tend to cooperate with universities."

Figure 6.2 Prof. XU, Richard SMITH, Bent DALUM, Bjorn ASHEIM, LI Mingfang, etc. were discussing in the workshop

The detailed contents of ISMOT2009 and ISMOT IDRC TIM-SME Workshop are shown in Appendix L.

6.2.5 Academic conference attended

Attending the international conferences is beneficial for the diffusion of IDRC Project output. By attending international conferences, IDRC project team members introduced the mechanism of leveraging innovation capabilities by TIM, which strengthens the influence of TIM theory at home and abroad. In the past two and a half years, the main conferences attended are ICMIT2008, ISMOT2009, and IEEM 2009.

Professor XU Qingrui attended the 4th International Conference on Management of Innovation & Technology (ICMIT2008), and gave a presentation about “Innovation capability building of China’s high-tech SMEs based on TIM: two case studies”.

Profssor XU Qingrui, Professor WEI Jiang and five Ph.D students of IDRC project team attended the IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2009), which was held in Hongkong, 8-11 Dec 2009. In the conference, Project team members gave seven presentations, and discussed with scholars all around the world.

Figure 6.3 Prof. XU & WEI, Ph.D students of IDRC project team, and XIE Min IEEM2009 conference chairman etc.

The project team members gave presentations, which focused on leveraging innovation capability via TIM in the ISMOT2009.

The detailed activities taken by IDRC project are listed in Appendix H.

6.3 Practical outputs

6.3.1 Policy briefs

10 policy briefs have been presented to the government. The topics of the policy briefs are described in Table 6.2. The main contents of policy briefs are described in Table 6.3. The detailed policy briefs are shown in Appendix K.

Table 6.2 List of policy briefs

No.	Title of Policy Briefs	Delivered to Government Agency
1	Strengthening industries-universities-institutes strategic alliance to promote Chinese indigenous innovation capability-building	MOST MOE S&T Group of State Council(SSTG) National Planning Office for Philosophy and Social Science(NPOPSS)
2	The global manufacturing network and indigenous innovation of the Chinese large and medium sized enterprises: current situation, bottleneck and solution	NPOPSS Governor of Zhejiang Province State-owned Assets Supervision and Administration Commission (SASAC)
3	Correcting the understanding about the connotation and new trends of innovation	NPOPSS
4	Policies to promote indigenous innovation and the innovation environment	MOST NPOPSS
5	Five Misunderstandings about indigenous innovation	NPOPSS SASAC
6	Choosing the correct indigenous innovation model by using mixed innovation resources integration model	MOST NPOPSS
7	Five major trends of Chinese indigenous innovation capability-building during “12th Five-Year Plan”	NPOPSS Governor of Zhejiang MOST
8	Promoting indigenous innovation of industry cluster, and accomplish ing Industrial economic transformation and upgrading	NPOPSS Governor of Zhejiang National Development & Reform Commission(SDPC)
9	Enterprises of Zhejiang Province need to build a local network of indigenous innovation, promote development of small and medium enterprises	Governor of Zhejiang Province SDPC MOST
10	Some suggestions for the development of productive services	Governor of Zhejiang Province NPOPSS

Table 6.3 Main policy briefs

No.	Main contents of policy briefs
1	a. Analyzing the situation of current industries-universities-institutes strategic alliance: the level is low; the momentum is deficient; it lacks a appropriate benefit sharing mechanism. b. Suggestions: Choosing the manufacturing-studying-researching strategic alliance; Working out a Chinese characteristic way of technology transferring; Implementing an open science and knowledge system and establish the academic priority and reputation system.
2	a. The innovative large and medium sized enterprises should grasp the direction and progress of indigenous innovation, from the technology and strategy topics. b. The large and medium sized enterprises should fully take account of the total innovation, based on the existed business ecosystem. c. The government should provide platform to stimulate the indigenous innovation practice of the large and medium sized enterprises.
4	a. Chinese government should reinforce the education on innovation b. Chinese government also need to establish a completed national innovation system, strengthen the cooperation between organizations, and build up a industries-universities-institutes strategic alliance.
6	a. The obstacles of indigenous innovation: shortage of resources and stimulation. b. Three basic models of indigenous innovations will exist and develop together. c. The government should apply the technological leapfrogging model. d. The resources will be optimized by two ways: collected integration and scared integration.

Table 6.3 Main policy briefs (continued)

No.	Main contents of policy briefs
7	a. Five major trends of Chinese indigenous innovation: The accelerating of global technological activities; The low-carbon economy, energy conservation and emission reduction; The adjustment of international trading structure and in-depth development of Industrial division; The project of building innovative country; Solving the economic and social difficulties
8	a. The innovation capability became a main factor constricting the development of Chinese industry cluster. b. Suggestions for Chinese government: Paying more attention on the industry cluster's indigenous innovation; Carrying forward the pioneering spirit of innovation further; Investing more resources
10	a. Three shortages of service industry in Zhejiang Province: the vulnerable point of the provincial economy development; productive services industry (PSI) obstacle development of service industry; technology-intensive and knowledge-intensive service industry constrict development of PSI. b. Suggestions: The modern logistics industry was the most critical one of the PSI supporting the interactive development of modern manufacturing industry; The different stages, during the upgrading of manufacturing industry, need relative supporting from key fields of PSI.

6.3.2 Training for SMEs managers and government officials

Project team has provided six trainings for SMEs managers and government officials. In all, 30 middle and senior managers took part in these trainings. The main content of these trainings are described in Table 6.4. Detailed trainings about firms and government are shown in the fifth part of final technical report.

Table 6.4 The Main content of trainings

No.	Name	Number of enterprises	Core contents	Major influence for enterprises
1	The 1st IDRC Seminar-TIM Training on Leveraging SME's Capability	58 senior managers	Analysis of the situation SMEs faced; TIM, Open Innovation, the related theory of indigenous innovation	Broadening horizons to get a comprehensive understanding of SMEs' development
2	The 2nd IDRC Seminar-TIM Training on Leveraging SME's Capability	52 senior managers	The mechanism of leveraging innovation capabilities of SMEs via TIM	Understanding the influence of TIM on firms development for application TIM theory
3	Specific Training for Top Management of Shandong Firms	36 senior managers	The development process toward innovative firm and leverage of innovation cap. characteristic in different stage of innovative firms	Understanding the enterprise development process and providing the strategic path to leverage innovation capability for firm planning
4	In-home Training for Sample Firm-Honyar	56 senior and middle managers	How to apply TIM theory and clarify the way to innovative firm and misunderstanding based on the actual situation of Honyar	Analysis of problems in the development process in Honyar and providing reference ideas for that enterprises develop toward innovative firm
5	SMEs training organized by Bureau of SMEs in Zhejiang Province	102 senior managers	Mechanism of leveraging indigenous innovation capabilities and analysis of innovation model; Construction of technology innovation system	Solving the related doubts about the application of innovation theory and carrying out further in-depth application

The main outputs of this project are described in following Table 6.5:

Table 6.5 List of Outputs

Type	Content		Number
Theoretical academic outputs	Peer-reviewed Articles		22
	Non-peer-reviewed Articles (Special Issue)		20
	Book		1
	Main case reports		21
	Conference hosted	ISMOT Workshop	1
	Conference attended	ICMIT2008	1
		ISMOT2009	6
		IEEM2009	8
Practical outputs	Training for SMEs and government officials		304 persons
	Policy Brief		10

6.3.3 The improvement of team members' capabilities

The implementation of IDRC project is beneficial to promote the accumulation of theory knowledge, enterprises practice and social experiences for the entire project team. It can be demonstrated in the following aspects:

(1) Theoretical knowledge Learned and accumulated

(a) Sharing the knowledge learned from reading literatures strengthens the theoretical base, which is the basis of communication and enterprises practices.

As the core of innovation capability, the project involves a broader scope based on the framework of TIM. Every week, Project team collectively read several papers published on the top journals of related fields as well as the books recommended by professors. Regular literature review improves the digestion and absorption of knowledge, and also broadens the team members' view.

Main journals that have been read are as following: *Journal of Business Management*; *International Journal of Small Business Managemen*t; *International Journal of Entrepreneurship and Innovation Management*; *Technovation*; *European Journal of Innovation Management*; *Journal of Technology Management*; *AMJ*; *AMR*; *Research policy*; *Journal of Marketing*; *Journal of Product Innovation Management* and so on.

Books that have been read are as follows: *Innovation To The Core*; *Successful Innovation*;*Compete for The Future*; *Innovation Strategies* And *Performance In Small Firms*; *Building Innovation Capability In Organization* and so on.

(b) Learning and application of research methods

Project team often organizes some experienced teachers to conduct trainings about research methods among team members. Professor XU Qingrui and GUO Bin gave several lectures on how to carry out outline design, survey and writing in case study, as well as data collection and processing. The implementation of the project involves the data processing as well as several case studies. Therefore, the project provides good tools for our follow-up research.

(c) Promoting cross-analytical knowledge

The team members have different background, and thus, new perspectives usually burst out during the process of research and discussion. To some degree, mind of team members has been broadened.

(d) Absorption of external knowledge by attending academic conferences.

The main conferences are as follows: ISMOT09 (The 6th International Symposium on Management of Technology) sponsored by Research Center of Innovation & Development (RCID), GMC09 (The Fifth International Symposium on Global Manufacturing and China)

sponsored by National Institute for Innovation Management (NIIM), and IEEM2008&2009, academic conference sponsored by Chinese Academy of Engineering.

(2) Integration of theory and practice

(a) The design of enterprise survey

Case study is the main content of project. In the implementation of this project, 44 firms have been investigated. The questionnaire design is another essential part of the project. The systemic design plays a guiding role for cases study and data analysis.

(b) Enterprise surveys and practice

By communicating with enterprise employees, team members can understand the firm environment well and acquire related knowledge to improve case study. Integrating with the analytical knowledge, team members find new problems in firms to enhance the team capabilities. Corporate practices also help us accumulate some social experience, such as how to communicate with other people and how to solve practical problems.

(c) Case writing promotes integration of theoretical knowledge and survey finding.

The project team conducts case writing, case reporting and case discussion. At the same time, theoretical knowledge used to explain the problems about enterprises development. With the promotion between theory and practice, analysis capability and summary capability of our team are being improved.

(3) Cooperating with government

One of the main characteristics of our project is the cooperation with government. We regularly communicate with government officials and show our research output to them. What's more, the involvement of government, such as EIC, BOSMEs, BOST of Zhejiang Province, facilitate the questionnaire delivery and the selection of case study sample.

(4) The improvement of other social experience

Other related activities have also been organized, such as firm surveys, innovation management forums, and regular seminars. The entire process strengthens the capabilities of project team members.

The enhancement of capabilities is described in Table 6.6.

Table 6.6 The enhancement of capabilities

Capabilities	Item	Improvement of Capabilities	Milestone
Theoretical capabilities	Articles writing	The depth and quantity of articles increase	The entire project team published 42 papers
	Academic conference	From participating and learning in international conference to making corresponding report	The project team CHEN Feng, ZHANG Jun, REN Zongqiang, CHEN Litian and ZHANG Suping make academic reports in the conference of ISMOT09 Workshop and IEEM2009.
	Project proposal	From taking part in project to designing project	Designing project proposal funded by the Chinese Academy of Engineering and com
Practical capability	Case reports writing	Based on the integration theory and practice, the project team summed up the experience and analyzed the improvement of innovation capabilities	21 main case reports
	Firm practice	Designing survey program to conduct firm practice, summing up the experience and taking part in firm practice	Team members designed the survey program to guide the investigation about FPI, R&D design; CHEN Litian often took part in the daily work in Sunyard; Participating in the application of National S&T Progress Award with SUPCON Group.
	Communicating capability	The expansion of communication surface and capabilities	The frequency, depth and breadth of communicating with government officials (EIC, BOST and BOSMEs), firms and domestic and foreign scholars increased
Team capability	Organizing capability	Reflected in the organization of activities	The preparation and carrying out of ISMOT 2009 workshop and the meeting with Zhejiang Government Officials & Scholars
	Collabrating capability	Reflected in the completion of the project	The project team finished the project funded by Bureau of Science and Technology in Zhejiang Province
	Sharing capability	Communication among team members and with government officials increased	The research output of questionnaire survey of the project was adopted by EIC of Zhejiang Province

Note: 1. Taking RCID (ZJU) Research Team as the example.

2. The information about the articles is shown in Appendix H and Appendix I.

3. The details about the international conference attended by the project team are shown in Appendix M.

4. The main contents of case reports are shown in the fifth part of final technical report.

5. The details about the team learning and the communication among internal team members are shown in the Part 5 Section 3 of the final technical report.

7 Science and/or Research Outcomes

The research group has focused on the problem of how to leverage the innovation capabilities of SME. Based on the Total Innovation Management (TIM) Theory, which was proposed based on the studies of large-sized enterprises' innovation capabilities leveraging, we have explore the applicability and applied pattern of TIM framework in SMEs. A variety of methods have been adopted such as multi-case study, statistical analysis, and so on, to conduct our studies. After about two and a half years' research, we have acquired the research outcomes as follows.

7.1 TIM framework for SMEs

7.1.1 Elements for capability leveraging in SMEs

SMEs are one of the most important components in a national economy. However, most SMEs are lack of competitiveness. Therefore, it is necessary and urgent for SMEs to leverage the capabilities to gain competitive advantages. Innovation capabilities leveraging is of the great importance.

Total Innovation Management (TIM) theory was proposed based on the study of large-sized enterprises, and it has been proved to be adaptive to large-sized enterprises. Whether TIM theory is adaptive to SMEs need to be proved.

Our research group has investigated 44 SMEs in the past two and a half years. Based on in-depth investigations in typical enterprises, the distribution of elements in SMEs' capabilities leveraging has been shown in Table 7.1.

Table 7.1 Elements for capability leveraging in SMEs

Enterprises / Elements	FPI	Honyar	Jvxing	Yinhe	Tiantang	Futong	Sunyard	Feiyar	Hengtian	Huadong	Sanyuan	Sunon	Gaobo
Leadership/organization	★	★	●		★	★	★	★	★	●	●	★	●
Strategy	★	★			★		★		★		★		●
Core competence cultivating		★		◇		★	●	●	●				◇
Culture			◇	★		●							
Technology	★	●	★	★	★	★	●	★	●		★	●	
Market	★	●	★		★		★		★	★	●		●
Innovative talents	★	★		◇			◇	●	◇				
HRM	●	★			◇		◇		◇				
Capital accumulation			●	●	●	◇	◇			★		●	◇
Network and outsourcing	●			●			●	★	●	◇			
Management/ Institution	●		★	◇	●	●	●	◇	●			★	◇
Knowledge management								●					★

★ — very important (5) ; ● — important (3) ; ○ — general (1)

Seen in Table 7.1, we can find that leadership/organization, strategy, technology, and market have been recognized as very important elements of innovation capabilities. Innovative talents, core capability cultivating, management/institution, network/outsourcing, capital have been thought important in capability leveraging. While culture, knowledge management, and human resource management have not arose highly concerning.

We have conducted in-depth interviews in those enterprises mentioned above and found that some elements necessary and common to almost all SMEs, in all the elements listed in Table 7.1. They are

strategy, technology, market, leadership and/or organization, and management. Among the five elements, leadership refers to the power of entrepreneur, who is the core of an SME. Meanwhile, for SMEs are lack of innovative resources, they should have to build up their networks to support innovative activities, which are the most important complementary assets. In practice, all those elements play a role in innovation capabilities leveraging. Based on these investigations, we can draw a primary conclusion that the TIM is adaptive to SMEs, however, some differences existing between large-sized enterprises and SMEs.

7.1.2 TIM framework comparison between SMEs and large-sized enterprises

We have proposed the framework of total innovation management in 2002 based on the studies in large-sized enterprises, such as Hair Group. TIM has played effective roles in leveraging large-sized enterprises. And based on the case-study, the research group has concluded the framework of TIM in large-sized enterprises, which is displayed as Figure 7.1.

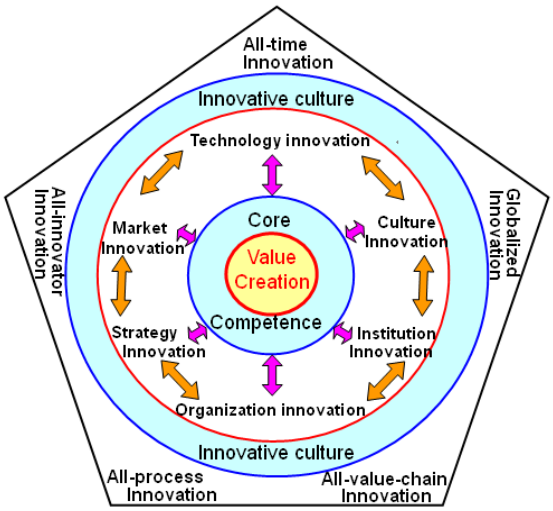


Figure 7.1 TIM framework in large-sized enterprises

Depicted as Figure 7.1, we can see in a large enterprise, innovation is all-element innovation. And all-element innovation refers to innovation including technology innovation, culture innovation, institution innovation, organization innovation, strategy innovation, and market innovation. All-element innovation is synergized by innovative culture. Besides all-element innovation in large-sized enterprises, all-time innovation, all-innovator innovation, all-process innovation, all-value-chain innovation and global innovation are important components of a comprehensive innovation management, namely, total innovation management (TIM). After almost eight years' research, TIM has been proved to be effective to leverage innovation capabilities of large-sized enterprises.

The research group has explored the applicability and applied framework of TIM in SMEs. And the TIM framework in SMEs has been depicted as Figure 7.2.

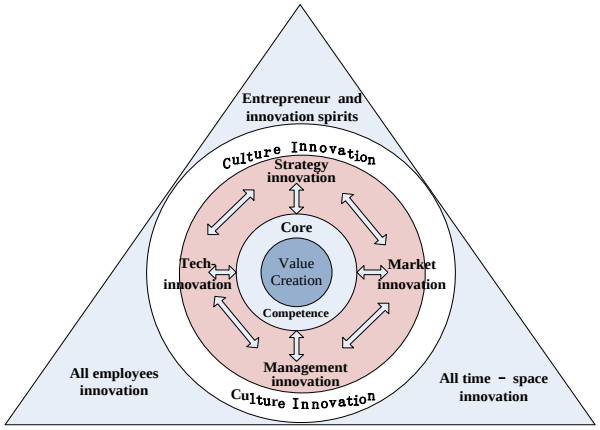


Figure 7.2 TIM framework in SMEs

The research group has explored the TIM framework in SMEs. There are some differences existing in TIM framework between large-sized enterprises and small and medium sized enterprises.

Firstly, entrepreneurs and entrepreneurship play more critical roles in SMEs. Innovations in SME may hinge mostly on an entrepreneur personally. Compared with the top manager in a large sized enterprise, the entrepreneur in SME can make better use of her/his personal charm and/or influence to promote or urge innovative activities to be carried out. Therefore, the entrepreneur is the key factor to SME' innovation.

Secondly, elements involved in total innovation are different. In large-sized enterprises, all-elements include strategy, market, management, organization, technology, institution and culture. While in SMEs, the element of organization and that of institution have not been included. Maybe in an SME, the informal structure and uncoordinated processes could provide more flexibility, which is conducive to respond to market or demands rapidly. By comparison, a formalized organizational structure and well-designed processes will do help to coordinate most activities in large-sized enterprises. Meanwhile, in SME, most institutions have not formed and some principles take the roles of coordination.

Finally, all-space innovation in large-sized enterprises is implemented as all-process innovation, all-value-chain innovation, and global innovation. While, all-space innovation in SMEs is not as conspicuous as that in large-sized enterprises. The characteristics of SMEs make them have no conditions and/or necessity to implement all-processes innovation, all-value-chain innovation and global innovation.

7.1.3 TIM promoting SMEs to leverage innovation capabilities

Firstly, the elements of total innovation capabilities (TIC) in SMEs distribute differently between large-sized enterprises and SMEs. For example, organization innovation, as an important element in large-sized enterprises, is not conspicuous in an SME. Namely, the elements of TIC are less in SMEs than those in large-sized enterprises.

Secondly, enablers to leverage innovation capabilities are different between large-sized and small and medium-sized enterprises. Entrepreneurs, business model innovation, and relevant policies and environments play more important roles in enabling an SME to enhance its innovation capabilities than those in large-sized enterprises. While new product development (NPD) plays a more important role in large-sized firms than that in SMEs except for high-tech SMEs.

Thirdly, the dimensions of innovation capabilities are distributed differently between large-sized

and SMEs. For example, the dimension of market and that of creative ideas are more common in the innovation capabilities of SMEs than in that of large-sized enterprises. Most SMEs' growth depends on market opportunities in the history of their development. This kind of developmental experiences has led SMEs to follow market excessively rather than to accumulate self core capability. In fact, the statistical results presented above have shown that SMEs are very weak in technological capability, which is consistent with the result of large scale questionnaire survey.

Finally, surveys in Fujian Province have shown that the form of innovation capabilities leveraging in SMEs via TIM is characterized as dominant element innovation synergized by peripheral multi-elements innovation. The dominant element may differ in different SMEs and at different development stages, which has been presented different innovation types, such as resource-oriented innovation, project-oriented innovation, brand-oriented innovation, quality-oriented innovation, and so on.

7.2 TIM theory: paradigm shift

7.2.1 From technology-dominant innovation capability to total innovation capability (TIC)

In 1980s, the research findings of the Project supported by World Bank had put forward four key dimensions of technology capability, which include human resource (H), information (I), technology (T) and organization (O). Among these dimensions, the core dimension is technology. This framework was appropriate to the situation of 1980s. At that time, manufacturing industries was the focus of development. Therefore, how to enhance the technology capability is the key problem. The status quo led academies to pay more attentions to the technology capability and its improvements. Consequently, the HITO framework of technology capability was proposed under those conditions.

With the development of world economy, the attentions paid merely to technology capability gradually exposed their limits. An enterprise does not just rely on technology. Therefore, technology capability should not be the only factor to determine an enterprise' development. With the environments become more and more fierce, an enterprise has to change itself to keep pace with the changes outside environment. Innovation, which was proposed by J. Schumpeter firstly in 1912, as a means of acquiring super-profit, has raised scholars' and practitioners' high concerning. Then the attention to technology capability has been converted to technology innovation capability.

In 1990s, information technology and networking technology had made advance by leaps and bounds. Simultaneously, the world economy headed its way for globalization more rapidly. How to gain the competitive advantage for an enterprise become increasingly severe. Value creation model becomes diversity. The capability of technology innovation may not be able to support an enterprise to face the intense market competition any more. Consequently, an enterprise need unlock potentials of all the elements by all kinds of means or even in all places and all the time. With regard of this issue and based on many years of research, Professor XU Qingrui and his research group put forward the total innovation management theory in 2002, after raising secondary innovation theory and portfolio innovation theory. And the paradigm of innovation changes from technology-dominant to total innovation.

7.2.2 Key dimensions of TIC

We have explored the key dimensions of innovation capabilities. Based on multi-case studies and statistical analysis, we conclude the dimensions of innovation capabilities as culture (C), knowledge-base (K), leadership and organizational learning (L), and management (M).

We admit that human factor is the core of capability. However, what is the core of human factor? We have to say: human resource is not equal to real capability. S company, for example, has quite a lot

of talents with undergraduate or even postgraduate backgrounds. However, performance of S company was unsatisfactory. We surveyed and found that most employees had no initiative to do their jobs. Even some ones were always ready to quit from S company. In turn, no salient capability has been built up. A firm is bundles of resources (Penrose, 1959). The key is who can play the role of making all resources become the bundles. In our surveys, we find that culture is the underlying determinant which will drive a person to think and act. From this perspective, innovating, as a kind of action, is a kind of cultural phenomenon to some extent, especially under the conditions of high-involvement innovations. Each person has been embedded in more than one social network. Culture, as one of the most components of a social network, plays a critical role to drive a person to take some given thinking ways. Therefore, human resources are the necessary but not sufficient condition of capability. Only if the human resources have been integrated by positive culture can they be transformed into real capability.

With the status of competition becomes more and more fierce, core capability building becomes more and more important. In times of knowledge explosion, knowledge has become the strategic assets of any firm or even those of any one. According to OECD, knowledge can be categorized as knowledge of know-what, know-why, know-who, know-where, and know-when. Most types of knowledge, compared with information, can guide a person to think or act directly. However, information needs further processing for usage. Meanwhile, information processing also needs knowledge. Therefore, knowledge has become the base of capability accumulating in the knowledge economy era.

Just as revealed in our surveys, in SME, the entrepreneur plays the critical roles in innovative activities via his personal influence and the influence's transitive way. In fact, the transitive way of an entrepreneur's personal influence is the way of information or knowledge transmitted. Barnard had pointed that the essence of an organization is a communication system. Both organizational structure and organizational institution are established to be conducive to communicating and information or knowledge flowing. Therefore, more and more attention has been paid to the leadership and organizational learning.

Finally, all the dimensions mentioned above need to be coordinated to unlock their synergic potentials. The coordinating role is to be charged by management. As known to all, the essence of management is coordinating.

In sum, with competition environment becoming more and more fiercely, more and more attention has been paid to innovation capability rather than technology capability only. The key dimensions of capabilities have developed from H-I-T-O of technology capability to C-K-L-M of innovation capability. We can find that the dimensions of capabilities care more attention to soft components such as culture. Total innovation management (TIM) theory proposed in 2002 by Professor Qingrui XU provides a new perspective to manage innovation capabilities, which emphasizes synergizing among all-element innovation, all-time-space innovation and all-innovator innovation. The synergic effect between hard components and soft component in capabilities leveraging has aroused high concerning. Therefore, the paradigm of capabilities leveraging has changed from leveraging of technology capabilities to technology-dominant innovation capability, and then to total innovation capability.

7.3 TIC and rules of TIC in SMEs

Our research group has searched information on innovation of SMEs in the database of National. Bureau of Statistics of China. Meanwhile, a large-scale questionnaire survey has been carried out. Based on the analysis of data, the rules of TIC revealing in SMEs can be summarized as follows:

（1） TIC can be divided into core capabilities and supplementary capabilities. The former is the determinant of sustainable competitiveness and the later is related to short-term profit.

In general, SMEs are weak in total innovation capability, especially the core capability, such as technology capability, strategy capability and manufacturing capability. Some supplementary capabilities, such as long-term market capability, are relatively strong in SMEs.

（2） The more close to the core the capabilities are the more difficult and longer time needed for them to form. Since the core capabilities are so important for gaining sustainable competitiveness, SMEs have to learn to keep an eye on gaining short-term profit and keep the other eye on cultivating core capability from the beginning. Of course, sustained investing is of the most importance in core capability accumulating.

（3） Total innovation capabilities of different SMEs in different stages show different dominant elements. For example, a high-tech small firm in its start-up stage, e.g. FPT, technology capability was the most important capability. With the development of FPT, market capability became more and more important. Then the capability of manufacturing became the focus of capability leveraging. Now, FPT focuses its attention to obtain the synergic effect of all elements innovation, which will be conducive to form the core capability. By contrast, a service firm may have the dominant element such as market capability at the beginning stage, e.g. R&D Design. When R&D Design grows up, it began focus on manufacturing capability. Then the service package providing become the main business, the synergic innovation of all elements become the most important concerning.

In sum, the theoretical outcomes can be summarized as follows:

（1） The paradigm of capability leveraging has changed from that of technology capability leveraging to technology-dominant innovation capability leveraging, and then to total innovation capability leveraging. TIM theory has provided an appropriate framework to leverage innovation capabilities. And TIM theory has made great advance in promoting innovation management theory to develop forward.

（2） The TIM framework in SMEs has been explored. We have identified the dimensions of total innovation capabilities (TIC). Differences in TIM framework between large-sized enterprises and small and medium-sized enterprises have been identified.

（3） The total innovation capability (TIC) can be divided into core capability and supplementary capability. The core capability is positively related to innovation performance. And the core capability needs time and resources to be built up.

8 Project Outcomes on SMEs

Strategic and structural challenges force SMEs to seek resources to implement sustainable innovation. Furthermore, the downturn has a great impact on Chinese SMEs due to their poor resource/capability, scattered allocation, weak competitiveness, and so on. Never before has innovation been so critical to the development of economy and society. Although crisis can be addressed as the catalyst for structural innovation, the precondition is the existence of an aggressive and proactive strategy to use the downturn as an opportunity. These challenges indicate that that SMEs need to search a more comprehensive approach to manage innovation. The need for an integrated innovation agenda in China is apparent. However, how can SMEs realize that the integrated innovation and what kinds of changes will be produces for SMEs in China? Based on analyzing the status quo of innovation in SMEs, this project constructs an analytical and practical paradigm to leverage innovation capability of SMEs and thereby contributes to the social and economical development of China. In order to illustrate this section in detail, we map out a way to understand the outcomes of "TIM-SMEs" project on SMEs. (See Figure 8.1)

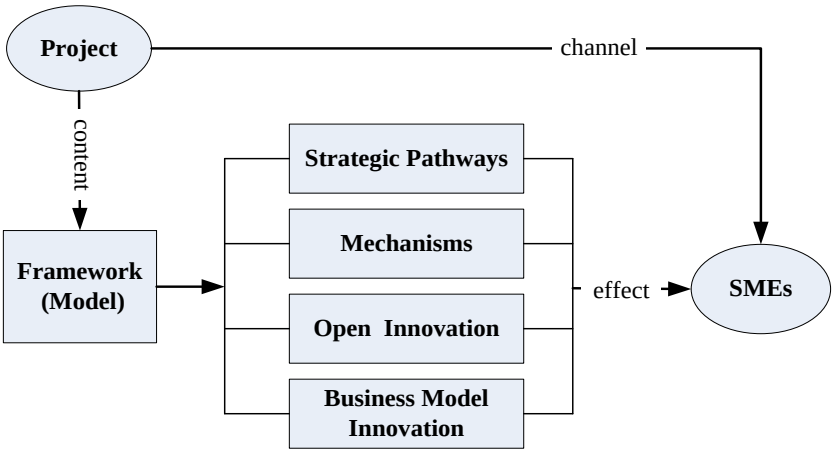


Figure 8.1 Map of project outcomes on SMEs

TIM is an advanced innovation theory that dynamically integrates the strategy, technology, structure, market, culture, and members at all levels of an organization. TIM has broken through the traditional paradigms of innovation management, and has achieved outstanding results in practice. In addition to understanding the common rules of innovation management, the theory also has answered the specific problems of innovation management encountered in Chinese context to the SMEs, and has helped them deal with innovation dilemma in current situations. For example:

"TIM helps us not only capture the essence of innovation, but also eliminate the fear of innovation."

"Don't attribute poor innovation to poor resources. It's the process, not the pocketbook. TIM offers the locus of innovation process."

"Output, quality and benefit is just indicators, not targets, we should pursue value added by

innovation."

"What time to innovate is obvious, but how to start is still very vague, TIM shows me the way."

From the feedbacks of interviewees above, we can see that TIM really plays on SMEs and advances innovation management. Theoratically, TIM helps SMEs understand the nature of innovation and establish the right innovation strategy. In practice, TIM broadens innovation horizon for SMEs and builds a systemic capability well-matched with the company's growth. Table 8.1 provides a summary of the project outcomes on SMEs.

Table 8.1 Summary of the project outcomes on SMEs

Innovation management	Leveraging innovation capability
• Cognition & vision • Innovation landscape • Innovation strategy	• Strategic pathways • TIM model for SMEs
• Innovation system • Locus of innovation process	• The Matrix of leveraging innovation capability • Enablers • Open innovation & networking • Business model innovation & differentiator

8.1 TIM-SME project outcomes on innovation management of SMEs

8.1.1 Changing the cognition and mental model to innovation

SMEs face strategic and structural challenges which will require sustained innovation from many resources. TIM is a new paradigm of innovation which is to leverage the enterprises' capability by the synergy of various innovation elements. And it reflects a management philosophy that views innovation as an integral part of conducting business. Furthermore, TIM delivers more than an innovation management approach; it can change an entire social system into new ways of thinking and organizing. As for SMEs:

- The nature of innovation is more than just invention or R&D, it is about doing things differently to deliver value to clients and capture value for the organization.
- Broadening the innovative horizon. TIM helps SMEs carry out innovation in a new landscape, including all elements innovation, all time-scope innovation and all members innovation.

Case 1

YAO Naxin, the CEO of Focused Photonics Inc., appreciates our opinions-"Innovation is not just the single technology or market innovation. We need a broader perspective to implement innovation". And he states that, "TIM should be implemented in our enterprise progressively, selectively and hierarchically."

Quoted from the Interview Records 2008.11

8.1.2 Guiding innovation management of SMEs in strategic way

SMEs must adapt themselves to a changing environment, and they need a positive innovation theory to convert innovation into competitive advantage. This study provides a strategic framework for Chinese companies to assess their potentials and identify innovative ways to move up the global value chains in their respective industries. For example, TIM stresses growth mode

and sustainable development by the implementation of multi-dimensions innovation: shifting away from efficiency to the quality of growth, from price to value, and promoting enterprise restructuring and upgrading.

8.1.3 Helping SMEs to build up total innovation capability

Primarily due to the lack of integration, innovation still poses real challenges for Chinese companies (IBM Global Business Services, 2008). Especially, SMEs need to construct an integrated innovation architecture to enhance innovation elements synergy or interaction, so as to improve the efficiency of resource use. Accordingly, innovation should be taken as a strategy rather than a function. Companies don't maintain a separate department for innovation, but rather integrate innovation as an overarching concept into the everyday process. As a result, innovation becomes a state-of –mind that guides both employees and corporate decision-making.

The views above are supported by our survey results. We carried out field studies in 44 SMEs. The List of case study samples is shown in Appendix B. As shown in Figure 8.2, most respondents (about 80%) report that TIM is "very" or "extremely" important to their management and innovation. About half of respondents (47.7%) indicate that they would adopt TIM to their innovation agenda. Furthermore, 18.2% of respondents has implemented TIM to their innovation working during the progress of this IDRC project operation.

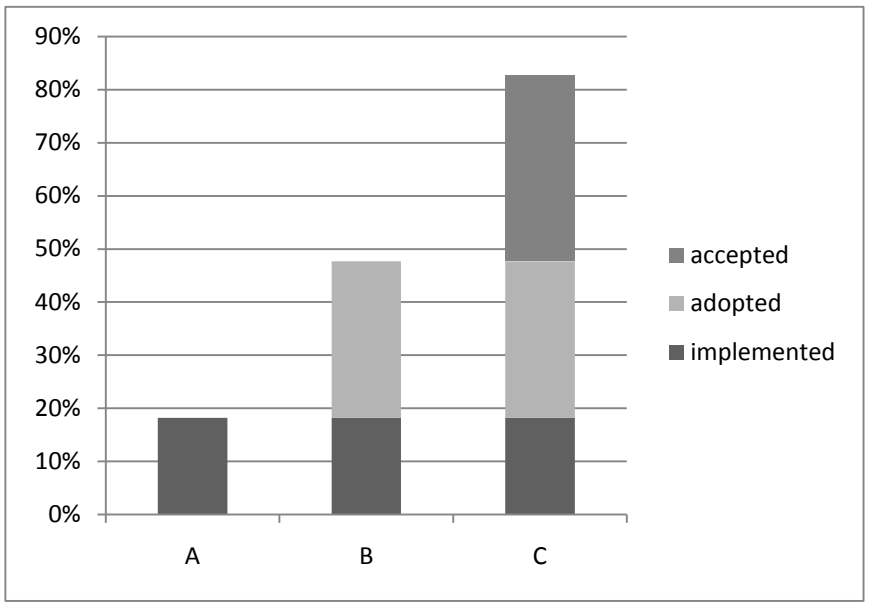


Figure 8.2 SMEs standpoints on TIM (n=44)

Note:A∈ B∈C

Implementation means the firm has developed strategy, objectives and implementation plan about TIM, and has established a TIM platform/ system, as the All Elemrnts Innovation (AEI) have reached, the All Time-Space Innovation/ All Innovators have partially reached, thus the Innovation platform was built-up. and innovation capability/ performance were obviously leveraged/improved.

Adoption means the firm have adapted TIM in their innovation agenda, and they have begun to take measures to implement. All Element Innovation were mostly achieved, and the innovation

capability/performance was improved gradually.

Acceptance means the firms are interested in TIM, and they have accepted the theory and implementation mechanism. They would promote/ advocate a climate for a comprehensive learning.

Case 2

Hangzhou Honyar Electrical Co., Ltd has achieved tremendous success based on the implementation of TIM in Financial Crisis. Total innovation model in Honyar is technology + management+ business model.

Technology innovation: Adhering to the market-oriented technology innovation, taking the market trend as a basis for designing future product structure and using high-tech and advanced equipment to upgrade the technology and product level.

Management innovation: Based on IT, management philosophy, management style, and organizational structure have been changed to improve the management capability. IT is an important way to practice the core values, "the pursuit of speed," "concerning about the cost," and "careful attention to detail".

Business model innovation: According to the different characteristics of the existing diversified industries, company designs the corresponding systems of the commercial operation, and strengthens the analysis on value chain to gain competitive advantages. At present, Honyar aims to improve the capability of autonomy manufacturing and explore new business including network marketing according to new market trends.

Adapted from survey report 2009

8.2 TIM-SME project outcomes on leveraging innovation capability of SMEs

8.2.1 Implementation models of TIM in SMEs

TIM is a new paradigm of innovation which is to leverage the enterprises' capability by the organic combination of various innovation elements. Due to SMEs' characteristics of size, resources, management, technology etc., the implementation of TIM in SMEs is different form that in large enterprises. (See Figure 8.3)

Due to the unique characteristics of SMEs (such as cost advantage, new properties of product etc.), at the startup stage, they can make full use of advantages to develop quickly. With the growth, they can integrate various innovation elements to pursue further development. Three typical paths of implementing TIM in SMEs have been explored and verified by case studies.

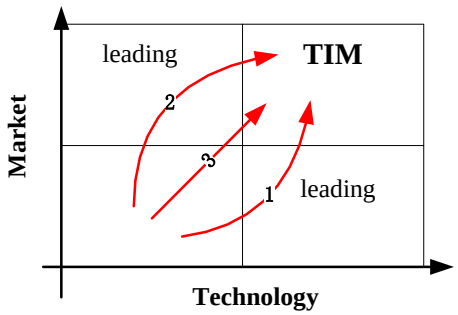


Figure 8.3 Three typical path of TIM implemention in SMEs

(1) From Technology Innovation (leading) to TIM: Technology innovation is the mainline of innovation management. Firms are linked to leading-edge technology and are able to provide NPD that can continuously drive innovation. For example, Futong Holdings has broken through the core technology bottleneck and grasped synchronize technology of preformed bar of optical fiber by continuous innovation.

(2) From Market Innovation (leading) to TIM: Market is a main driving force for innovation. There are a variety of ways to increase market share. For example, Tiantang Umbrella distributes a great diversity of umbrellas to capture niche markets by continuously researching customer needs.

(3) From Technology - Market Integration to TIM: Firms focus on both ends of "Smile Curve", that is to say, they adhere to the business principle of "technology innovation internally as push force and the market innovation externally as pull force". For example, Focused Photonics Inc. provides global customers with advanced high-end analysis measurement products and process analysis solutions, and leads the market with R&D.

From the framework and typical models above, main attributes of TIM are concluded: Expanding the vision of innovation management and focusing on synergy to aggregate strength.

- Changing the cognition and mental models to innovation
- Expanding the landscape of leveraging capability
- Helping SMEs to establish total innovation system
- Guiding innovation management of SMEs in strategic way

As innovation appearing to be a dynamic and continuous process, the starting point of SMEs' stage by stage innovation- dominant elements are advanced with the times. It includes 4 links.

(1) Alternation between old and new: Former form is faded, while rising element is highlighted. When the former element-oriented innovation pattern appears to weaken value, the element which is in line with the market demands and enterprises' development trend in the new period will highlight to meet the tendency, and the former head element of later development elements sequence will update to be the new dominant element.

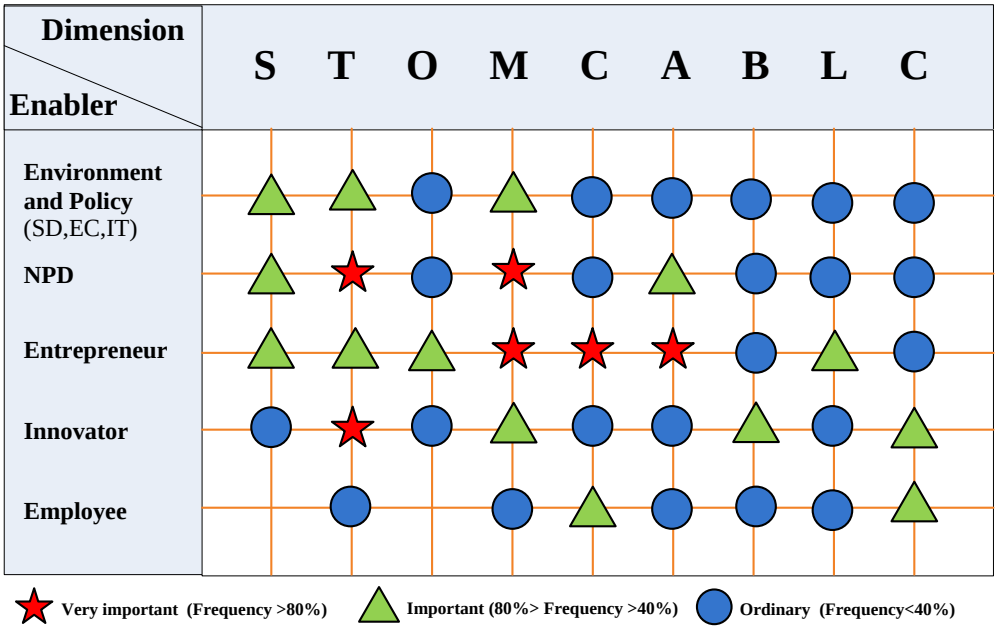
(2) Convergent innovation: mainstream innovation lead, new stream innovation gestates. It is the key link of element-oriented innovation pattern evolvement. When mainstream innovation leads the current stage innovation, at the some time, the new stream which represents the trend of future development of enterprise is gestating and saving up strength to start out; both of them are interactive and complementary during the whole innovation process of SMEs.

(3)Result representation: dominant model generate, dominant pattern appear. Under the dominant and promotion of mainstream innovation, dominant innovation model and dominant innovation pattern sequentially generate and exert their innovation effect. The dominant innovation model varies from mainstream innovation to mainstream innovation, and further shows in innovation practices to form dominant innovation pattern.

(4) Meet recycling: fulfill innovation target, and evolvement gestate. Due to the effect exerts of dominant innovation pattern, enterprises realize the periodic goal. However, surviving in the changing competition environment, SMEs can not stop the innovation rhythm. Thus, when former innovation achievements have fulfilled, the new round of evolvement recycling is already.

8.2.2 Strategic pathways of leveraging innovation capability in SMEs

Based on literature review and empirical study, a matrix of leveraging Capability have been constructed and verified in practices of SMEs. (See Figure 8.4)



NOTE:
S-strategy, T-technology, O-organization, M-market, C-culture, A-alliance, B-base L-learning, C-creativity.
SD-sustainable development, EC-e-commence, IT-information technology

Figure 8.4 Matrix for leveraging innovation capability (N=44)

Based on the matrix, three strategic pathways of leveraging innovation capability are proposed as follows:

(1) Total elements innovation strategy

Innovative firms have constructed a strategic platform enabling the synergy of all the elements of innovation capability. However, innovation is dynamic in nature and the combination of elements generating innovation capability is changing at different stages.

- First level: technology innovation /market innovation
- Second level: organization innovation /management innovation
- Third level: strategy innovation /culture innovation

According to the framework of TIM in SMEs, innovation portfolio across three levels in general. Innovation portfolio is not limited to one level, and crossing different levels are more consolidate and sustainable.

(2) Enforcing basic innovation capability strategy

Harnessing capability base can increase firms' adaptiveness and power source to fuel the sustainable development of innovation capability. Strategic initiatives on SMEs' capability-building efforts reflect that knowledge and ideas are primary imports into the innovation process. Important variables of basic capability for SMEs include Innovation networking, learning and knowledge management, creativity and intelligence, as well as basic research and accumulation. On one hand, they expand the breadth of external knowledge searches and facilitate the acquisition of innovative ideas from outside sources. On the other, they foster ingenious knowledge cross-pollination within the firm for initial development of novel capability. For example, core training activities to build the organization's intellectual capital are central to

leverage innovation capability via exploring the following basic capability:.

- Innovation networks
- Learning and knowledge management
- Creativity and intelligence
- Basic research strength, etc.

(3) Innovative talents development strategy

Human resource is the most important element of innovation whose subjective initiative and creativity is the only fundamental driver to promote social development and progress. In preceding matrix, we can find that leaders, innovators (champion) and employees are critical enablers for sustainable innovation. For example, characteristics of CEO, leadership skills, and management philosophy that support innovation can positively influence innovation capability in organizations. The strategy of innovative talents included.

- Innovative entrepreneur and entrepreneurship training
- Innovator training and activities
- All-invovlement innovation, etc.

The study identifies relationships between innovation elements and innovation strategies at different stages of capability building and suggests that alternate strategic pathways foster innovation.

Case 3

Based on TIM, Focused Photonics Inc. established a plan of three-stage innovation management. With the development of enterprise, they would expand the innovation horizon to pursue total innovation.

Level	First stage	Second stage	Third stage
Technology+Market			
Organization+ Management			
Strategy+Culture			

At the first stage, they focused on technology and market innovation to accumulate resources, experts and capital, etc. At the second stage, the reform of organization has been carried out to improve and refine innovation system. For example, a matrix of organization structure and IPD process, has been constructed to increase efficiency. A series of new institutions to motivate employee also has been developed. At the third stage, they will promote the strategy and culture innovation, and construct a new innovation architecture to generate a high level of communication throughout the company.

Adapted from survey report 2009

Case 4

Fujian Haiyuan Automatic Equipments CO., LTD was set up in 1998. It is a private enterprise about building materials machinery manufacturing.

Haiyuan following the guidance of TIM theory, explored and analyzed the principle contradiction and problems in each stage; studied each stage's innovation characteristics and element-oriented innovation shape; and found out their own unique features in innovation: project-oriented innovation model, element-oriented innovation shape upgrading path, product-oriented technology innovation teams cultivation path, consulting "Win-win" marketing mode and 5S service system, matrix organization structure, unique quality management system, green "harmony" culture system, the unique TIM platform which is able to generate sci-tech SMEs upgrade to innovative SMEs. To sum up, TIM theory offers an important theoretical guidance for Haiyuan's development course.

Adapted from survey report 2009

8.2.3 Mechanism of leveraging innovation capability in SMEs

We conflate the literature reviews with surveys to present a holistic framework to demonstrate the mechanism of leveraging innovation capability. (See Figure 8.5)

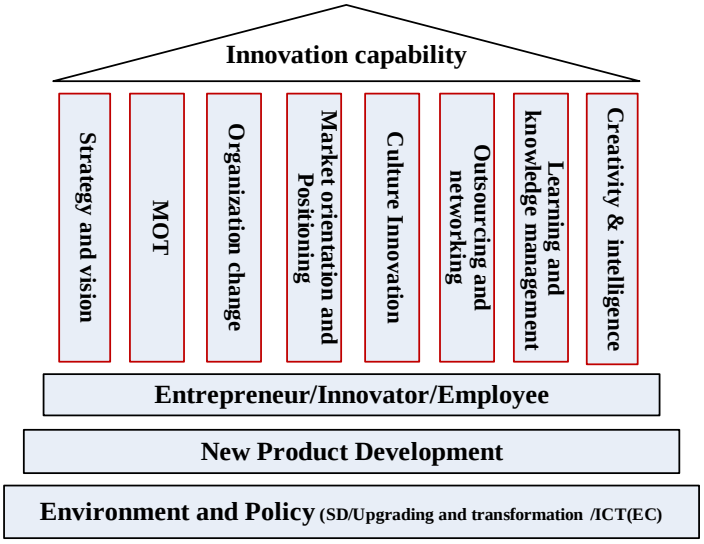


Figure 8.5 Mechanisms to leverage innovation capability via TIM

The Mechanism of leveraging innovation capability can be achieved by sub-mechanisms which are consisted of key elements in SMEs. In order to help SMEs capture the essence of the mechanism, we will analyze the detail contents of various mechanisms.

(1) Strategy and vision

- Guided by the clear and shared vision, limited resources can be allocated in a more suitable way, so that the efficiency of new product development can be improved.
- Fitness between organizational structure and strategy influence the innovation capability building by changing the style of organizational learning and resources allocation.
- Innovation capability can be leveraged if corporate culture and strategy are fit with each other. And organizational learning acts as a mediator during the process.

Case 5

Sunyard System Engineering Co., Ltd has a practical strategy grounded in original, deep insight:

First, Mr Guo, the entrepreneur, possessed a strong market perception capability. During the strategy formulating stage, he integrated the technological capability and market demand, which was beneficial for the core capability establishment.

Second, when the strategy was implementing, the entrepreneur kept the organization structure and the strategy fit. Both of the changing the resources distribution oriented strategy and the organizational learning method encouraged the accumulation of the core capability. On the other hand, Sunyard transformed from strategy-restricted culture to strategy-assisted culture, which focused on the main contradiction within the organization. The company commenced the work from employee's thinking, improved the organizational consent of the strategy and ensured the strategy's implementation.

The experience of leveraging innovation capability by strategy innovation is summarized as following:

- Integrating market demand and technological capability when making strategy
- Establishing strategic platform to coordinate innovation capability elements
- Combining different capability such as organizational structure, technological capability to support new product development
- Transferring the strategic poison from product maker to solution provider

Adapted from survey report 2009

(2) Management of technology

- Using technology and knowledge accumulation to harness the capability base
- Building core tech capability by integration
- Adjusting the structure of technology by strategy orientation
- Joint innovation mechanism to promote technological innovation: for example, user-led innovation will become even more important to harness user ideas in innovation and to help firms select innovations to meet customer needs.
- Optimizing resource allocation to motivate and support innovation by organization and process.

Case 6

In order to enhance technology capability, all time-space innovation has been implemented in Sunyard.

First, the "Research Center of Zhejiang University-Sunyard Information Security Technology" has been established to develop the password technology. This practice utilizes the basic researching advantage of the universities and institutions, and greatly reduced the development cycle of the new VPN products.

Second, in order to obtain technology support, Sunyard cooperates with Intel and a Singapore firm. For example, the Singapore firm provided great help in the development of the VPN products. Meanwhile, Sunyard outsourced the manufacturing tasks to ESATCOM and paid more attention on its main business. Besides, in order to solve the profit system coordination during the intra-enterprises cooperation, Sunyard gives the channel to its partners and achieved a win-win result.

Adapted from survey report 2009

(3) Market orientation and positioning

Market orientation maintains a research into customer needs and value to help the organization to form a clear vision of industry direction.

- User innovation based on differentiated user demand. Previous research suggests User-led innovation will become even more important to harness user ideas in innovation and to help firms select innovations to meet customer needs.
- Firms can establish different marketing strategy through analyzing competitors in terms of the product condition and strategic competitive advantage.
- Constructing suitable business model based on the analysis of market trend to find the right market entry point for enterprise development.
- Good business model positioning encourages enterprise to quickly upgrade to better meet the need of target markets and customers, and continue to achieve market competitive advantage.

Case 7

Gaobo, a production tech services company, achieved growth by creating value for customers.

Based on the analysis of tech innovation capability of Chinese enterprises, Gaobo aims to provide tech services to make profit. Firstly, a large part of the production equipments are out of date. Secondly, they don't take advantage of those production equipments. From the perspective of President JI, those problems have been turned into opportunities. Because of the complex of machine, many enterprises would like to outsource the installment and maintenance services. The complexity and diversity of machines make it difficult for large enterprises, especially state-owned enterprises to install and maintain those equipments, so they hope society can support those functions; outsource those functions to professional service team.

Adapted from survey report 2009

(4) Organization change

- Optimizing resource allocation can increase the number of innovation initiatives and improves the probability of stimulating innovation.
- Learning & knowledge management: learning is the ability to continuously absorb, accumulate and create the knowledge necessary to spur new ideas for innovation, besides that, openness to ideas and diversity enhances innovative working. Knowledge management can offer a systemic integration of knowledge to harness capability base.
- Structural links and coordination, the degree of specialization, functional structure, centralization, formalization as well as other aspects of innovation has a direct effect on the performance of organization. In general, the flatter organizational structures, top-down directive and autonomy facilitate innovation.

Case 8

Honyar has taken specific measures to facilitate direct, person-to-person communication across the organization, such as rethinking the organization chart, taking IT as knowledge management enabler.

As a state-owned enterprise in traditional electrical industry, the organizational innovation of Honyar is less prominent than that in the private entrepreneur-led SMEs. However, in the course of research, for technology-oriented business goals, the organizational structure still carry out a matrix designed to meet the exhibits rapid R&D and production needs.

Adapted from survey report 2009

(5) Culture innovation

- Corporate culture is intellectual impetus for employees and greatly encourages employees to innovate, thus leveraging enterprises' innovation capability.
- Corporate culture supports the formulation and implementation of strategy, promoting risk-taking climate for employees to innovation and thus leveraging enterprises' innovation capability.
- Culture promotes high-involvement learning and knowledge flowing, and leads to a climate of creativity and innovation through system innovation.

Case 9

Although most SMEs are in the stage of innovation culture germination, TIM stresses the fact that the DNA of innovation should be embedded within their management systems and organizational cultures at the starting point. Following TIM views, some SMEs have started to cultivate innovation culture to make innovation a widely held and deeply embedded value in people.

Main ways	Content	Sample firms
Style of leadership	Openness to ideas, tolerance of failure and promotion of risk taking, maximizing diversity,etc.	Saintyear Holding, Honyar Co. Galaxy Co.
Institutions	Dual-channel mechanism of promotion, investment in talent for innovation, the appraisal system for innovation, etc.	Sunyard Co. Futong Holding. Greatstar Co.
Organization structure	Teamwork, bringing the outside in, mixing as the new norm, making more time for learning, etc.	Focused Photonics Inc. Sunwave Co.
Strategy	Goals directly aligned with innovation, personal development objectives explicitly related to innovation	Shikefeng co. Fujian Haiyuan Co.
Training	Self-efficacy/confidence, original problem solving, strategic thinking, knowledge base, etc.	Honyar Co. Focused Photonics Inc. Uni-power Group

Adapted from survey report 2009

(6) Entrepreneur role

Entrepreneur is a critical enabler of leveraging innovation capability. There are two main paths by which entrepreneurs leverage innovation capability.

One is direct, referring that entrepreneur should focus on cultivating their own abilities and entrepreneurship. The other is relatively indirect, making full use of employees.

- Cultivating entrepreneurship and entrepreneurial abilities
- Stimulating the enthusiasm of employees and nurture their abilities
- Strategic communication, giving directions of innovation for employees
- Creating a climate for innovation
- Cultivating employees' abilities via learning and knowledge sharing
- Developing organizational institutions to facilitate the process of innovation

Case 10

Uni-Power Guaranty in Zhejiang Province founded on May 18 2004, with registered capital 2.8498 billion RMB, is the largest Sino-foreign joint financial company in Zhejiang Province.

President CHEN in UPG has a forward-looking vision. Before the formal operation, it took President Chen nearly two years to thinking about the value of UPG in the industry.

President CHEN attaches great importance to the integration of internal and external resources. He has integrated the resources of Zhejiang University, Venture Capitals, and government of Zhejiang Province to better serve SMEs.

Organizational learning in UPG is emphasized. President Chen believes that *"Staff training is the best welfare"*, and attaches great importance to nurturing in-house training experts.

Adapted from survey report 2009

Systems theory is one of theoretical basis for TIM which emphasizes on system thinking, so TIM concentrates on principles of holistic management. That is to say, whole is greater than the sum of its parts, and TIM focuses on the synergy and "Holistic force" for innovation. In order to attract enough attention to that, the holistic mechanism is demonstrated bellow.

Table 8.2 Mechanism to leverage innovation capability

Mechanism / Elements		Leveraging capability via TIM				
		Leadership & Decision	**Enabling/ motivating**	**Cooperation/ organization**	**Learning & accumulation**	**Cooperation/ networking**
Strategy & vision	Guiding allocation of resources	●				
	Coordinating organization structure			●		
	Culture Coordination and Construction		●			
MOT	Integration					●
	Accumulation				●	
	Orientation	●				
	Joint Participation					●
	Motivation& organizing		●			

Table 8.2 Mechanisms of leveraging innovation capability (continued)

Mechanism / Elements		Leveraging capability via TIM				
		Leadership & Decision	**Enabling/ motivating**	**Cooperation/ organization**	**Learning & accumulation**	**Cooperation/ networking**
Mkt orientation	Market orientation	●				
	Positioning business mode			●		
	Competition & Differentiation	●				
	Customer participation					●
Organization change	Optimizing resource allocation	●				
	Learning & knowledge management				●	
	Structural Links and coordination			●		
Culture I.	Motivation		●			
	Cohesiveness			●		
	Learning & creativity				●	
Entrepreneur role	Providing & allocating resource	●				
	Guiding & constructing Organization			●		
	Supporting & motivation					●
	Culture construction		●			

Case 11

As one of the leading suppliers of products, systems, solutions and services for industrial automation in China, SUPCON serves over 6,000 customers worldwide to optimize their business and increase industrial productivity. They take the innovation as a system to trigger the interrelated elements potential in the innovative process.

Element	Main Content/experience
Strategy and Vision	Employing high-tech technique to retrofit the traditional industry to satisfy the needs of customer. focusing on technology innovation, product innovation, service innovation and management innovation and strive to pursue better and sustainable development
MOT	Multi-level innovation systems support the sustainable development of technology innovation. IP Strategy, Quality Management and Famous Brand Strategy
Market Orientation and Positioning	Market-oriented innovation, pinpoint accuracy with product demand in SMEs, grasping the opportunity and market trends of the information transformation of traditional industries by informationization, achieving breakthroughs in major automation project
Organization Change	Tech-center and central-academe, R&D organization within the various Division and Branch, co-building the external R&D organizations
Culture Innovation	Mission is to develop automation industry. Spirit is Devotion, Cooperation and Innovation
Employee	"Talent oriented" and "Development together" are the talent policy (Technical Leader, innovators etc.) Science and Technology Association for Workout
Capability Base	Institutional assurance of innovation input Knowledge management system for accumulation of innovative experiences (knowledge pool based on IT). Reliability of Project Management System for quality. QC Management System for testing and controlling.

Adapted from survey report 2009

8.2.4 Open innovation

External collaboration is indispensable. Many senior managers interviewed stress the overwhelming importance of collaborative innovation – beyond company walls. *"We should open up our innovation processes to make them more cost effective"* (Yao Naxin -the CEO of Focused Photonics Inc.). Innovation Networks can help SMEs get maximum benefit from open innovation, however, the extent to which local actors successfully draw on such networks depends on their ability to identify, interact, assimilate and exploit new sources of knowledge. TIM focuses on collaborative innovation in the extended enterprise network to achieve greater performance. These will cross markets, cross disciplines, sectors and national borders. TIM suggest that mobilizing and making better use of resources will depend on agile and entrepreneurial internal networks, and the Internal-external Innovation Networks co-evolution are critical for enterprises to leverage their capability. It is now clear that innovation cannot be limited to in-house R&D but must embrace the whole organization across internal silos as well as engaging business partners, customers and even entire industry ecosystems in order to be effective. So we demonstrate a framework to study interaction and synergy of internal and external innovation networks, and propose strategic pathways to leverage SMEs' capability by networks. (See Figure 8.6)

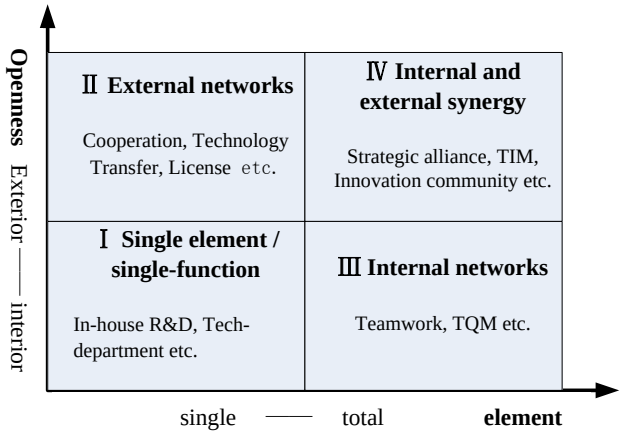


Figure 8.6 Co-evolution of external-internal networks based on TIM

On one side, they can help SMEs to grasp the critical dimensions and use networks to get advantage in the Complex Networks, on the other side, they can guide SMEs accelerate the shift away from pipeline models of innovation towards more open, networked approaches.

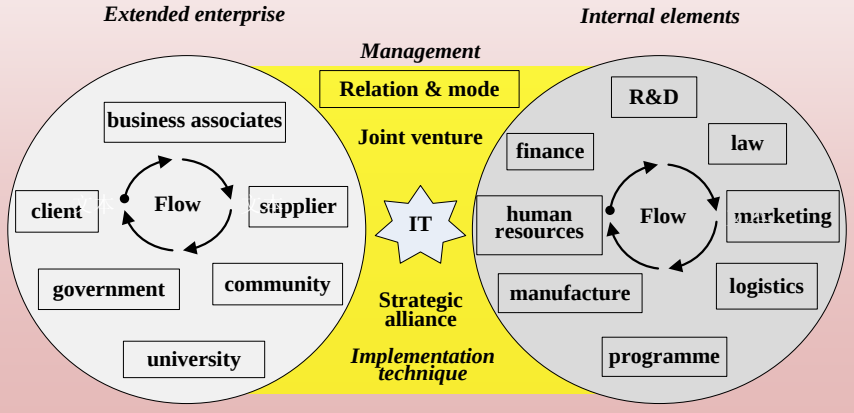
- Internal-external networks co-evolution for synergy: two dimensions of innovation network construction
- Leveraging capability by elements combination in networks: different combination produce different capability
- Reconfiguration business model based on open innovation

Case 15

Hangzhou Honyar Electrical Co., Ltd., had reconfigured innovation networks based on TIM, and every actor was defined as specific function for innovation.

Actor	Category	Primary Value	Approach
University	New product	Super- profit	NPD
Regular customer	Old product	Sales Volume	Maintaining relationship
Dealer	improved or new product	Sale Revenue	Exploiting markets
Supplier	Improved product	Cost reduction	Price & Quality
Government & community	New product	Added-value	Social responsibility & corporate image

The external network and internal network are mutual promotion and co-evolution.



Adapted from survey report 2009

8.2.5 Business model innovation

Henry Chesbrough, in his work on open innovation, has emphasized the importance of business models in creating value from technology. The intense competition has emphasized the importance of business model innovation in SMEs. Especially, business model innovation will provide a fast and low-cost way out of recession.

For example:

- Innovation in the whole value chain (all time-scope innovation)
- Transformation from manufacturers to new service providers
- Focusing on value added to compete beyond prices
- Brand construction
- Using of advanced technology(IT) to re-build marketing models

Case 16

Based on TIM, Sunyard has gone through a business model transformation from a product-focused company to a solution provider. The shift of business model was reflected on two aspects. Firstly, the dominant product was transferred from the one of information security software to BPO business. Secondly, the target market was transferred from banks of Zhejiang Province to financial institutions across the country. It has been proved that the transformation is quite successful. After the transformation, the core technology (OCR technology) with indigenous intellectual property has been successfully developed. And Sunyard is ranked first in BPO companies across the country.

The innovation success is attributed to the synergy among innovation elements during the business model innovation process. Firstly, the market demand, technology trajectory and internal capability were integrated during the strategy formulation process. Secondly, in order to implement the strategy, the R&D network was established to achieve and reallocate innovation resources.

Adapted from survey report 2009

8.3 Brief conclusion

All above mentioned outcomes directly gave obvious impact on enterprise innovation capability leveraging. In this part, the influence on innovation capability of IDRC project will be described. First of all, some important indicators for evaluating the enterprise innovation capability will be discussed based on literature and government document. Secondly, based on the descriptive statistics of large sample data, the correlation between implementation of TIM and enterprise innovation capability is analyzed. Finally, three typical cases about how to leverage innovation capability via implementing TIM are analyzed.

8.3.1 Indicators proposed for evaluating the innovation capability of firms

ZHOU Yuan, the deputy director of MOST, said that, “Three conditions are required for becoming an Innovative firm. Firstly, innovative firms should have their own core technologies with indigenous intellectual property. Secondly, the technology of innovative firm should position in the leading level in the industry. Thirdly, the sustainable innovation capability is required for becoming an innovative firm.” Thus, some evaluation criteria of innovative firm are proposed by MOST. The indicators include R&D investment, the number of invention patents, new product output rate and the productivity.

Besides, according to many literatures, the synergy between market demand and technology development is critical for innovation success. New product development is the unique indicator employed by European Commission to identify the innovative firm. Thus, based on the literature

and government document, five major indicators are adopted by our project team for evaluating the enterprise innovation capability. The indicators are new product output rate, productivity, new product meet the customer's demand, growth of the number of new patents' applications and R&D investment.

8.3.2 Leveraging enterprise innovation capability via implementing TIM

(1) The correlation between implementation of TIM and enterprise innovation capability is analyzed, based on the descriptive statistics of large sample data

The 741 respondents of questionnaires were divided into three groups: start-up enterprises, developing enterprises and matured enterprises. In our previous study, it was founded that along the development process, enterprises are facing increasingly complex contradictions. In order to solve the problems, more innovation elements are involved in the innovation process. The way toward innovative firm is from single element innovation to portfolio innovation, afterward, the enterprise employed the TIM pattern. The innovation elements involvement in matured stage is higher than that in start-up and developing stages. The correlation between implementation of TIM and enterprise innovation capability is founded, based on the descriptive statistics of large sample data. With the involvement of various innovation elements, the growth trend of enterprise innovation capability is more and more clear. The result of descriptive statistics of large sample data is showed in Table 8.3 and Figure 8.7.

Table 8.3 The value of innovation capability indicators in different stages

Indicators	Start-up enterprises	Developing enterprises	Matured enterprises
New product output rate (%)	27.74	48.93	50.82
Productivity (ten thousand Yuan per person)	66.06	77.93	83.07
New product meet the customer's demand (score of item)	5.80	6.73	6.70
Growth of the number of new patents' applications(score of item)	5.17	6.83	6.6
R & D investment(score of item)	5.10	4.77	4.53

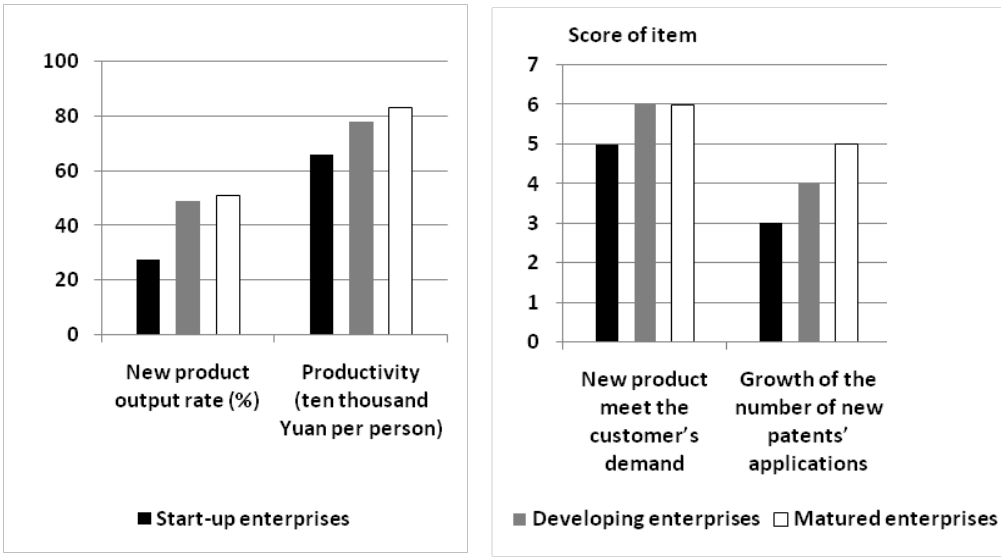


Figure 8.7 The value of innovation capability indicators in different stages

We found that the score of indicators are increasing stably, beside the score of indicator "growth of the number of new patents' application". The fluctuation of the "growth of the number of new patents' application" indicator can be explained by the corporate life cycle theory. The speed of development is lower in the matured enterprises than that in the developing enterprises. In conclusion, when more innovation elements involved in the innovation process, the growth trend of enterprise innovation capability becoming clear.

(2) Leveraging innovation capability via implementing TIM in typical enterprises

Through follow up investigation, we found that the main reason why innovation capability leveraging in many specific enterprises roots in the implementation of TIM. The case of Sunyard, Honyar and Supcon will be described in-detail in the Appendix F and Appendix G. The innovation capability leveraging process in Sunyard, Honyar and Supcon are showed in the Figure8.8, Figure8.9 and Figure8.10 respectively. We found that the score of indicators are increasing stably.

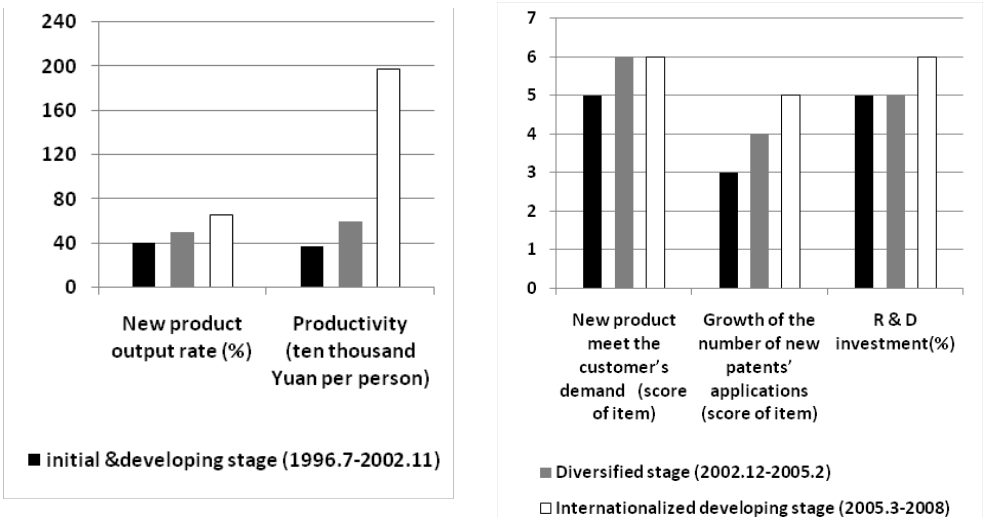


Figure 8.8 The value of innovation capability indicators of different stages in Sunyard

The NPD output rate, R&D intensity and the profit rate of Honyar are showed in the Figure8.9.

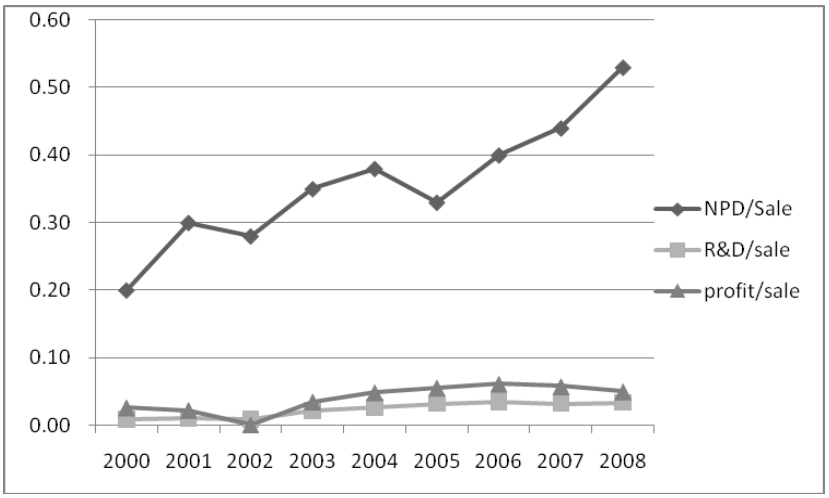


Figure 8.9 The indicators about Innovation in Honyar

The New product sales, productivity and R&D intensity of Supcon are showed in the Figure8.10.

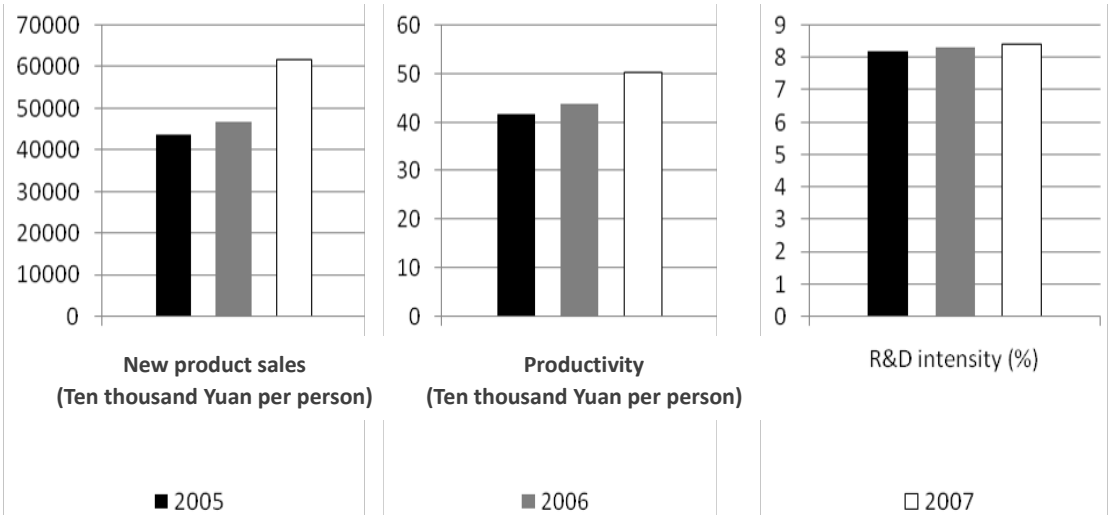


Figure 8.10 The value of innovation capability indicators in Supcon

During our investigation, we found that in these firms, the innovation capability, which composed of innovation input capability, innovation process management capability and innovation output capability are enhancing sustainably based on TIM. Firstly, firms are risk-taking. The innovation input capability， which can be measured by R&D investment, is increasing stably. Secondly, during the new product development process, the synergy between product design and customer's demand has been emphasized. Then, the innovation output capability of these firms, which can be measured by productivity, profit, new product sales and the number of new product and patent, are all increasing rapidly.

9 Policy Influence

9.1 Impact on government policies

In the last two and a half years, TIM theory has broadened the policymakers' horizons and affected the policy regimes. The impact on the government policy of IDRC project is described in detail in the following parts.

9.1.1 Broadening the policy horizons of policymakers

(1) Deeper understanding of barriers of innovation capability leveraging in SMEs

After communicating with IDRC project team, policymakers found the root cause that blocked the innovation capability leveraging in SMEs. They shifted their view from resource shortage to the side of culture, system and mechanism.

Firstly, in the past, government officials held the view that, in the macro level, the reason that blocked SMEs' innovation capability leveraging rooted from the capital shortage and technology shortage. However, after cooperate with IDRC project team, they further realized that, at the macro level, the truly reason was the problem generating from the existed institution and mechanism. CAI Zhangsheng, Senior Officer of Bureau of SMEs in Zhejiang Province, said, "The IDRC project takes advantage of the current crisis, which stimulates government to understand the real reason that blocked the innovation capability leveraging in SMEs. After communicating with IDRC project team members, we found that the in-depth reason that blocked innovation capability leveraging is the problem generated from the existed mechanism and institution, rather than the capital or technology shortage. Government is responsible for cultivating high-level talents by holding training programs. However, the shortsighted strategy was prevailed the Government and SMEs of Zhejiang Province. For example, because of its slow output, the manufacturing industry developed slowly. What's more, because of long R&D cycle, many SMEs hesitated to innovate. In conclusion, three reasons hinder the innovation capability leveraging In Zhejiang Province's SMEs. Firstly, the enterprise lacks an appropriate mechanism to stimulate innovation; secondly, the society lacks an innovative climate; thirdly, the government lacks institutions to encourage SMEs to innovate."

Secondly, in the past, government officials held the view that the reason blocking innovation capability leveraging at the micro level was the technology capability shortage of innovators. However, after further study, they found that in the micro level, the root cause was the problem generated from the existed personal values and organizational culture. In China, the history of more than 2000 years' feudal monarchy brought some barriers that emancipate the mind. On the other hand, the innovative culture shortage discouraged the innovations fundamentally. CAI Zhangsheng, Senior Officer of Bureau of SMEs of Zhejiang Province, said that, "The importance of innovative culture are emphasized by the IDRC project. One of the important dimensions of innovative culture is the risk tolerance. However, the risk tolerance culture is weak in China, which is the root cause of shortsighted strategy."

(2) Rethinking about the basis of innovation

The policymakers rethink about the Innovation basis. They shifted their view from pure technological side to both technological and management side.

In the past, government officials thought the innovation success was based on the technological basis of the enterprises. However, after further study in this cooperated IDRC project, the importance of innovation management capability is realized by policymakers recently.

LI Jingning, the director of Technological Advances and Equipment Section of Economic and Information Commission, stated that, “Most SMEs are lacking innovation resources. Thus, strong innovation management capability is critical for SMEs to survive in the fierce competition. IDRC project broadened the horizons of government officials.”

After realizing the importance of management basis, Bureau of SMEs of Zhejiang Province introduced policies to improve the innovation management capability. “Policies are designed to improve the strategic capability, marketing capability and management capability. The specialized production, lean management, indigenous innovation, intensive management, information technology driven, brand operations and international expansion are cultivated. Hidden Champions, which are specialized, lean manufacturing, characterized and innovative, lead the development of other SMEs in Zhejiang Province.” (Source: Government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs”, pp.13, issued by Bureau of SMEs of Zhejiang Province, December 18, 2009)

In order to popularize the TIM theory, Bureau of SMEs of Zhejiang Province issued a document titled “Contribution of TIM Theory on SMEs’ Technological Innovation in Zhejiang Province”. It said that, “The TIM theory provided a new idea and path for Bureau of SMEs of Zhejiang Province and other government agencies. It opened their vision in SMEs’ directing and servicing activities. It definitely had strong theoretical contribution and practical value.”(Source: Government document titled “Contribution of TIM Theory on SMEs’ Technological Innovation in Zhejiang Province”, issued by Bureau of SMEs of Zhejiang Province, April 10, 2008).

(3) Acceptance of a holistic view of innovation

In the past, policymakers only paid attention to technological factor, but now, the importance of non-technological factors and their interactive relationship are realized by government officials. JIANG Taiwei, the director of Zhejiang Bureau of Science and Technology, said “we need deeper analysis in case studies, not only identify existed problems, but also analyze reasons behind those problems and propose suggestions. What’s more, further research toward the interaction between innovation factors should be considered.”

Organizational innovation and institutional innovation were emphasized by the government. For example, in the policy issued by Bureau of SMEs of Zhejiang Province, it said that “In order to meet the market demand, SMEs are encouraged to establish appropriate institution and operational system. Corporate governance structure and organizational structure change in SMEs are also encouraged.” (Source: Government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs”, pp.12-13, issued by Bureau of SMEs of Zhejiang Province, December 18, 2009)

9.1.2 The influence on the policy regimes

(1) Emphasis of cultivating innovative talents and entrepreneurial learning

In the past, policies were designed to leverage the technological capability of SMEs. However, TIM theory has been infiltrated into government policies recently. The non-technological factors, especially the human factors are emphasized in many policies recently. More and more policies are designed to cultivate innovative talents, and enhance entrepreneurial learning. In this section, we will take two typical policies as the examples.

(a) Establishing the evaluation system of enterprise technology center based on the TIM theory

In the 1990s, the establishment of technology center in large enterprises was encouraged by

government. The reason is that scattered resources can be accumulated to support innovation activities in large enterprises. And now, in order to encourage SMEs to innovate, the government decides to encourage SMEs to establish some technology centers. When the technology center is approved, the government will provide some preferential policies, which is beneficial for the SMEs' innovation. The assessment of approving technology center is an important government activity.

In the past, the evaluation system of enterprise technology center paid more attention to enterprise's technological capability, and ignored some important non-technological factors. However, after several years' practice, the human factor was being emphasized gradually. For example, LI Jingning, the director of Technological Advances and Equipment Section of Economic and Information Commission, stated that, "The concept of high involvement innovation was accepted when designing the assessment system of technology center. The number of innovation proposals from staff was considered to be an important indicator. What's more, we held a further discussion with Professor CHEN Jin and ZHENG Gang in order to take more advantage of the assessment system. The way of innovation capability leveraging was reconsidered from a new perspective. Harnessing the direction of policy is one of the most important functions of government. The cooperation between government and IDRC project team was broadening policy horizons of policymakers."

Organized by the Economic and Information Commission, the assessment of approving the enterprise's technology center was held under the guidance of TIM theory, which was proposed by the IDRC project team. The non-technological factors, such as strategy, culture, institution and organizational system, are emphasized by this assessment system.

After several years' practice, it has been proved that this assessment system is feasible and reasonable. It not only provided guidance for building up an enterprise technological innovation system centralized by the technology center, but also improved the enterprise indigenous innovation capability.

Thus, the verification document was issued by the government to appreciate the contributions of IDRC project. "Till the end of last year, Zhejiang Province has built up 31 national enterprise technology centers, and 429 provincial enterprise technology centers. Some important indicators have an obvious improvement from the last two and a half years, such as organizational system, institutional system construction, R&D investment, R&D basic facilities construction, technological capability, the indigenous knowledge copyright, new product contribution, patent, standardization level and production and research co-operation, etc." (Source: Government document titled "A Statement about Contributions of TIM Theory on SMEs' Technological Innovation in Zhejiang Province", issued by Economic and Information Commission of Zhejiang Province, April 15th, 2008).

(b) Formulating policy to establish a long-term online training project on TIM for technology centers' engineers and officials

Compare to the past, more policies are designed to cultivate innovative talents, and enhance entrepreneurial learning recently. LI Jingning, the director of Technological Advances and Equipment Section of Economic and Information Commission, stated that, "The importance of entrepreneurship and learning capability was realized by scholars and government officials."

From September 2009, in order to improve the indigenous innovation capability of Zhejiang Province and conform to "The Plan to Improve Indigenous Innovation Capability in Zhejiang

Province", Economic and Information Commission formulate the policy, which titled "A Solution for Improving the Online Training Capability of Zhejiang Province Enterprise Technology Center" (issued by Economic and Information Commission, no.167, 2009). This policy established a completed enterprise innovation system under the guidance of TIM theory, and improved the indigenous innovation capability, built up innovative firms, and established strategic cooperation with National Institute of Innovation Management (NIIM).

The cooperation content mainly included that establishing a provincial enterprise technology online training capability leveraging platform (as shown in Figure9.1), a multi-layer innovation management training system, an ordered on-site training by different industries, and a qualified enquiring service. Meanwhile, it also involved many integrated cooperation that is three-dimensional, all directional, and multi-layered, such as the face-to-face training, on-site observation and customized training. This cooperation is on going now and the network institution officially was initiated on October 2009 (Website: http://www.zjjszx.gov.cn/Default.aspx). The NIIM becomes the academic support unit for this website. And till Jan 5th 2010, the online training website had been watched 1433 times.

Figure 9.1 Screenshot of the Network College of Enterprise Technology Center in Zhejiang Province

Recently, the two parties are going to establish a completed cooperation based on the "Provincial Enterprise Technology Center Innovation Capability Leverage Project". The content includes the online training project. It is designed to improve some important capabilities of employees in Zhejiang Province Technology Centers, such as the professional quality, the management capability, the concept of indigenous innovation, and the sustainable innovation capability.

(2) Formulating policies favorable to open innovation

Due to the resource shortage of SMEs, government officials realized that SMEs should not only rely on indigenous research and development, but also make full use of external resources to implement open innovation. Compare to the past, government policy encourages SMEs to implement open innovation recently.

For example, LOU Jianren, the director of Bureau of Science and Technology in Hangzhou,

said that, “In science and technology project, policies are designed to support the development of network platform technology. For example, the ‘Wensan Street Online’ project, which was held by the Information Ebeid Company, has been treated with Venture seed funding from the government of Hangzhou city. What’s more, the Bureau of Science and Technology in Hangzhou also introduced many advanced manufacturing and management techniques, such as CRMS, EPRS, MC, to enterprises. Those techniques improved the productivity of enterprises, and encourage them to innovate.”

Government realized the impact of innovative talents and industry-university-research lab strategic alliance on indigenous innovation capability leveraging. “Policies are designed to encourage the development of products with their own intellectual property and brand, the cooperation between SMEs and research institutes, and the introduction of innovative talents to provide intellectual support for technological innovation. (Source: Government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs”, pp.12, issued by Bureau of SMEs of Zhejiang Province, December 18, 2009)

(3) Formulating policies to promote the industry upgrading

Facing the financial crisis, the IDRC project team cooperated with government officials to formulate response policies and measures to overcome the difficulties. CAI Zhangsheng, Senior Officer of Bureau of SMEs of Zhejiang Province, said, “The IDRC project takes advantage of the current crisis, which stimulates government to reconsider the existed difficulties and problems in the economic development of Zhejiang Province. Firstly, SMEs in Zhejiang Province are facing many challenges, such as increasing price of raw materials, strengthening constraints for energy saving and emission reduction, and rising labor costs. Secondly, from the perspective of industrial structure, the capital-intensive industries play the dominant role. The advantage of massive concentration has not been established yet. Thus, it is urgent to promote the industry upgrading in Zhejiang Province.”

In December 18, 2009, LV Zushan, the governor of Zhejiang Province, chaired the 44th executive meeting of the provincial government to consider the adoption of the “Policy to Speed up Innovation and Entrepreneurship for SMEs”. In the next five years, Zhejiang provincial government will actively proactive to guide and promote the development of SMEs to speed up structural adjustment on the implementation of “entrepreneurship and innovation” strategy. It would effectively optimize the environment of policy, service and financing for SMEs. SMEs, which are entrepreneurial, innovative, export-oriented, and brand-based, are expected to be cultivated in next five years.

After discussion, the government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs” was adopted. It said that, “In order to promote the industry upgrading, the policy that formulated to support innovation can be divided into eight parts: promote industrial upgrading; speed up process innovation; leverage indigenous innovation capability; strengthen IP protection; promote the specialization in the cooperation; promote joint mergers and acquisitions; stimulate institutional and mechanism innovation; improve enterprise management capability. Among them, the policy priorities include three parts: speed up process innovation; leverage indigenous innovation capability; promote joint mergers and acquisitions. Zhejiang government have design some specific methods to facilitate the implementation of these policies.” (Government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs”, issued by Bureau of SMEs of Zhejiang Province, pp.3, December 18, 2009)

The evidence of the impacts on policy will be presented in Appendix N. And some typical evidence has been listed in the following Table.

Table 9.1 Some typical evidence of the impacts on policy

Government document	Government agency	Date
"Policy to support IDRC project team implementing investigation in enterprises"	Bureau of SMEs of Zhejiang Province	December 11, 2007
"Contributions of TIM Theory on SMEs' Technological Innovation in Zhejiang Province"	Bureau of SMEs of Zhejiang Province	April 10, 2008
"A Statement about Contributions of TIM Theory on SMEs' Technological Innovation in Zhejiang Province"	Economic and Information Commission of Zhejiang Province	April 15, 2008
"Policy to Speed up Innovation and Entrepreneurship for SMEs"	Bureau of SMEs of Zhejiang Province	December 18, 2009

9.2 Mechanism and process to influence government policies

The reason why the policy horizons and regimes can be influenced by IDRC project is that the cooperation among government, industries, universities, and research institutes was being established gradually during the implementation process of IDRC project. In the last two and a half years, Professor XU Qingrui, Professor CHEN Jin, and Associate Professor ZHENG Gang, the main team members of the IDRC project, were invited by government and enterprises to set up 51 presentations, which were focused on the TIM theory. IDRC project team has held internatianal conference (ISMOT'09). TIM workshop and three SME training courses were exhibited by IDRC project. Nine team members went to Hong Kong and attended the IEEM 2009 conference to present research findings. What's more, many IDRC project members participated in the government policy pre-research and give suggestions in last two years.

Through these activities, a communication platform and dialogue mechanism for the government, enterprises and universities was established. Government officials, enterprise managers, and academic researchers participated and communicated with each other. Under the current Chinese situation, a close relationship with government is beneficial for the project carrying. For example, our team sent out 2068 questionnaires with the help of the Economic and Information Commission and Bureau of SMEs of Zhejiang Province. Through the Bureau of SMEs, the team also obtained the agreement to implement investigation in 44 enterprises. On the other hand, by attending the activities held by IDRC project, the organizational boundary between commissions, such as EIC of Zhejiang Province, Bureau of SMEs of Zhejiang Province, Hangzhou BOST, were broken to encourage knowledge sharing and organizational learning, which was oriented by project objectives. The government's understanding of TIM was improved and reflected when formulating and implementing the strategy.

Through the IDRC project members' participation in the government policy pre-research, government was not only focused on the technological innovation, but also the total innovation management when setting up the strategy. The human factor has been paid more attention. Professor WEI Jiang and some other TIM project members participated in the "Major Issues Study of the Technological Innovation Capability and the Establishment of the National Critical Innovation Base" project. In the pre-research suggestions for the national "twelfth five years plan", it said that, the enterprise innovation would enter into the TIM era. The establishment of enterprise technological innovation system should not only consider the technology construction, but also emphasize the synergy among non-technology factors, such as strategy, culture, and institution.

Dr ZHENG Gang participated as an adviser in the Zhejiang Province's enterprise academy building-up symposium and the first batch of the enterprise academies assessment. He suggested that the assessment standard of enterprise academy should not only include the hard factors (enterprise scale, R&D investment, and patents), but also the soft factors (innovation strategy, organizational management system, operation system, innovative culture, and industry-university-institute cooperation). Meanwhile, the indexes of TIM capability should be included in the standard. This suggestion won a high attention of the government officials and being accepted. Besides, ten policy recommendations have been sent to the central and local government agencies, such as the national philosophy and social sciences planning office, state S&T leading group of the State Council, MOST, Ministry of Education and Zhejiang Provincial Government.

What's more, Dr ZHENG Gang was invited to give a presentation on the starting ceremony of the online training platform, "Applying the TIM theory to build the technology innovation system centralized by technology center to leverage the enterprise innovation capability". More than 200 Zhejiang SMEs attended this starting ceremony.

Just as LI Jingning, the director of Technological Advances and Equipment Section of Economic and Information Commission, stated that, "On the one hand, IDRC project team leveraged innovation capability in SMEs directly via providing scientific innovation management methods. On the other hand, IDRC project team leveraged innovation capability of SMEs indirectly via pushing the government to guide enterprises in their innovation activities in better ways.

In conclusion, the mechanism and process to influence government policies is shown in Figure9.2.

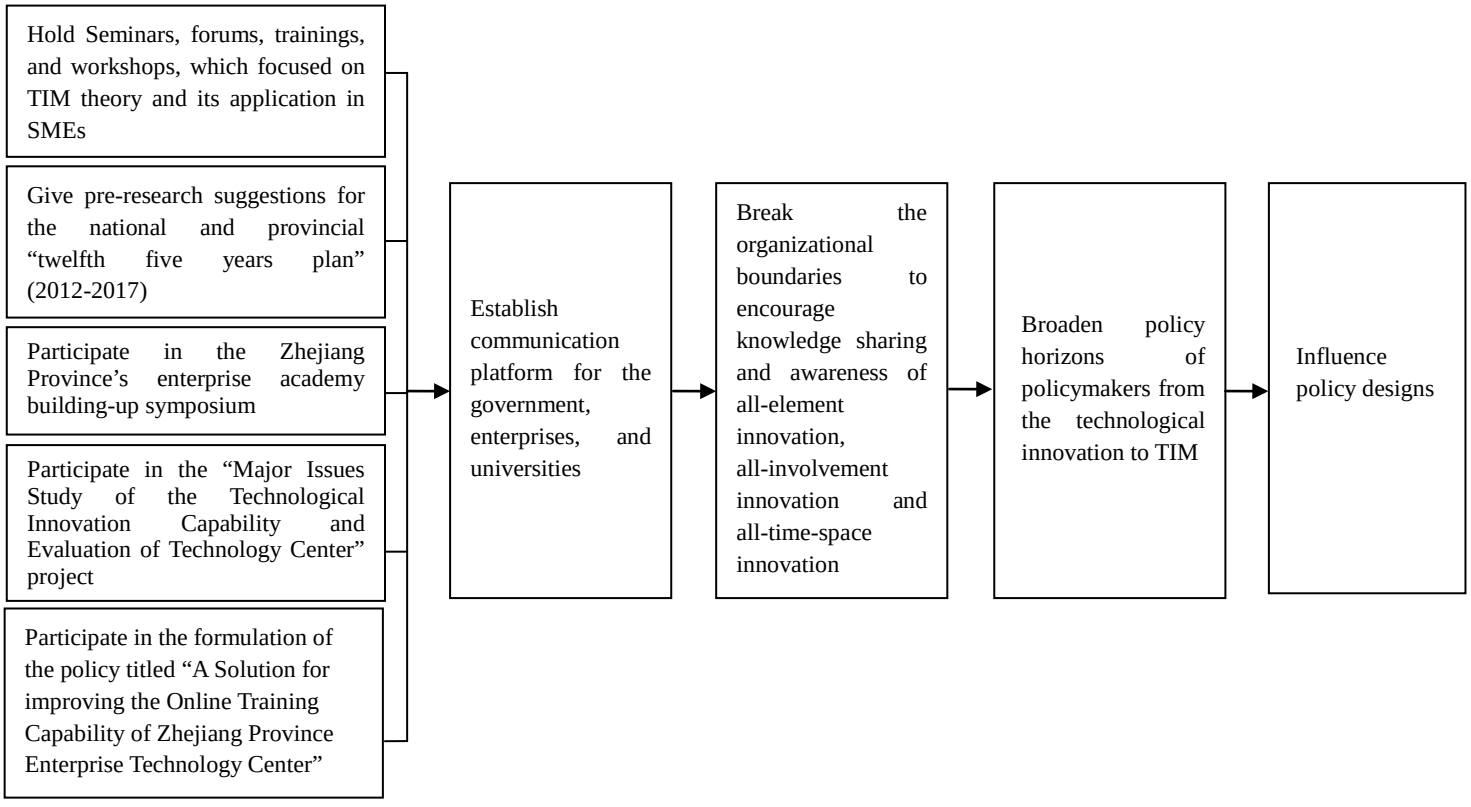


Figure 9.2 Mechanism and process to influence government policies

10 Social Impact

10.1 The overview of social impact of IDRC Project

The project has been on for more than two years and its impact toward society speeds gradually. In general, the project improves cognition and understanding of innovation on the whole society and helps the diffusion of TIM theory. Recently, the outstanding performance of this project at this stage mainly manifests at government policy level and corporate level.

10.2 The measure of social impact

The measure of IDRC project includes three parts:

First of all: holding and attending academic conferences and forums

In the last two and a half years, we have launched Zijin Innovation Forum, China Youth Forum on Innovation and Academic Network, Senior Forum for SMEs Innovation Capability Leverage, Global Manufacturing and Innovation Management Doctor Forum, Innovation Management Forum, and participated in the China Youth Innovation Forum, China's Technical and Economic Seminars, Innovation Management Case Forum for Chinese Enterprises and so on. By means of national and regional forums, we introduce and promote TIM theory and get high recognition from academic institutes, government, enterprises and guilds.

Figure 10.1 SHEN Jian, Vice Mayor of Hangzhou make a speech on Forum

Figure 10.2 JIANG Taiwei, Direct of BOST make a speech on Forum

Based on academic conference, project team extends TIM theory in the field of academy and enterprise. For example, on the sixth "International Symposium on Management of Technology" 23rd, 2009, Professor XU Qingrui, our project leader, addressed the report named "Toward Innovative Firm by Application of TIM to Leverage Innovation Capabilities of Chinese SMEs", which got much attention. Besides, as the project's stage summary, our team held workshop "Application of TIM to Leverage Innovation Capabilities of Chinese SMEs" on this symposium. This symposium invited Haier, Midea, Green Full, Geely, American IEG Group and other enterprises. Though discussion, the TIM theory was better diffused. In addition, our team member attended Industrial Engineering and Engineering Management International Conference2009, China's Enterprises Innovation TOP100 Evaluation Meeting, the Year Conference of Chinese Management Academy, China's International Conference on Innovation and Academic Networks, China's Science and Technology Policy Conference and other academic conferences, spreading the leverage of SMEs Innovation Capability by TIM theory.

Figure 10.3 The 20 business mentor being presented

Figure 10.4 The 8th Zijin Innovation Forum start

Second: Visits and exchanges

Since late 2007, there were dozens of international renowned scholars and academic delegation visiting us and NIIM, and giving us lectures. They are from EU, U.S., Britain, Australia, Switzerland, Denmark, Singapore, India, and other countries and regions, such as Professor Goldratt of International Renowned Management Institute and Professor Joe Tidd of British Sussex University Science Policy Institute (SPRU), Professor SHI Yongjiang of Cambridge University, Professor Simon Pattinson, Professor C.C-Hang of National University of Singapore, Professor LIU Xielin of Chinese Science and technology policy Research Institute, and other famous scholars. Our team members introduced them the TIM-SMEs Project output.

In addition, with visits and exchanges of team members, the TIM theory of this project also diffuses. For example: Professor WU Xiaobo, the vice president of Management School and Deputy Dean of NIIM, visited Switzerland with Professor Guo Bin and SHOU Yongyi. They visited several famous universities including Eidgenossische Technische Hochschule Zurich, ETHZ, HES-SO Valais, Ecole Polytechnique Federale de Lausanne, EPFL, University of Lausanne, University of St. Gallen etc., as well as some Science & Technology Parks including TechnoArk, IDIAP Research Institute etc. During their visit, they reached many cooperation consensuses with some universities and research institutions and spread our “TIM-SMEs” theory of this project and research output.

Third: Case collection contest

For better promoting the TIM theory and its application on leveraging innovation capability of Chinese SMEs, RCID issued Zhejiang University Innovation and Development Fund's Contest on “Case Study on leveraging innovation capabilities of Chinese SMEs” and gave out the relevant requirements and incentive instructions of the case assembly, to better diffusing impact.

10.3 Feedback of society

As the feedback of society, our team gets some awards:

Table 10.1Awards of our team

Person/Institute	Contents of award	Award time
XU Qingrui, CHEN Jin, ZHENG Gang etc.	2008 Second Prize of Science and Technology, Zhejiang Province	February 11, 2009
XU Qingrui	China Management Science Special Contribution Award	January 10, 2009
XU Qingrui, CHEN Jin, ZHENG Gang etc.	China Management Science Award	January 10, 2009
National Institute for Innovation Institute(NIIM)	2008 China's Top Ten Innovative Training Leading Institutions	November 29, 2008
XU Qingrui, CHEN Jin, ZHENG Gang etc.	Second Prize of Universities and Colleges’ Outstanding Achievement, Ministry of Education	December, 2009

Also, because of outstanding contribution in the field of innovation management , the project leader Professor XU Qingrui was interviewed by Zhejiang Province's Science and Technology Museum on the topic " how to do research and how to cultivate talents" on April 30,2009. He introduced "Leveraging Innovation Capabilities of Chinese SMEs via TIM theory" toward the whole society via media and gave his ideas and summaries. The picture is as follows:

Figure 10.5 Prof. Xu with officers and journalists from Zhejiang Science and Technology Hall

Finally, as the feedback of Case Collection Contest, "Kaidi Model on Corporate Technological Innovation", which was from the School of Management, Wuhan Technology University, got highly remarks.

Relevant awards documents are listed as follows:


浙江省科学技术奖

证 书

为表彰浙江省科学技术奖获得者，特颁发此证书。

项目名称：全面创新管理：理论与实践

奖励等级：二等

获 奖 者：浙江大学

许庆瑞、陈 劲、郑 刚、朱 凌、梁欣如、朱建忠、赵晓庆、水常青、谢章澍

证书号：0802081

Figure 10.6 Award for TIM from Provincial Government(2008)


Management Science Awards of China

管理科学奖荣誉证书

许庆瑞 先生

荣获中国管理科学学会管理科学特殊贡献奖

特发此证

中国管理科学学会

联合主办单位

Figure 10.7 Award for the Excellence Contribution of TIM on Management Science

11 General Appraisal and Recommendation

11.1 General appraisal

IDRC project research is undertaken by Professor XU Qingrui and his research team. As the director of Research Center for Innovation and Development of Zhejiang University, Professor XU with his research team has engaged in the research of innovation management for almost thirty years, which provides IDRC project research with a solid foundation. Simultaneously, Zhejiang Province is one of the regions with most plentiful and most active SMEs. The number of SMEs has amounted to about 99.8% of total number of enterprises, which offers the research with rich study resources and makes this study be of great importance. What's more, the research begun to be conducted, not long after, the sup-prime crisis happened. Sub-prime crisis spreading made SMEs be faced to a harsh surviving environment. Consequently, the importance of innovation has gained high concerning from both academy and practice. Meanwhile, it provided a specific research context for studying SMEs' innovation, and good opportunities for applying total innovation management (TIM) theory to SMEs as well. Therefore, the IDRC project being conducted by Professor XU with his team of Zhejiang University has enjoyed the situation of the right place, right time (China government enforce the Innovation strategy on indigenous innovation and Innovation country & enterprise.) and right people.

The overarching goal of IDRC project is to leverage the innovative capabilities and the competitiveness of small and medium sized enterprises via total innovation management (TIM), and thereby contribute to the social and economical development of Zhejiang and other provinces in China. Of course, the research outcomes are also expected to be useful to instruct the SMEs of all the developing countries to develop, since SMEs are the important components in any national economy. By constructing a theoretical and practical TIM paradigm for SMEs, the project will contribute towards the national policy on innovative firms. It is also expected to increase the capability for employment within SMEs, and thereby contribute towards poverty & unemployment reduction or wealth creation.

After two and a half years' study, the research team has achieved some important theoretical and practical outcomes. Simultaneously, by research activities, the IDRC team members have been trained and improved. Therefore, IDRC project research has important implications, whether the research itself or the research outcomes. The implications can be summarized as follows.

Firstly, the research has achieved theoretical outcomes, which makes the advances in innovation management theories. The main theoretical outcomes include follows:

(1) The paradigm of TIM applied to SMEs has been explored, which makes total innovation management (TIM) theory advanced. From practical perspective, the TIM-SMEs framework may give SMEs the guidelines to implement innovative activities.

(2) The questionnaire for measuring total innovation capabilities (TIC) have been developed and played critical role in our research. By this questionnaire, the status of TIC in SMEs has been surveyed in Zhejiang Province, Shandong Province and Fujian Province. The questionnaire will provide great reference to measure the status of SMEs' total innovation capabilities.

(3) The dimensions of TIC have been identified. And the laws of TIC developing in SMEs have been studied and concluded according to different stages, different level of performance and different scales. Distribution of dimensions of TIC in SMEs will help SMEs diagnose their strength and weakness in TIC. And the laws of TIC developing will guide them to develop or

build up their innovation capabilities according to their characteristics.

Secondly, both mechanisms and strategic pathways of leveraging innovation capabilities in SMEs via TIM have been explored, which have practical implications for SMEs to engage in innovative activities. The primary steps identified in the strategic pathway will instruct an SME to implement innovations.

Thirdly, the research outcomes have helped the governmental officials' broaden their horizons in policy-making and guide the policy-making directions. Based on the research outcomes, some recommendations for policy making have been presented to different levels of government, including central government, relevant bureaus and provincial government.

Finally, innovative methods have been used in project research. By close cooperation among universities, government and industries, the project conducted more smoothly. It makes sure that the research outcomes have both the theoretical and practical implications. The cooperative and participative model for project conducted is effective to bridge between academic and practitioners, which is conducive to make management research have an impact on management practice. It is an important innovation in research methods.

In sum, the research outcomes have the implications as follows:

(1) The research has got TIM theory progressed, and contributed to innovation management theories as well.

(2) The research outcomes, such as questionnaires developed, laws of TIC developing in SMEs concluded, and the strategic pathway for leveraging innovation capabilities, have practical implications in guiding SMEs to engage in total innovation, besides their theoretical implications.

(3) The cooperative and participative model adopted in project research has had our research outcomes diffused more quickly and smoothly, not only in policy-making but also in SMEs' innovative practice.

(4) By the project research, our research team members have acquired well training.

11.2 Further research

Innovation will drive the next wave in China's economic growth, displacing cost advantages as its prime competitive tool and enabling China's industries to deliver and capture more value. Yet, innovation still poses real challenges for Chinese companies. For example, IBM report stated this is primarily due to lack of integration (IBM Global Business Services, 2007). TIM as a new paradigm of innovation management offers a more comprehensive approach to innovation, and has achieved outstanding results in practice. As for this research project, we have taken great efforts to implement TIM in Chinese SMEs, and to help them leverage innovation capability dramatically. But there are still many areas for future research. An extreme topic is the Environment part for SMEs. Mainly as follows:

11.2.1 Innovation service system and its platform in industry and region

Promoting innovative working within the public sector could be a focus for the future. Service system play a central role in the design and delivery of services, it provides a framework to help organizations provide integrated services that meet the needs of individuals , and achieves greater diversity of provision and draw upon the strengths of the third sector. But the innovation service system has important differences with the manufacturing sector in terms of productivity, innovation activity and external markets orientation. Accordingly, there are a lot of questions to be studied in future. For example:

What are the critical roles of innovation service system for company/region innovation?

What are the characteristics of innovation service system as for non-technological innovations?

How can innovation service system embed themselves in the innovation networks?

What is the mechanism of innovation service system to leverage firm's capability based on TIM?

11.2.2 Cluster innovation supporting SMEs to innovate

Cluster innovation as a collaborative innovation process of specialized SMEs in the same or related industries that cooperate with suppliers, customers, marketing network, government, and other actors in the cluster. A lot of research discussed the competitive advantages of the cluster from the aspect of technology, social capital, and knowledge transfer etc. The role of innovations and clusters has increasingly dominated local and regional development policies in recent decades. TIM focuses on the synergy and "resultant power" for innovation based on the interactive mechanism of total innovation- all elements, all members and all time-scope. The downturn could stimulate a new wave of networked innovation in cluster innovation. Firms will need to open up their innovation processes make them more cost effective which may result from co-location of related firms, collocated segments of a value chain, or inter-firm networks. However, there are still significant gaps in the use of tactics such as outsourcing or the use of a third-party utility operator. (IBM Global Business Services, 2007) how to leverage company's capability in cluster based on TIM is next important research.

11.2.3 RIS/NIS and its policy supporting SMEs to innovate

The activities of National Innovation System have important influence on the national economy. On the one hand, optimization and upgrading of industrial clusters should be combined with industrial structure adjustment and technological progress. On the other hand, the adjustment of industrial structure should be coupled with investment structure and demand structure adjustment to maintain a balanced development of the national economy as a whole. Especially in China, government policies have an important role in promoting innovative working. But a lot of specific policies are needed to stimulate innovation in current situations. For example,

- During our research, we noticed the fact that most innovation policy still supports a traditional focus on a linear, pipeline model of innovation based on R&D, and many local governments are still very much focused on keeping up with technological innovation.
- Innovation networks in cluster have strong externalities, and entirely market-driven result is not satisfactory, especially for SMEs. Consequently, government should guide the flow of innovation resources to SMEs, and strengthen third-party forces to promote the construction of Innovation networks, e.g., trade associations, intermediary agencies, etc.
- Policy makers must take into account the heterogeneity and the multidimensional nature of innovation within the service sector when formulating and implementing policies.
- Policymakers can play a role in integrating research findings on the characteristics and behaviors that support innovative working into policy initiatives.

11.2.4 The relationships between FIS, RIS and NIS

Innovation is complex system engineering in complex environment. Combining the construction of the firm innovation system (FIS) with national, regional and industry innovation system is critical for sustained innovation in China. Our study finds that, at present, the capability

of indigenous innovation is still to be resolved within the industry, in the cluster (region) as well as in the open innovation. We integrate Firm --- Industry --- Region innovation systems as following figure11.1 below:

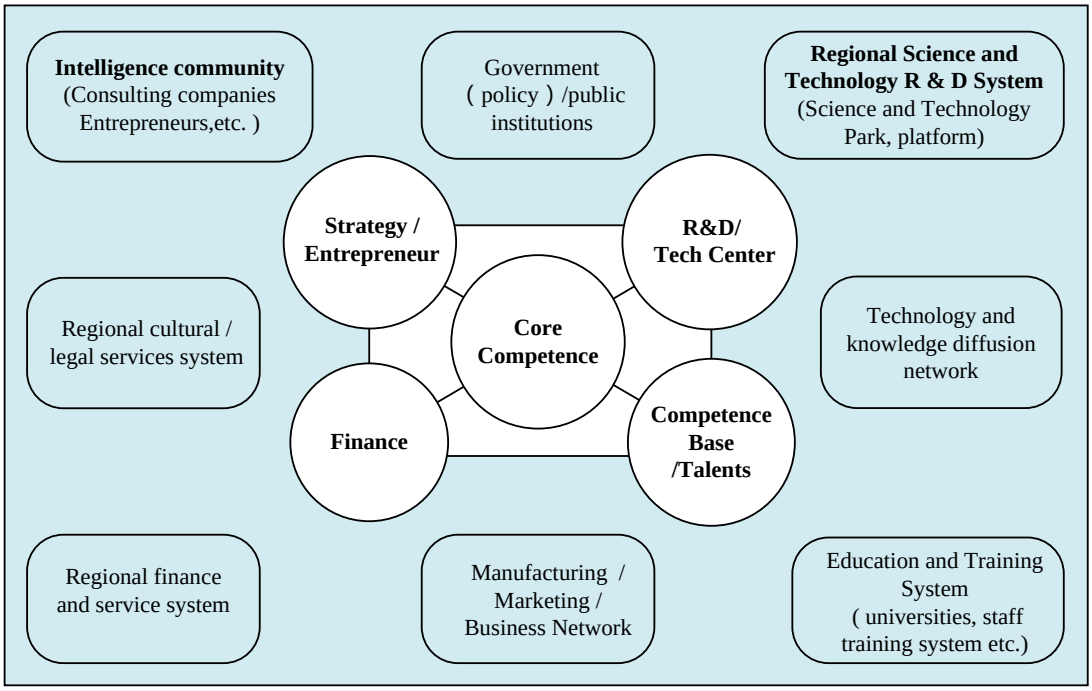


Figure 11.1 Framework of FIS-RIS/NIS

For example, the main relationships between the bodies within the entire innovation system are as follows:

- Firm is the main body of technological innovation,
- Universities and research institutions are the main body of knowledge innovation,
- Government is the main body of making innovation policy and improving the innovation environment.

There are lots of question to be studied in future research. For example, How do the relations between internal mechanism and policy implications be coupled structurally? What is the non-liner dynamics of total elements interaction? How does the innovation grow the boundaries of the companies by all time-scope innovation?

In summary, the project not only provides practical insight into how TIM can better innovation for SMEs in China, but also sets a theoretical and empirical basis for future research.

11.3 Recommendation

The IDRC project, “Application of Total Innovation Management to Leverage Innovation Capabilities of Chinese Small & Medium Sized Enterprises” is to be closed. However, our research has not been over yet, and will never stop. Along the project progressing, some new research problems occurred and have been identified. We show our many thanks to IDRC for its substantial support. Simultaneously, some suggestions will be presented to IDRC.

(1) The study on SME innovation and development should be conducted from multi-level and multi-perspective.

Up to date, most studies on SMEs innovation are mainly on the micro-level, namely,

firm-level. However, the regional innovation system, national innovation system, or even globalized innovation system play critical roles in firm-level innovation. Consequently, it is necessary to study the relationships among micro-, meso-, and macro-level innovation systems. Multi-level research on SME innovation and development is a trend. As well, technology capability is always the center of innovation capability. Therefore, R&D investments and R&D activities have been taken as the most important factors for innovation capability. Non-R&D capability has been ignored. Since SME is characterized as weakness in resource, non-R&D capability as another important factor in innovation capability should be put on the research agenda. Even design science could be introduced into the system of innovation management theories.

(2) More broader roles for IDRC to play in supporting researches are expected.

IDRC's support is directed toward creating a local research community whose work will build healthier, more equitable, and more prosperous societies. And the main role of IDRC is the financial supporter. Our project funded by IDRC is to be closed. However, the diffusion and deeper application research never stop. To make more firms from different countries to benefit from TIM theory, it needs to attempt to collaborate with more partners from some typical countries to engage in the next research and outcomes diffusing. Consequently, it is necessary to build up research collaboration among different countries, which will facilitate the researches conducting. IDRC is expected to play a role in bridging different research groups distributing all over the world.

It is worth to continue the study. We expect the future outcomes may provide more direct instructions to SMEs from more developing countries to innovate more smoothly. We thank to the grants to our research team, we expect we could keep close cooperation with IDRC continuously.

Appendix

Appendix A Project Questionnaire

"Application of TIM to leverage Chinese SMEs' innovation capability" project questionnaire

Innovation is the main source of modern productivity growth. As the reform and opening up of Chinese economy, SMEs become important component of Chinese economy. However, because of low innovation investment and weak innovation capability, SMEs still at a disadvantage in the fierce competition, the viability and sustainable development capability is also weak.

This project is supported by IDRC, and directed by Professor Xu Qingrui, who is the academician of Chinese Academy of Engineering. We want to improve the innovation ability of SMEs, expect to establish a fully new innovation management model. The goal of this project is investigating the current condition of SMEs from Zhejiang and other province, and assesses TIM strategy which can improve the effect of enterprise innovation capacity.

The research result can be used as precise strategic suggestion by Zhejiang, other province government and central government. Thus, the participation and support is very important for accomplishment of this research project expected goal.

This questionnaire is composing of 13 parts:

A. basic information of enterprise
B. strategic capability
C. culture capability
D. technological innovation capability
E. organization capability
F. market capability
G. innovation performance
H. competitive advantage
I. environment
J. innovation trend
K. innovation source
L. policy
M. entrepreneurship

If you have any questions on the questionnaire, you can contact with Wang Lihua, whose phone number is 0571-87951886 and email address is wanglihua_angela@163.com. Your participation is critical to our research, thus, thank you for spending lot of time and energy to corporate with us, thank you!

We will send you a book as a present if the quality of the questionnaire is good!

Please choose one from four books below:

1.Total innovation management 2.the horizon of innovation 3.research,development and technological innovation management 4.management（21centry textbook）

We will keep your information as secret and the result of data analysis is only for research. What's more, we will send you a completely research result, please tell us your name and address, or enclose with your business name card.

Your name: Position: Working period: ( )years

Enterprise's name: Address: Post code:

Phone number: E-mail:

Part 1 Basic information of your enterprise

1. Enterprise's name: ( ); was established in( );
2. The property of your enterprise: ( ) A. state owned B. collective C. private D. joint venture E. fully invested by foreign capital F. others
3. The main business recently: ( )
4. Basic data of your enterprise: employee's number( );technician's number( ); sales income per year( ); sell profit margin( )%;new product production value rate( )%;the weight of products and services exports in total sales in recent three years( )% ;
5. What kind of enterprises dominant the whole supply chain/ value chain in the field of main business? A. raw material supplier B. components or semi product producer C. producer D. whole sale dealer E. dealer G. others ( )
6. The current development stage of enterprise is: A. beginning stage B. development stage——diversification C. mature steady stage,internationalization
7. please evaluate your enterprise I the following table:

Totally, in recent 5 years, our enterprise's	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Business process changed radically	1	2	3	4	5	6	7
Organization structure experienced great change	1	2	3	4	5	6	7
Business field is in a major adjustment	1	2	3	4	5	6	7
Product structure is in a major adjustment	1	2	3	4	5	6	7
The region of our business is enlarged	1	2	3	4	5	6	7
Our production equipments are improved	1	2	3	4	5	6	7
The key unit of technological process changed	1	2	3	4	5	6	7
Our marketing activity changed radically	1	2	3	4	5	6	7
after-sales service system changed radically	1	2	3	4	5	6	7
corporate Strategy experienced great change	1	2	3	4	5	6	7
marketing position experienced great change	1	2	3	4	5	6	7

Part 2 Strategic capability

In our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Have clear strategic intention	1	2	3	4	5	6	7
TMT reach the agreement on business strategy	1	2	3	4	5	6	7
TMT can make decision in time when facing the environmental change	1	2	3	4	5	6	7
Project team are preparing the Preparatory Program for environment change	1	2	3	4	5	6	7
Move faster than industry rivals when facing strategic change	1	2	3	4	5	6	7
Professional stuffs are employed to correct strategy	1	2	3	4	5	6	7
Technological innovation and marketing innovation are considered seriously and combined	1	2	3	4	5	6	7
Plans are made to identify and face the environmental changes	1	2	3	4	5	6	7

Part 3 Culture capability

In our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
TMT support all staff involved in innovation	1	2	3	4	5	6	7
Often try new ideas and find new ways	1	2	3	4	5	6	7
Innovation risk is considered too big to be encouraged	1	2	3	4	5	6	7
Often analyze failure and communicate with others	1	2	3	4	5	6	7
Managers tolerate innovation risk and failure	1	2	3	4	5	6	7
Motivate and award innovative employees	1	2	3	4	5	6	7
Employees can broke traditional thinking and find bright new prospect	1	2	3	4	5	6	7
Staff learning is investment but payment	1	2	3	4	5	6	7
TMT pay attention on exploration of new business filed	1	2	3	4	5	6	7
TMT pay attention on development of new technology opportunity	1	2	3	4	5	6	7
TMT have a sense of crisis toward development of enterprises	1	2	3	4	5	6	7
Employees have many opportunities to propose their constructive suggestion	1	2	3	4	5	6	7
Allow departments broken regular working process, in order to keep the flexibility and dynamic of work	1	2	3	4	5	6	7
Encourage employees' innovation though establish completely management mechanism	1	2	3	4	5	6	7

Part 4 Market capability

In our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Consider the long term developing trend while making market strategy	1	2	3	4	5	6	7
Keep good and long term relationship with customer	1	2	3	4	5	6	7
Pay attention to the feedback information from key users	1	2	3	4	5	6	7
The marketing unit can meet product and business demand well	1	2	3	4	5	6	7
Strong control on distribution channel	1	2	3	4	5	6	7
Often provide new product and service when enter new market	1	2	3	4	5	6	7
Strong control on product's price	1	2	3	4	5	6	7
Have completely sale system	1	2	3	4	5	6	7
Our enterprise understand market demand well	1	2	3	4	5	6	7
We will show fast response to the changing demand	1	2	3	4	5	6	7
We pay attention to the after-sales service	1	2	3	4	5	6	7
The marketing unit can meet enterprise development demand well	1	2	3	4	5	6	7

Part 5 Technology capability

In our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
We have enough technician to do new products' development	1	2	3	4	5	6	7
The technology of our products is leader in the industry	1	2	3	4	5	6	7
We have strong system integration capability	1	2	3	4	5	6	7
We have strong construction capability of product platform	1	2	3	4	5	6	7
We have good choose mechanism on new product development	1	2	3	4	5	6	7
We will consider production process flow during new product development	1	2	3	4	5	6	7
Our enterprise's product level match up the process level	1	2	3	4	5	6	7
We improve our production process flow continuously	1	2	3	4	5	6	7
We can absorb, grasp and apply introduced production machine and process	1	2	3	4	5	6	7
We are good at absorb and take advantage of technologies and knowledge outside	1	2	3	4	5	6	7
We have strong track capability toward technology development trend	1	2	3	4	5	6	7
We have strong technology integration capability	1	2	3	4	5	6	7
We have strong production capability	1	2	3	4	5	6	7
Propose advanced production system such as CIMS, ERP, etc during the production process	1	2	3	4	5	6	7
We have advanced R&D equipments	1	2	3	4	5	6	7
Employees have strong equipment operation capability	1	2	3	4	5	6	7
We have strong equipment improvement capability	1	2	3	4	5	6	7

Part 6 Organizational innovation

In our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Employees from different functional department learning with each other and share experiences regularly or frequently	1	2	3	4	5	6	7
The responsibility of different departments are fixed clearly in our enterprises	1	2	3	4	5	6	7
We have clear organization process	1	2	3	4	5	6	7
The information transferred between departments are accurate	1	2	3	4	5	6	7
The information transferred between departments are in time	1	2	3	4	5	6	7
Information sharing is considered very important	1	2	3	4	5	6	7
Information sharing between functional departments is encouraged	1	2	3	4	5	6	7
Communication method based on IT are widely used	1	2	3	4	5	6	7
The instinct of flat is quite high	1	2	3	4	5	6	7
TMT create opportunities to support communication between different functional departments	1	2	3	4	5	6	7
There are standardized operating and producing processes	1	2	3	4	5	6	7
The projects have a fixed assessment process	1	2	3	4	5	6	7
In the company-wide to establish a unified information platform	1	2	3	4	5	6	7
There are completely budget system	1	2	3	4	5	6	7
The projects have a fixed assessment process	1	2	3	4	5	6	7
Database and documentation are updated real time	1	2	3	4	5	6	7
Encourage learning and training toward employees	1	2	3	4	5	6	7
TMT often participate in training and learning	1	2	3	4	5	6	7
Often learn relative experience from counterparts	1	2	3	4	5	6	7
Often training employees to improve their skill	1	2	3	4	5	6	7

Part 7 Innovation performance

Totally,in recent 5 years,our enterprises	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
The sales of new products are raising	1	2	3	4	5	6	7
The development period of new products are shortening	1	2	3	4	5	6	7
The profit of new products are raising	1	2	3	4	5	6	7
The success rate of new product development is improving	1	2	3	4	5	6	7
The number of patent applications are increasing	1	2	3	4	5	6	7
New product attach the profit target	1	2	3	4	5	6	7
The releases of new product meet themarket share target	1	2	3	4	5	6	7
Totally, the new products we released meet customer's demand well	1	2	3	4	5	6	7
Development cost of new products always within the buget	1	2	3	4	5	6	7
We release new products quicker than competitors	1	2	3	4	5	6	7
TMT are quite satisfied for the development speed of new products	1	2	3	4	5	6	7
New product development meet enterprise development strategy demand well	1	2	3	4	5	6	7

Part 8 Competitive advantage

Totally,compare with competitors, our enterprise,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
We have advantage in products(or services)	1	2	3	4	5	6	7
We have advantage in products' performance	1	2	3	4	5	6	7
We have advantage in products' quality	1	2	3	4	5	6	7
We have advantage on cost	1	2	3	4	5	6	7
We have advantage on cost-effective	1	2	3	4	5	6	7
We have advantage on timeliness to provide a product (or service)	1	2	3	4	5	6	7
We have advantage on brand	1	2	3	4	5	6	7
We have advantage on labor cost	1	2	3	4	5	6	7
We have sustained competitive advantage	1	2	3	4	5	6	7

Part 9 Environment

Totally,in our main business field,	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Technology changed rapidly in the industry	1	2	3	4	5	6	7
It's quite difficult to predict the changing trend of technology in this industry in the coming two or three years	1	2	3	4	5	6	7
There are many new technological opportunity in the industry	1	2	3	4	5	6	7
There are fierce competition between similar enterprises	1	2	3	4	5	6	7
Price war is quite popular among enterprises in the same industry	1	2	3	4	5	6	7
In the same filed, if one company can provide some products and service, then this won't take long, other competitors will give out the same things	1	2	3	4	5	6	7
The new technology is quite difficult to be imitated by competitors	1	2	3	4	5	6	7
It's easy to predict the development trend of technology involved in business	1	2	3	4	5	6	7
We can easily predict the growth rate of market	1	2	3	4	5	6	7
Users' preference and functional demand always changing	1	2	3	4	5	6	7
Users are quite sensitive on price	1	2	3	4	5	6	7
The market demand changed regularly	1	2	3	4	5	6	7
Market and users can adopt new technology easily	1	2	3	4	5	6	7
There are fierce competition from technology and products	1	2	3	4	5	6	7

Part 10 Innovation Tendency

We care about long-term effect, not short term when allocating innovation materials such as human recourse and money	1	2	3	4	5	6	7
We pay more attention on key-technology innovation, not on normal technology when allocating innovation materials	1	2	3	4	5	6	7
We prefer to continual technology innovation	1	2	3	4	5	6	7
Compared to product innovation, we prefer to process innovation and promotion	1	2	3	4	5	6	7
Material devotion is not enough on process and flow innovation	1	2	3	4	5	6	7
Material allocation incline to satisfy the requirement from current customer	1	2	3	4	5	6	7

Part 11 Innovation Origination

Acquiring channel of technology knowledge	Important content for product development and promotion	Important content for process/production flow and equipment development and innovation
Communication and contact with employees from other innovation company	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Employ new employees from other innovation company	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Back-courting project/copying products and technology from current products or competitors	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Interior research and development	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Upper supplier or major customer(key customer) provider technology direction and training	1 2 3 4 5 6 7	1 2 3 4 5 6 7
When solving the technology requirement and question from key customer and special customer, we can obtain idea, feedback and technology experience	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Obtain ideas and technology from supplier's employers (raw material, parts and equipment)	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Cooperation with university	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Cooperation with research agency	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Cooperation with companies in the same business or occupation	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Technologic information and training are supplied by business association	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Technology and knowledge obtain from technical license	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Technology and knowledge obtain from release of patent gazette	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Technology and knowledge is obtained from technical publication and technical meeting	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Business exhibition	1 2 3 4 5 6 7	1 2 3 4 5 6 7

Part 12 Policy

Policies with strategy	Understanding content for this policy (1:not understand; 7:very understand)	Impact of this policy to promote the innovation of media-small companies
Independent innovation and high technology is supported by government purchasing	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Preferential tax policies before deducting technology development tax for small and medium enterprises(SMEs)	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Encouraging SMEs to establish technology center	1 2 3 4 5 6 7	1 2 3 4 5 6 7
High technology SMEs which are assessed by national agency, can enjoy preferential tax policies according current policies	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Intellectual property department should supply help for personnel or small company to apply or maintain patent of invention whatever national or international	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Supply a scale support when SMEs want to participate in setting business technology standard	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Establish SMEs' information public service desktop, promote the application of information technology	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Supply preferential tax policies to employee training investment when companies want to increase the devotion on employee skill training and technician bringing up	1 2 3 4 5 6 7	1 2 3 4 5 6 7
During the government purchasing, under the same condition, SMEs' products should be purchased preferentially if it has been listed on the government purchasing independent innovation products summary	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Supply discounting subsidy when SMEs applying loan though special fund which is set for development of SMEs	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Financial agency should provide financial support when SMEs want to import core technical software or export equipment produced by new technology, which are used for research and development and conformed to relative national policy and principles for commercial credit	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Encourage SMEs list on the market and get financing from it	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Promote the development of technologic intermediary services agency	1 2 3 4 5 6 7	1 2 3 4 5 6 7
In the area where SMEs are relatively centralized or having a business advantage, setting up a public technologic supporting desktop	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Setting regional patent teaching service, supply patent inquiring, applying direction, management and maintenance	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Supplying financial support and preferential tax policies, using jointed financial, commonly entrust method to do cooperative research	1 2 3 4 5 6 7	1 2 3 4 5 6 7
For the new established high technology companies which are set in the national high technology business developing area, providing deducting preferential tax policies for companies' income tax	1 2 3 4 5 6 7	1 2 3 4 5 6 7

Part 13 Entrepreneurship

Generally, we need to improve factors for independence innovation	Quite disagree	Disagree	Not so agree	No idea	Agree a little	Agree	Quite agree
Enterpriser should have the ability of forecast, do long term strategy planning	1	2	3	4	5	6	7
Enterpriser should have the spirit of risk	1	2	3	4	5	6	7
Enterpriser should have the consciousness of innovation	1	2	3	4	5	6	7
Enterpriser should have a wide international view	1	2	3	4	5	6	7
Enterpriser should be good at grasping market opportunities	1	2	3	4	5	6	7
Enterpriser should have a good technological base	1	2	3	4	5	6	7
Enterpriser should have a good knowledge base	1	2	3	4	5	6	7
Enterpriser should have the ability of making good judgments and decision	1	2	3	4	5	6	7
Enterpriser should have an insight into employees' character, know how to use them	1	2	3	4	5	6	7
Enterpriser should have a close connection with crowd, and encourage everyone to do innovation	1	2	3	4	5	6	7
Enterpriser spend a lot of money to hire innovative talents	1	2	3	4	5	6	7
The attention content, which enterpriser pay on completely innovation	1	2	3	4	5	6	7
The attention content, which enterpriser pay on fully space-time innovation	1	2	3	4	5	6	7
Enterprise is willing to invest enough money on technology innovation	1	2	3	4	5	6	7
Enterprise has the courage to do innovation on system	1	2	3	4	5	6	7
Enterprise has the courage to do innovation on management	1	2	3	4	5	6	7
Enterprise has a good innovation culture, encourage risky spirit, and tolerate failure	1	2	3	4	5	6	7
Enterprise has a good innovation network, and can integrate innovation material	1	2	3	4	5	6	7
Enterprise has a good learning culture organization learning system	1	2	3	4	5	6	7
Enterprise has a good knowledge management base (absorbing, shoring, accumulating and spreading knowledge)	1	2	3	4	5	6	7

Appendix B List of Case Study Samples

Table 2.1 List of Case study Samples

Company	Industry	Company Location	Established Time	Developmental Stage	The Number of investigation
SunYard System Engineering Co.,Ltd	Computer Software Services	Hangzhou, Zhejiang Province	1996	Development Stage	Investigating for 9 moths
Hangzhou GaoBo Intelligent Machine Co.,Ltd	Machinery Manufacturing	Hangzhou, Zhejiang Province	2000	Development Stage	4 time/ 4 persons
Zhejiang Institution of Textile	Public Service Platform	Shaoxing, Zhejiang Province	2006	Development Stage	14 times/ 8 persons
SUPCON Group	Computer Services	Hangzhou, Zhejiang Province	1993	Development Stage	6 times/ 9 persons
Fuchunjiang Group	Electrical Machinery and Equipment Manufacturing Industry	Fuyang, Zhejiang Province	1985	Maturation Stage	5 times/ 6 persons
Hangzhou HonYar Electric Co., Ltd.	Electrical Machinery and Equipment Manufacturing Industry	Hangzhou,Zhejiang Province	1984	Development Stage	Field study for 4 Men-Months
Focused Photonics Inc	Machinery Manufacturing	Hangzhou, Zhejiang Province	2002	Start-up Stage	Field study for 4 months
Hangzhou R&D Design Ltd.	Commercial Services	Hangzhou, Zhejiang Province	1999	Development Stage	4 times/3 persons
Zhejiang Uni-Power Guarantee	Security Industry	Hangzhou, Zhejiang Province	2004	Development Stage	5 times/ 4 persons
Zhejiang Sunon Furniture Manufacturing Co., Ltd.	Furniture Industry	Hangzhou, Zhejiang Province	1991	Development Stage	3 times/3persons
Zhejiang FAI Electronics Ltd.	Machinery Manufacturing	Hangzhou, Zhejiang Province	1999	Start-up Stage	2 time /3 persons
Hangzhou Great-start Tolls Co., Ltd.	Fabricated Metal Products	Hangzhou, Zhejiang Province	1992	Development Stage	2times/ 3persons
Zhejiang Huadong Steel Group	Fabricated Metal Products	Hangzhou, Zhejiang Province	1993	Development Stage	2times/ 3 persons
R&V Website	Entertainment	Hangzhou, Zhejiang Province	2005	Development Stage	5 times/ 6 persons
Hangzhou Fangyuan Plastics Machinery Co., Ltd.	Machinery Manufacturing	Hangzhou, Zhejiang Province	1992	Development Stage	3 times / 3 persons
001 Group	Transport Equipment	Hangzhou, Zhejiang Province	1988	Development Stage	3 times / 3 persons

Company	Industry	Company Location	Established Time	Developmental Stage	The Number of investigation
Sunwave Communications Ltd.	Communication Equipment	Hangzhou, Zhejiang Province	1993	Development Stage	2 times/ 3 persons
Hangzhou Latitude Industry Co., Ltd.	Textile	Hangzhou, Zhejiang Province	2001	Development Stage	3 times/ 3 persons
Hangzhou Jinfuchun Silk & Chemical Fiber Co., Ltd.	Textile	Fuyang, Zhejiang Province	1998	Development Stage	2 times/ 3 persons
Fujian Tiansheng Agriculture Stock Co., Ltd	Food Manufacturing	Fujiang Province	2000	Development Stage	Frequently
Shi Da Computer Co., Ltd in Fujian Province	Computer Services	Fujiang Province	1988	Development Stage	Frequently
Fujian Haiyuan Automatic Equipments Co., Ltd.	Machinery	Fujian Province	2003	Development Stage	Frequently
Fujian Fengzhu Group Co., Ltd.	Textile Industry	Fujian Province	1987	Development Stage	Frequently
Zheng Hang Food Co., Ltd in Shandong Province	Food Manufacturing	Shandong Province	1993	Development Stage	3 times/ 3 persons
ShiKeFeng Chemical Co., Ltd	Chemical Products Manufacturing	Shandong Province	1994	Development Stage	4 times/ 3 persons
Fufeng Group	Food Manufacturing	Shandong Province	1999	Development Stage	3 times/ 1person
Shandong Xuyang Machinery Co., Ltd.	Machinery Manufacturing	Shandong Province	2005	Development Stage	3 times/ 1person
Zhejiang Tongxiang QuePing Textile Finishing Co., Ltd.	Textile Industry	Jiaxing, Zhejiang Province	2002	Development Stage	3 times/ 4 persons
Futong Group	Electrical Machinery and Equipment Manufacturing Industry	Fuyang, Zhejiang Province	1987	Development Stage	3 times/ 6 persons
Hangzhou TMAX	Machinery Manufacturing	Hangzhou, Zhejiang Province	2000	Development Stage	3 times/ 5 persons

Other investigated firms include: Hangzhou Yinyu Cable Co., Ltd; Sainteyear Holding; Hangzhou Hengtian Flour Group Co., Ltd; Hangzhou Tianqi Television and Animation Co., Ltd; Hangzhou Second Office Ltd.; Hangzhou Safety Base InfoTech Co., Ltd; Hangzhou ICafe Technology Co., Ltd; Hangzhou DFYD Information Technology Co., Ltd; Hangzhou Temax Technology Group; Zhejiang Taizilong Culture Communication Co., Ltd; Ego Group; Southeast Space Frame Co., Ltd; Hangzhou Zhonghen Electric Co., Ltd; Hangzhou Paradise Umbrella Group.

Appendix C Semi-structural Interview Outline

The Project -- "Application of Total Innovation Management to Leverage Innovation Capabilities of Chinese Small & Medium Sized Enterprises" Interview Outline

Part 1 Background of enterprises

1. Please introduce the development of your enterprise and the current status.
2. Please describe the composition of current business.
3. What about the competition of each business in industries? What are the main sources of competitive advantages?
4. What about the industrial environment faced by each business? (Such as competitors, substitutes, bargaining power of suppliers, bargaining power of customers, potential competitors)
5. What about the basic data (the number of employees, the number of technical personnel, R&D investment, total assets or net assets, asset-liability ratio etc.) and the change of operating results (especially the annual sales revenue, pre-tax profit (rate), the value (rate) of new product development, the number of patent applications, the number of new products and the average development cycle of new products in the last five years)?

Part 2 Total Innovation Management

6. How do you consider on the development of the whole enterprise and the technology?
7. What about the development of the technology strategy? What is the reason that triggers changes in technology strategy? How to accomplish these changes?
8. How to develop technology strategies? Are there some persons or departments responsible for the formulation, implementation and amendment of technology strategies?
9. How about the convergence of technology strategy with business strategy and market strategy?
10. What about the investment of human resources and financial resources in the technological development (product development and process development)?
11. What are the strategy, principle and priority of resource investment in new product development and technology development?
12. How to get technology developers and financial resources?
13. What technological areas does enterprise currently mainly apply? What are the core technology areas?
14. What are the channels of technology acquisition? (Such as internal research and development, imitation, patent analysis and cooperation of industry, university and institute). How about the effectiveness of each channel? Why?
15. Can your enterprise keep a good balance between product innovation and process innovation?
16. How to develop the capabilities of product innovation and process innovation? What experiences and lessons are learned in the process?
17. What about the current organizational structures? What are the changes in the organizational structures?
18. What about changes in the structure of technological development department? What are the reasons triggering changes?
19. What are the problems of current organizational structures form the innovation perspective?
20. What about the process of new product development and process development?
21. What about the general conditions and effectiveness of the cooperation among industry, university

and institute? Please introduce some typical projects carried out by your company.

22. What kinds of mechanisms in your enterprise that can encourage employees participate in the process of innovation? (Such as the reasonable proposals) How about the effects and problems?

23. Does your company cooperate with peers and suppliers on the technological development? (The frequency of cooperation, any cross boundary or cross time zones cooperation) How to manage these co-operations? What about the effect of cooperation? What problems are existed? Please give some typical examples.

24. Can different departments coordinate and cooperate well with each other in the commercialization of new products? What are the successful experience and problems?

25. How does the top management team treat technology management and innovation activities? Are you willing to make long-term strategic investment in technological innovation?

26. Are different R&D research teams willing to share experience and knowledge in the process of innovation? What are the mechanisms that encourage knowledge sharing?

27. What about the changes in the culture and incentive systems in recent years? Please introduce the specific practices and their effects.

Part 3 Innovation-related Policies

28. What central policies and local policies supported indigenous innovation do you know? Which policies does your company currently enjoy? Do these policies improve the enthusiasm of indigenous innovation? If the results are ineffective, what are the reasons? What are your recommendations of existing policies?

29. [Questions asked to high-tech SMEs] On April 28, 2006, Zhejiang Province proposed the policy-"Speeding up the capabilities of indigenous innovation, and building up the innovative province and Science and Technology province." The18th term of this policy indicates that "actively exert the roles of government procurement policy to support innovation and high-tech industrial development."

Details are as follows: "Within the framework of indigenous innovation products identified by the People's Republic of China, Provincial Department of Finance in conjunction with the relevant departments, identifies the provincial catalog of innovative products, and create incentives institutions for indigenous innovation in government procurement and ordering system. All levels of government organs, institutions and groups, using financial capital for procurement must give priority to purchase indigenous innovation products. In the budget approval process, the Department of Finance gives priority to the budget for indigenous innovation products under the premise of the identified procurement expenditure items. In the focus of government investment projects, the procurement ratio of domestic equipment generally should not be less than 60% of the total value; If do not comply with the rules, the Department of Financial will give no funds." Based on this information, what do you think about setting up the evaluation criteria for indigenous innovation products? What aspects should be judged from?

30. What other kinds of policies promoting innovation do you want to have (enjoy)? Why?

Appendix D Case of Sunyard

1. Firm investigation

Since 1996, Sunyard Co., Ltd. has been established for more than 13 years. Famous for its software R&D, system integration products and operation service, Sunyard System Engineering Co.,Ltd (Sunyard for short) is a software company in China, which is a designer, manufacturer and seller of financial IT software, outsourcing business and environmental protection products. Sunyard has become one of the most excellent developers and manufacturers of financial and securities software. In Sunyard, 30% of employees are managers as well as 50% are technicians. More than 80% of employees have achieved bachelor degree or even higher degree, forming a high-qualified specialized team in fields of R&D, manufacturing, integration, technology support and services.

Through a follow-up investigation, we collect data from in-depth interviews and secondary data sources. The scope of interviewees covers the top managers, the departmental managers, the technicians and the first-line operators, etc. After the data collection, the mechanism of innovation capability leveraging in Sunyard is analyzed. It is believed that, first, the innovation is a comprehensive process. Innovation performance should be based on firm's innovation capability, which is composed of various elements, such as strategic capability, organizational capability, technological capability and marketing capability. Second, innovation can be enabled by government policies, entrepreneurship, new product development, innovators and the information technology. Third, the firms strategic resonance capacity is the key to enterprise innovation capability leveraging. The dynamic fit between strategy and other innovation elements, such as culture, technology, and market determines the efficiency and effectiveness of innovation capability leveraging.

Table 4.1 Investigation in Sunyard

Item	Content
Investigation Period	From March 24, 2008 to August 10, 2009
Major Participants	Prof. XU Qingrui, Prof. GUO Bin, Dr. ZHENG Gang, REN Zongqiang, ZHANG Jun, CHEN Litian, ZHANG Suping, CHEN Feng, JIN Lu
Major Interviewee	CHENG Kailin, the general manager of Sunyard System Engineering Company JI Baiyang, the general manager of Technology Company in Sunyard JIANG Xiaolin, the project manager of VPN product WU Gengfan, marketing manager of Technology Company in Sunyard
Main topics	The development process of Sunyard; the activities of total innovation management; key capabilities and successful experience

2. The Development stage and innovation practice in Sunyard

From year 1996 to 2001, the main target of Sunyard was to solve the conflict between the demand of the bank's informationization and the shortage of technological capability. In order to settle down this conflict, the company worked out a strategy, "half step lead in technology and market", and determined to satisfy the market demand via improving its technological capability.

From 2002 to 2005, Sunyard went into the diversified stage. During this stage, especially

after IPO, the conflict between the financial disclosure pressure and the low profit became the central issue in Sunyard. In order to increase the short-term profit, the company applied an un-related diversification strategy. Under the guidance of this strategy, Sunyard entered into the environmental protection industry and established many strategic business units (SBU).

From 2005, Sunyard enters into the internationalized developing stage. The main conflict of Sunyard is between the scattered innovation resource and the core capability shortage. After realizing this conflict, Sunyard decide to leverage its technological capability. The company's strategy returned to its main business. The technology center was established to integrated scattered R&D resources.

Table 4.2 shows Sunyard's innovation practices in different stages. The process of innovation performance leveraging is shown in figure 4.1. Important performance indexes, such as the sales and productivity of Sunyard are shown in figure4.2 and figure4.3 respectively.

Table 4.2 Innovation practices in Sunyard

Stage **Dimension**	**Initial & developing stage** **（1996.7-2002.11）**	**Diversified stage** **(2002.12-2005.2)**	**Internationalized developing stage** **(2005.3-2008)**
Strategic innovation	- Half-step advanced strategy -Construction of core products & competence - No.1 or No.2 in segmented market	-Developed new business, such as environmental protection products -"Three Helps"(Users, Partners, employees) - BPO business mode	-The diversified strategies combining system, integration products, outsourcing and operating. -ITO (information technology outsourcing) & BPO: from China to world -Supporting outstanding subsidiaries
Technological innovation	-Bank bill CD microphotography system -Self-property right encryption algorithm - Call center - Electronic imaging	- Environmental protection of science and technology products - Virtual private network - Wireless POS	-Exploiting high-end ecological link, -Developing basic and general software platform and components
Organizational innovation	-Restructured the firm's architecture -Integrated technological resources & established R&D center	-Electronic document image information processing platform -Technology center -Zhejiang-Sunyard information security technology research center	-Established unified central research institute - Established international communication department - Acquired Dalian company - Integrated organization architecture and strengthened concentration(flat）
Management innovation		-Implemented the CMM3 authentication - Balanced and meticulous financial accounting -Individual economic responsibility system	- Improved institutional system -Strengthened the budget management and the fund dispatch - Advocated self-supervision in employees -Change of company management mechanism
Marketing innovation	-Developed financial business	-Entered in non-banking areas	- Opened up overseas market - Built distribution channels
Cultural innovation	-Honesty, elegance and high-efficiency	-Culture loss caused by institutional changes & the employee shifting	-Fusion of the pluralistic culture based on 'honesty, elegance and high-efficiency, innovation and integrated'
All Time/Space And All involvement innovation		- Alliance with SMEs built-up by former employees - Cooperated with a Singapore firm on VPN	

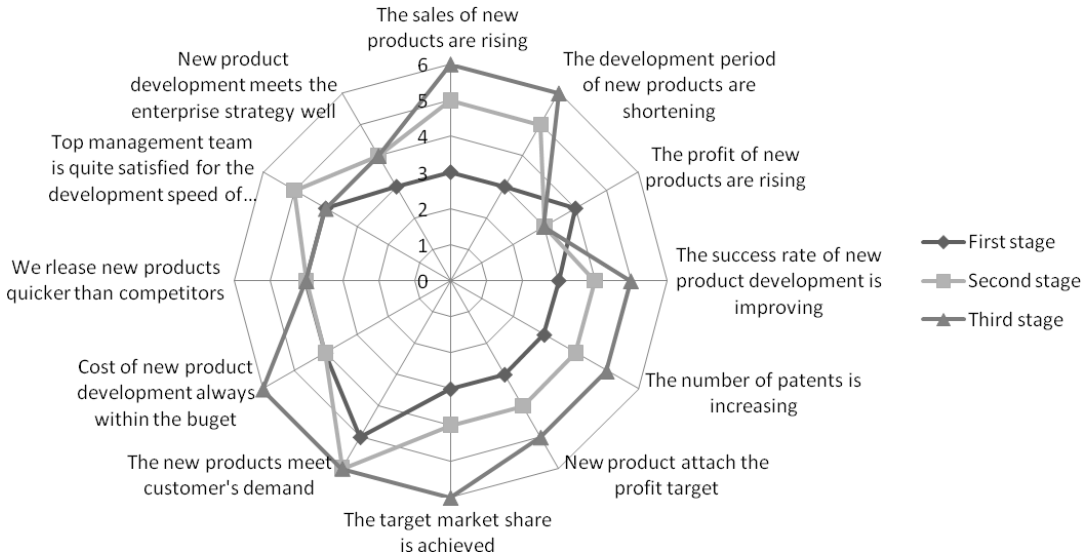


Figure 4.1 Innovation performance in Sunyard

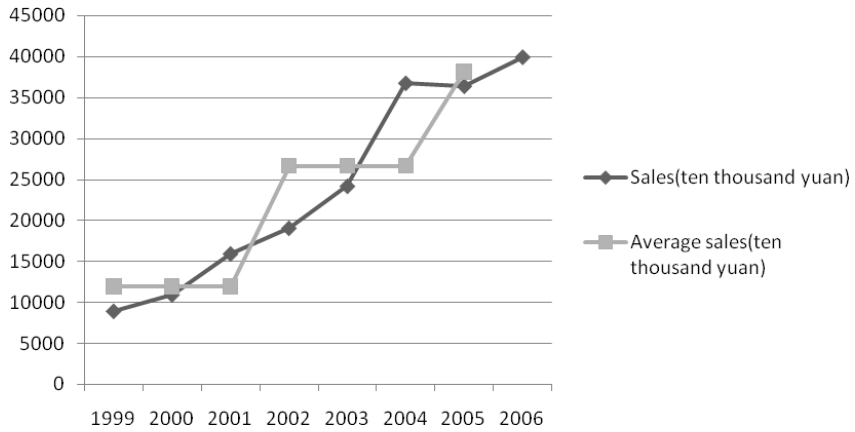


Figure 4.2 Sales of Sunyard

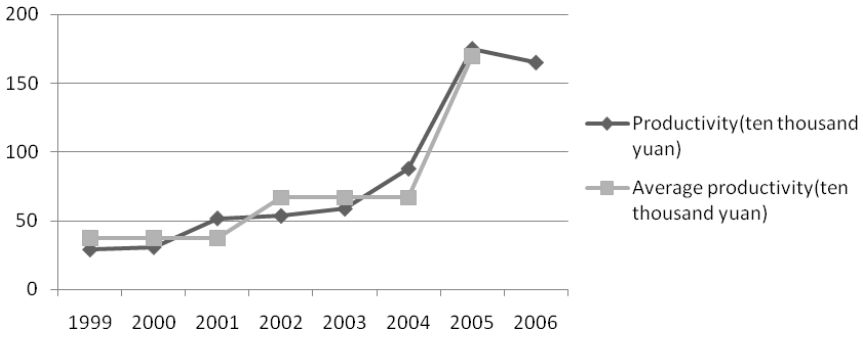


Figure 4.3 Productivity of Sunyard

As shown in above figures, we can find that the score of two indexes, the "continuous increase profit from new products" and the "top management's satisfaction for the development speed of new products", have fluctuated (the score of these two indexes were decreased in the second stage, but became increased in the third stage), and the index, "issuing new products faster than competitors", had no change. The other indexes were all increasing gradually.

The improvement of innovation performance relies on the innovation capability leveraging.

What's more, the innovation is a systematic engineering. In order to improve the innovation capability, the company should try to improve the element capabilities related to the innovation.

3. The enhancement of innovation capabilities of Sunyard via TIM

Based on the literature, we design an evaluation system of innovation. Then the innovation capabilities of Sunyard in its different stages were assessed using the seven-point Likert scale questionnaire. The results showed in Table 4.3.

Table 4.3 Innovation capabilities of Sunyard in its different stages

Evaluations system of innovation capability			Score					
			Year 2003		Year 2005		Year 2008	
Innovation Capability	Strategic capability	Integrating internal capabilities and market demand	5	4.7	4	3.7	6	5.3
		Coordinate the development of mainstream and new stream products	6		4		5	
		Avoid short-sighted strategy	6		3		5	
		Specialized strategic organization and persons	3		5		6	
		The technology, marketing and manufacturing department are cooperated with each other to develop the innovation strategy	4		2		6	
		Awareness of green innovation	4		4		4	
	Organizational capability	Design organizational learning system according to strategic goal	5.7	4.9	4.7	3.9	6.1	5.7
		Fit between organizational structure and strategy	6		3		6	
		Clear organizational process	3		4		5	
	Cultural capability	Transfer from strategy-bound culture to strategy-assist culture	6	4.7	4	4	5	4.3
		Transfer from memory type culture to learning culture	5		4		3	
		Construction of cultural system	3		4		5	
	Technological capability	Harness the industry's core technology	3	4.3	4	4.1	3	4.9
		Coordination between the product design and manufacturing function	3		5.3		6.7	
		R&D investment intensity	6		3		5	
	Marketing capability	Understand customer's existed and potential demand	4	3.7	5	4.8	6	5.5
		Distribution network design	3		4.5		4.5	
		Market investment intensity	4		5		6	

Among the sub capabilities, both the strategic capability and cultural capability are the highest layer capability for the guidance role they played. Organizational capability is at the middle layer for building innovation management platform, which played an intervene role on influencing technological innovation performance. Both the technological capability and marketing capability are the third layer capability, which influence innovation performance directly. In order to demonstrate the development process of innovation capability, we separate the sub capabilities into two groups. Figure4.4 shows the development of strategic, organizational and cultural capabilities in Sunyard. Figure4.5 represents the development of technological and marketing capabilities. Some important capability indexes, such as innovation investment and number of core talents of Sunyard are shown from figure4.6 to figure4.9.

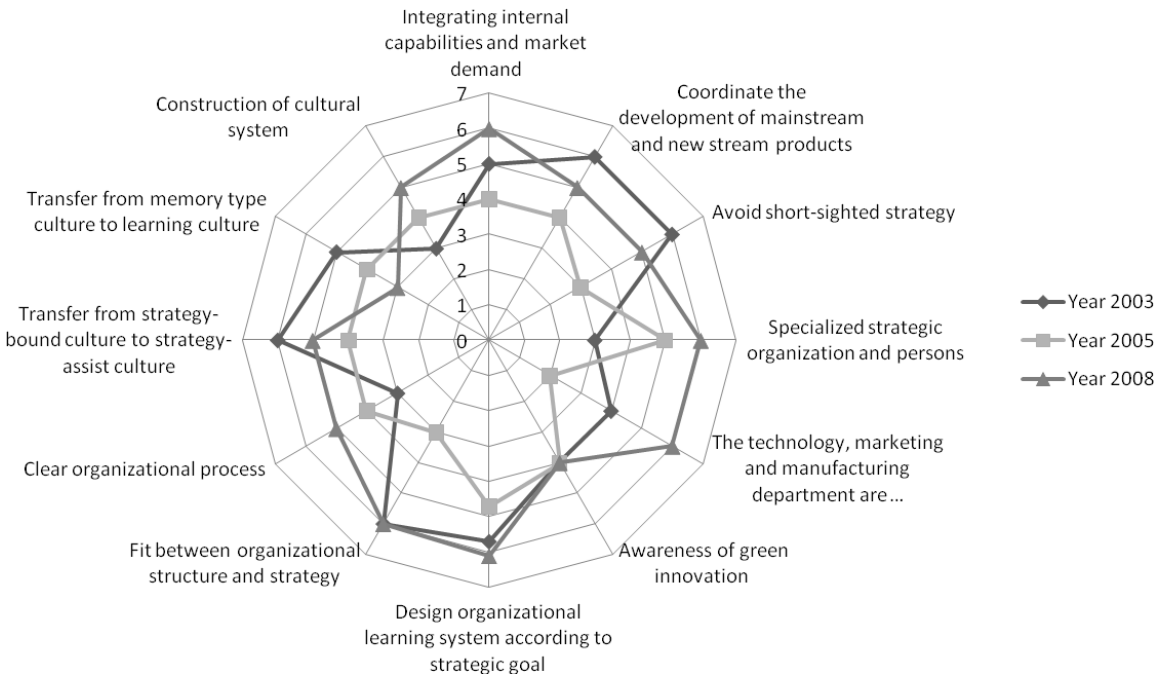


Figure 4.4 The development of Sunyard's strategic, cultural and organizational capabilities

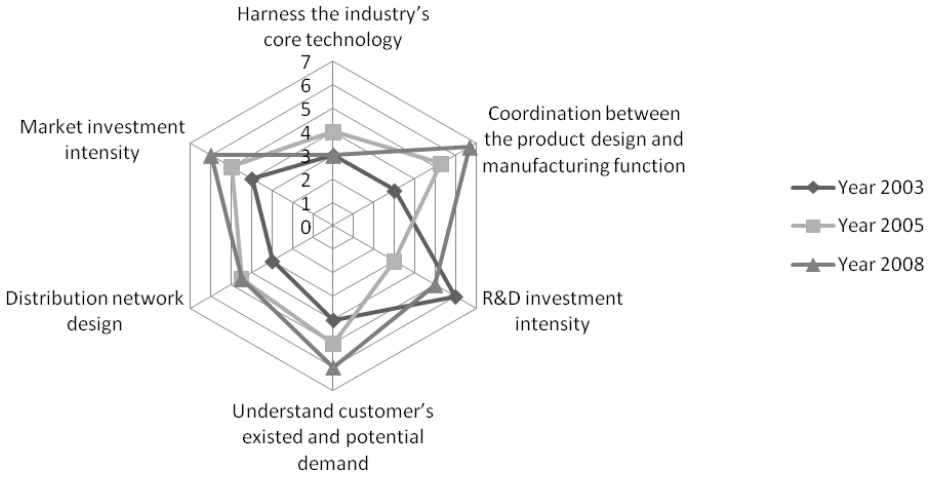


Figure 4.5 The development of Sunyard's technological and marketing capabilities

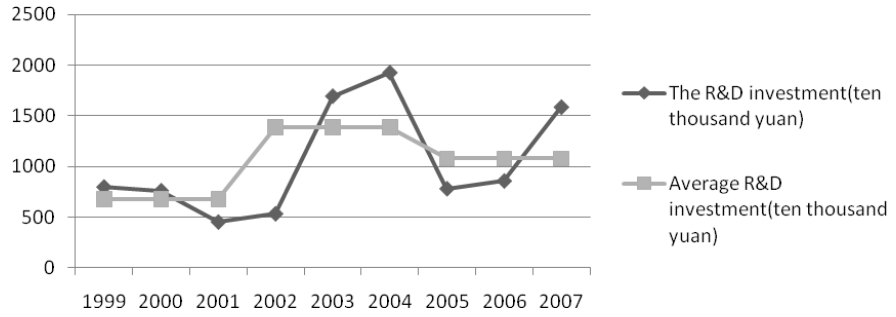


Figure 4.6 The R&D investment in Sunyard

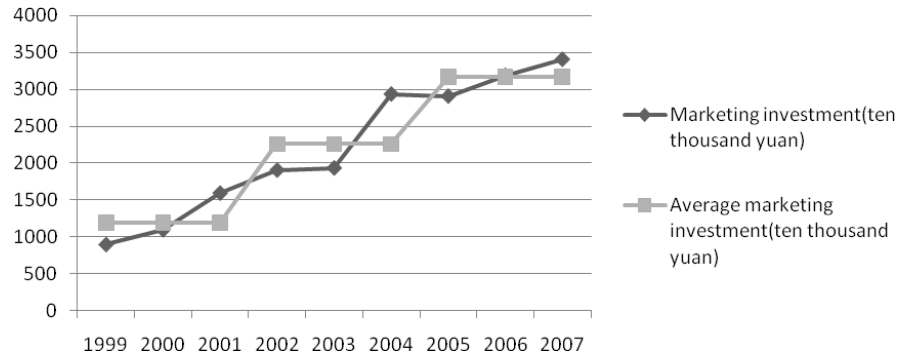


Figure 4.7 Marketing investment of Sunyard

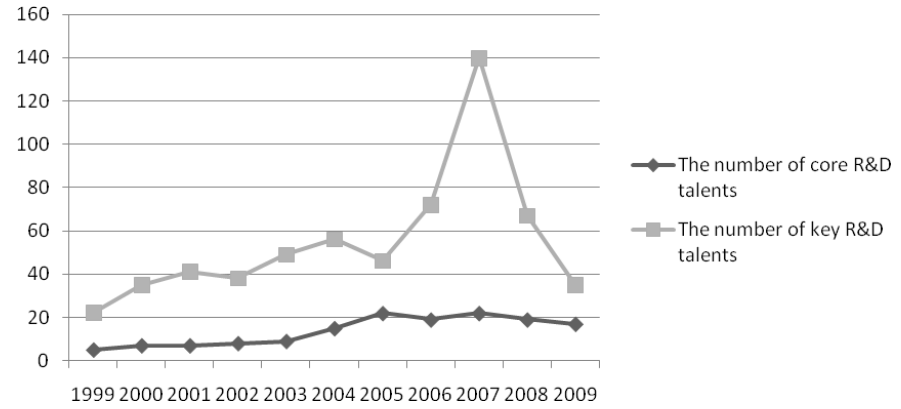


Figure 4.8 The number of core and ey Technological Talents in Sunyard

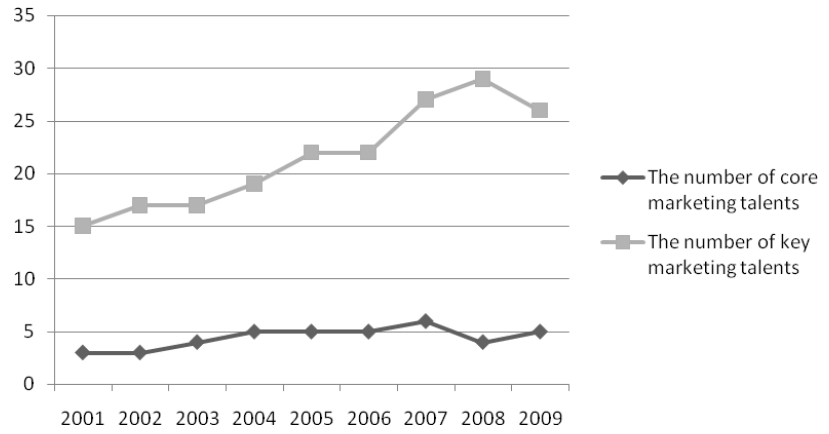


Figure 4.9 The Number of Core and key marketing talents in Sunyard

From above figures, we can easily find that, firstly, with the development of the enterprise, the enterprise's management system becomes more and more completed. The score of "specialized strategic organization and persons" index was increasing sustainiously. Compared to heavy industry, the environmental pollution created by software enterprises is much less. Therefore, the score of "awareness of green innovation" index always holds on a stable and high level. However, the score of other strategic capability indexes, such as "integrating internal capabilities and market demand", "coordinate the development of mainstream and new stream products", "avoid short-sighted strategy" and "departments are cooperated to develop strategy", showed a

fluctuation in the second stage. In the first stage, the enterprise's strategy was innovative. Therefore, the score of the above four indexes in the first stage was higher than that in the second stage. Because of the diversification strategy in the second stage, all indexes showed a decrease more or less. On the other hand, because the strategy exerted a guidance impact on the core capability, this adjustment has a series of influence on the following organizational, technological and marketing capabilities. Finally, it also influenced the trend of the innovation performance indexes. The fluctuation of performance let the enterprise realized that the diversification strategy was not suit for the enterprise. Sunyard had no option but made a strategic adjustment to return to its main business. In the third stage, score of indexes was increasing again, which directly demonstrated the success of this strategic change.

Secondly, with the mature of enterprise management, the organizational process of Sunyard became more and more clear. Meanwhile, because of the influence of strategic capability's fluctuation, the matching extent between Sunyard's organization's structure and strategy was also being changed gradually.

Thirdly, with the influence of the fluctuation of the strategic organizational capability, the two indexes, the "transfer from strategy-bound culture to strategy-assist culture" and the "transfer from memory type culture to learning culture", also showed fluctuations simultaneously. However, with the enterprise's development, the capability of the construct cultural system appeared a gradual increase.

Fourthly, in order to establish core capabilities, Sunyard outsourced its manufacturing function to EASTCOM and kept a close communication with it. During the products design process, Sunyard would consider that whether the design idea can be achieved in manufacturing process. Therefore, the capability of "coordination between the product design and manufacturing function", showed a gradual increase. Meanwhile, under the guidance of technology-oriented strategy, the score of the "innovation investment" index and the "harness the industry's core technology" index were very high. However, because of the diversification strategy in the second stage, the resources were being scattered. The above two capabilities had been negatively influenced. Only after the strategy adjustment, the score of these two indexes became higher.

Finally, Sunyard paid a great attention on the establishment of the marketing capability. The company increased its investment on marketing, and cultivates lots of market staff. The purpose of Sunyard was to explore potential market. The capabilities, which were "marketing investment" and "understand customer's existed and potential demand", reinforced. Meanwhile, with the enterprise's development, the capability of "establishing distribution network" and "grasping the trend of the market" was also leveraged

4. The Successful experience of Sunyard

4.1 Synergy among innovation elements was achieved by implementing all-element innovation

The innovation capability is a comprehensive capability, thus the synergism between different elements played is critical to innovation capability leveraging. Through a positive synergism between innovation elements, the experience of the innovation capability leveraging is summarized as following:

First, Mr Guo, the entrepreneur, possessed a strong market perception capability. During the strategy formulating stage, Mr Guo integrated the technological capability and market demand,

which was beneficial for the core technology accumulation and the core capability establishment.

Second, when the strategy was implementing, the entrepreneur should keep the organization structure and the strategy fit. Both of the changing the resources distribution oriented strategy and the organizational learning method encouraged the accumulation of the core capability. On the other hand, Sunyard transformed from strategy-restricted culture to strategy-assisted culture, which focused on the main contradiction within the organization. The company commenced the work from te employee's thinking, improved the organizational consent of the strategy and ensured the strategy's implementation.

The successful experience of all elements innovation is shown as table4.4.

Table 4.4 Successful experience of all-element innovation

Content / Dimension	Successful experience of all elements innovation
Innovation capability leveraging via strategy	1. Integrate market demand and technological capability when making strategy 2. Establish strategic platform to coordinate innovation capability elements; 3. Combine different capability such as organizational structure, technological capability to support new product development 3. Transfer the strategic poison from product maker to solution provider
Innovation capability leveraging via organization	1. Set institution and rules to support stimulate creativity 2. Apply information technology to facilitate organizational infrastructure 3. Establish some cooperation platform to seek technology outside of the organization 4. Extend innovation chain to user, supplier and coorperator
Innovation capability leveraging via MOT	1. The secondary innovation capability is growing fast 2. Advanced R&D process 3. Maintain high knowledge and R&D intensity to reintegrate knowledge 4. Customers are invited to participate in the process of innovation
Innovation capability leveraging via culture	1. Cultivate knowledge sharing culture to stimulate knowledge exchange; 2. Cultivate risk taking and innovative culture
Innovation capability leveraging via marketing	1. Maintain strong customer orientation to explore customer's existed needs and potential needs 2. Establish distributed channels

4.2 External resources and opportunities were obtained by implementing all-time-space innovation

Compared to big enterprise, SMEs do not have enough innovation resources and innovation experiences. The industry-universities-institutes cooperation was greatly beneficial for SMEs to obtain technologies, market information and management experience. Thus, it can also reinforce the knowledge storage, reduce the cost, shorten the developing period and improve the innovation efficiency and effect.

The successful experience of all time-space innovation in Sunyard is concluded as follows.

First, the "Zhejiang University-Sunyard computer information security technology researching center" was established to develop the password technology. This practice utilized the basic researching advantage of the universities and institutions, and greatly reduced the developing period of the new VPN products.

Second, in order to obtain technology support, Sunyard cooperated with Intel and a Singapore firm. The Singapore firm provided great help in the development of the VPN products. Meanwhile, in order to improve the efficiency of core capability accumulation, Sunyard outsourced the manufacturing tasks to ESATCOM and paid more attention on the development of its core arithmetic. Besides, in order to solve the profit system coordination during the

intra-enterprises cooperation, Sunyard gave the channel to its partners and achieved a win-win result.

4.3 Organizational intelligence is enhanced by implementing high-involvement innovation

First, Sunyard encouraged the employees to do a pioneering job within the organization, which was beneficial for the enterprise's long-term development by integrating the personnel and the enterprise's development targets and ensured the implementation of the innovation strategy by cultivating innovative culture.

Second, during the development of financial IT products, the customer participated in the whole process of the innovation. From the product design to the product test, Sunyard improved the customer needed capability and created the value for the customers.

Appendix E Case of FPI

1. Firm investigation

From November 2008 to 2010, Professor XU and his project team have conducted field study in Focused Photonics Inc for five times, then team members JIN Lu and WANG Lin are arranged to participate in the practical work.

Focused Photonics Inc. (FPI) is a hi-tech enterprise created by returning brains. Company gathers the technology and management elites from international well-known universities and applies itself to the research and application development of the new generation of photoelectric measurement technology, process analysis technology and laboratory analysis technology; it develops, produces and sells the analysis measurement instruments which meet the demands of both domestic and overseas markets, and provides perfect technical support as well as service. FPI was founded in 2002, January. The registered capital was 12 million dollars. Now, FPI possess 4 subsidiary companies, 19 offices and customer service terminals, and about 1000 employees.

FPI conducted R&D and sales of high-end monitoring instruments in the theme of health, environment protection, safety and efficacy. The main technology platforms are: semi-conductor laser absorption spectrum (the core), ultraviolet spectrophotometer technology (the core), near-infrared spectrophotometer technology (the core), and multi-channel spectrum analysis technology. Main products: on-line laser gas analysis system (LGA) (the core), continuous emission monitoring system (CEMS) (the core), process spectrophotometer analyzer (OMA), near-infrared spectrum analyzer (SupNIR) and so on. Main business areas served by FPI are: metallurgy industry, petrochemical industry, energy sources and environment protection, biochemical pharmacy industry, etc.

Table 5.1 Investigation in FPI

Item	Content
Time	2008.11-2009: three months
Participants	Prof. XU Qingrui, Prof. ZHENG Gang, Ph. D REN Zongqiang, ZHANG Jun, ZHANG Suping, WANG Lin, JIN Lu
Interviewee	Chairman WANG Jian; WANG Xin, Director of Project Development Department; CEO YAO Naxin; ZHANG Zheng (Director of Marketing) etc.
Main topics	Development of FPI; the activities of total innovation management; key capabilities and successful experience

2. Industrial environment analysis of FPI

FPI has begun its business on the development of core technology-- Diode Laser Absorption Spectroscopy Technology (DLAS), then gradually spread spectrum technology to form multi-modality model in the core of LGA platform, OMA platform, NIR platform. Products and solutions of FPI are primarily for industrial process monitoring, environmental protection and public safety monitoring and food monitoring. Characteristics of industry environments are shown in the following.

(1) The industry is a slowly-varying one. Therefore, the development of enterprise relies on core technology. Enterprises with core technology will have strong core competitiveness, but the

core technology needed to be able to meet market demand. The whole industry in the country is in a fledgling development state and not fast, so the process requirements are not very high, but the products also need to have a strong differentiation and better performance.

(2) The industry is located mostly related to environmental protection industry. Customers are mainly a number of industrial enterprises (such as steel mills, power plants, chemical plants, etc.) as well as government departments (EPA, the Water Conservancy Bureau, the Urban Council, SOA, etc.). As the higher and higher people's living standards, the demanding of state environmental protection have become increasingly. If there is no clear policy direction, for the profit-oriented enterprises, it is difficult to take the initiative to produce the related needs. Therefore, enterprises need to closely follow market trends, and provide technical reserves. In the marketing process, firms need to be able to better grasp the business opportunities channel through a series of relationships.

(3) Products of FPI are high technology integration, more complex and require personalization and a high degree of customization. It is needed from the pre-communication, system design, complete supply, installation put into operation to a set of user training course. It is difficult to establish the local market for foreign enterprises service network, which makes foreign companies to develop more mature domestic market has become an obstacle, so the competition is mainly among the main domestic competitors.

3. The development stage of FPI

The development history of FPI can be divided into two stages.

(1) Start-up Stage (2002—2005). In this stage, President WANG Jian, already has his own patent, which is the predecessor of FPI’s core technology (Semiconductor Laser Measurement Technology). The major objective in this stage was to explore a market based on the core technology. The product line was still narrow.

(2) Rapid Development Stage (2005-2008). The principal contradiction at the second stage is the dissonance between technological and market factors. In order to resolve this problem, FPI pay attention to organizational and institutional innovation, so that the complete innovation system has been established to balance the elements of technology and market. What’s more, in order to improve the turnover, the product line has been expanded in this stage.

The company's main products are around the themes "health, environmental protection, safety, efficiency." In the past two years, FPI continued to focus on the development of the environmental protection industry and the security industry. Initially FPI entered into the market relying on the LGA system and then quickly shifted to the environmental protection industry. After promulgating of the environmental protection policy, all the industrial enterprises involving pollution rapidly became the potential customers of FPI. When FPI acquired steady status in the environment protection industry, it jumped out of industry and aimed at the civil market--the opportunity of food safety and inspection. FPI developed from seeking for market by technology to being market orientation. Based on the market research, FPI entered into the industry of environment and food. Closely combining with market trend, FPI purified the market information and formulated the cooperation strategy on the analysis the detail of the market and technology environment. Then, they developed and reserved the corresponding technology. For FPI, in the next several years the way of development is from the laser to ultraviolet, infrared, they have done the spectrum industry; and from gas measurement to liquid measurement, solid measurement, they involved different

forms of material measurement.

Table 5.2 Characteristics of different development stages in FPI

Item Stage	Firm establishment	Start up (2002-2005)	Rapid development (2005-2009)
Technology background	Mature of DLAS	Laser gas analyzer developed in a leading position; foreign companies' advanced technology is not used in domestic market	An extension of spectroscopy: UV / Visible / Near-infrared; situ extraction / sequential injection
Market background	Contradiction between high-end analytical instrument vacancies and the objectives of constructing environment friendly society	The rapid development of steel industry shows a huge demand	The State Environmental Protection proposed progressively stricter building requirements; similarity demand from various industries
Strategy focus	Industrialization of the core technology	A single product searched for the relevant market, the development of ferrous metallurgy field; technology in search of markets	Multi-series products, multi-industry applications; technology and market synergies, integrating internal and external resources for technology development and market expansion
Main problem	Venture	Search for relevant market	Core technology development, segment markets demand mining, building sales channels
Organization structure	____	the project standard as R&D as the core	The introduction of IPD process, organizational structure optimization: market, research and development, supply, engineering

4. TIM of FPI

Table 5.3 Total innovation activities of FPI

Stage / Dimension	Start-up stage (2002—2005) (R&D and sales of single product)	Rapid development stage (2005-2008) (R&D, sales and service of multi series products and industries)
Principal contradiction	*The difficulties came out when commercialize the core technology of FPI	*The dissonance between technological and market factors
Strategic innovation	*Targeted at high-end strategy *Take advantage of DSAL technology to accomplish industrial engineering Monitoring *The technological strategy was local market oriented.	*Focus on the field of environmental protection equipment. *The hierarchical system of indigenous innovation strategy was established *Focus on establishing R&D and marketing system, rather than manufacturing. *The product Review Committee was established to reinforce the strategic making capability.
Technological innovation	*Laser-line gas analysis system and UV technology were successfully developed. *The technological capability was leveraged through the cooperation with research institute and university.	*Near-infrared technology, full-spectrum ultraviolet technology and environmental monitoring system were successfully developed. *With the market as the orientation, comprehensive technological investigation was done concerning products that are going to be put into production. *The importance of intellectual property was emphasized *A multi-layered technological innovation system was established *The efficiency and effectiveness of R&D were increased through the application of project system and IPD process
Marketing innovation	*Seize the market opportunity: Laser-line instruments *Customizing the End User Experience *The direct-sales model was established	*The entrepreneur was good at Tracking heat Point of national policy *Respond to market demand rapidly *a multi-level market research was carried out, so that the customer demand and competitor intelligence can be understood more completely. *The concept of customization was emphasized *Portfolio marketing model was established
Institutional innovation	*Broad carrier development prospective *the training system was established	*Multi-facet incentive system was established *The recruitment system was improved *Matrix system of assessment mechanism was established
Management innovation	*Funnel-shaped R & D decision-making process	*The quality Assurance System was established *The R&D process based on IPD and CMMI *The Information System Platform was established
Culture innovation	*Fair and simple relationship among employees	*win-win cooperative spirit *Teamwork spirit
Entrepreneurship	* Complement management and technical talent *Entrepreneurs are good at analyzing the market situation, seizing market opportunities, and adjusting the direction of development *The company leaders have a clear understanding of the company's core strength *Focus on core technology development and intellectual property protection *Entrepreneurs adhere to the spirit of perseverance to pull the company continually advance	

5. The enhancement of innovation capabilities of FPI via total innovation management

5.1 R&D input

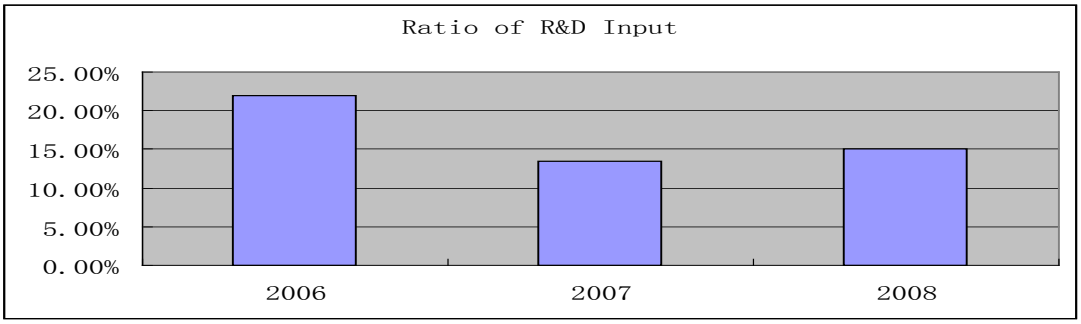


Figure 5.1 Ratio of R&D Input

The costs of R&D input generally accounted for about 15% of sales. Comparing to general corporate R&D ratios in the same industry, the R&D input was much higher. R&D input accounted for 21.9% of sales revenue in 2006 and 13.4% in 2007

5.2 Product development cycle

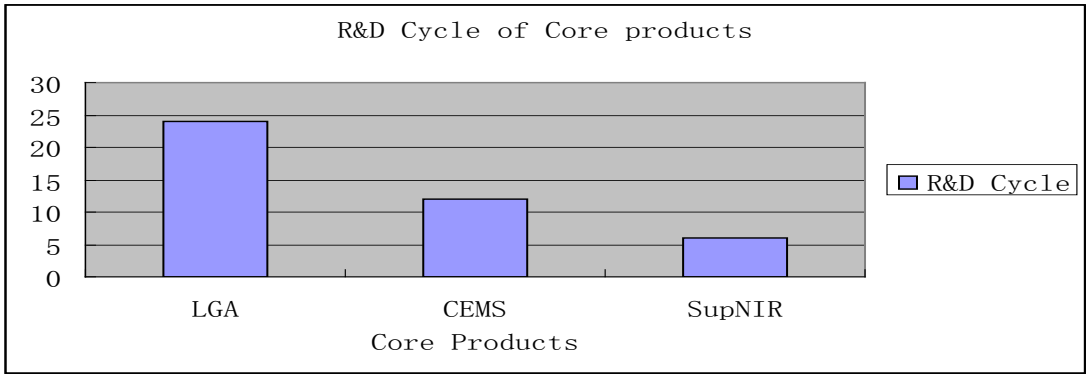


Figure 5.2 R&D Cycle of Core Products

Note: LGA: On-line Laser Gas Analysis System; CEMS: Continuous Emission Monitoring System; SupNIR: near-infrared spectrum analyzer.

5.3 The performance of FPI

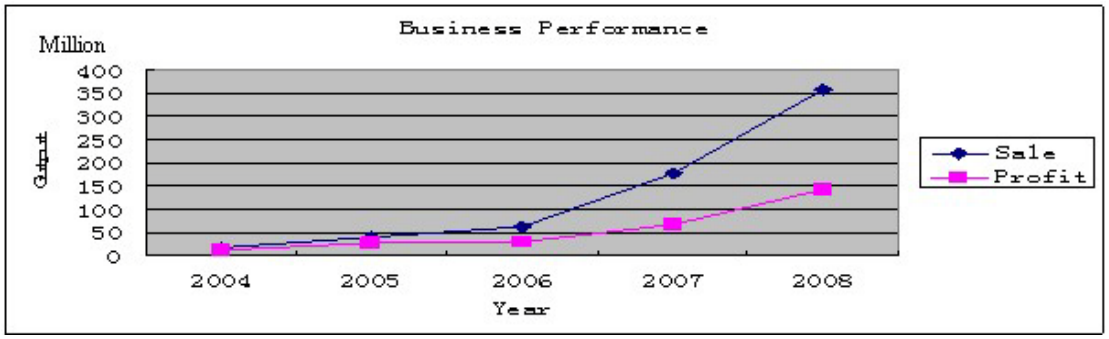


Figure 5.3 Business performance of FPI

The sales and profit of FPI got rapid growth, and the share of the new product accounted the

major part. The good performance showed the strong innovation capability of FPI.

Table 5.4 Some other data of FPI

Item	Content
R&D input	About 15% of sales revenue
The number of firm employees	From 30(2003)~ 1000(2008)(included 300 technicians)
Product development cycle	From 24 months (2004) to 6 months (2008)
Sale revenue	From 1 million (2003) to 400millions (2008)
Profit	From 29 millions(2006) to 100 millions(2008)
Patents	42 invention patents, 59 utility model patents and 25 software copyrights(2008)
Performance	The core product LGA occupied 95% of domestic market share and the sales of CEMS got the first place in the industry

6. Inspiration for TIM

6.1 Market-oriented innovation

Market demand is the power source for firm innovation. When firms are in close connection with market demand and positively response, they can launch differentiated products and win the market opportunities. Market can point out the direction for technological innovation. Closely combining with market trend, FPI purified the market information and formulated the cooperation strategy based on the analysis the detail of the market and technology environment. According to the strategy, they developed and reserved the corresponding technology. FPI developed from one industry into other industry and can obtain high market share in every industry. Innovation capability got improved quickly.

6.2 Entrepreneurs integrated internal and external resources and carried out market expansion based on the core technology

FPI is a binary structure and the two entrepreneurs have their own expertise, technology and market respectively. They can grasp the two ends of the dumbbell properly and integrate the internal and external resources (technology, talented person and so on) for firm development. FPI put high investment in the development of the core technology and can market competition advantage by the core technology. So, FPI can grow quickly.

Appendix F Case of Honyar

Hangzhou Honyar Electrical Co., Ltd. (Honyar), established in 1984, has produced various kinds of building electrical appliances products for more than 20 years and is well-known domestic electrical appliances production, operating enterprise. It is also the national 863 plan CIMS application engineering business model、national demonstration enterprises of intellectual property, the high-tech enterprises and demonstration enterprise of patent in Zhejiang Province. In new era, Honyar is committed to be the provider of the electrical connection with the construction of electrical control systems integration and promote Chinese electric industry into the era of intelligent. Accordingly it is focusing on the innovation capability based on total innovation management with the comprehensive information management and a strong marketing network to enhance its core competitiveness.

1. Main investigation in Honyar

Table 6.1 Main investigation in Honyar

Time	Participants	Respondent
9/22/2008	Prof. Zheng Gang,Li Wenting, WangLin	Tech- center, CEO Office
04/21/2009	Prof. Zheng Gang, Prof.LiuJingjiang, Ren Zongqiang,WangShu	Tech- center (manager LiLixin, WangHaiping)
05/22/2009	Prof. XU Qingrui, Prof. Zheng Gang, Ren Zongqiang,	CEO(WangMicheng), Tech- center managers (LiLixin, Wang Haiping)
2009/06/03-05	Prof. XU Qingrui, Prof. LiuJingjiang, Dr.ZhuJianzhong, DingXIao Ren Zongqiang, Zhang Jun, Zhang Suping, Wang Lin, Jin Lu	CEO(WangMicheng), Central-academe managers (LiLixin, Wang Haiping) Human-resources department manager(ZhuWei), Information center manager,CEO Office, Market department Director(ZhangYuan)
11/2/2009	Prof. XU Qingrui, Prof. Zheng Gang, Ren Zongqiang,	Senior managers (56)

2. TIM of Honyar

Table 6.2 Characteristics of different development stages in Honyar

Item	Growth stage 1984-1998	Development stage(1998-2005)	Rapid development (2005-)
Technology background	Quality improvement Technology accumulation	NPD, IT-CIMS, introduction of new technology by Joint.	NPD, Advanced Manufacturing Technology , technology of energy saving
Market background	Contradiction between high-end analytical instrument vacancies and the objectives of constructing environment friendly society	The rapid development of domestic market, Constructuion, Decoration, Real estate etc.	The diversity of needs and aspirations of quality of life for different people
Strategy focus	Capturing the market by quality	Diversity and market expansion	Upgrading value-chain in Industry, Sustainable Development
Main problem	Quality and Brand	quality and efficiency	innovation for value added
Organization structure	Functional Structure	divisional organization	matrix management

Table 6.3 TIM of Honyar

Stage / Dimension	Development stage （2003—2005）	Rapid development stage （2005-2008）
Principal contradiction	• Quality and efficiency	• Upgrading value-chain in Industry, Sustainable Development
Strategic innovation	• Pursuing market expansion by diversification • Focusing on efficiency and quality •	• Focus on the field of environmental protection for sustainable development • Transformation from traditional manufacture to new provider.
Technological innovation	• Introduction of new technology by joint venture • Building tech-center to develop new product • Developing new technology to enter the new industry	• Cooperation with Zhejiang university for CIMS, Co-Lab. • Taking the market trend as a basis for future product structure • Using high-tech and advanced equipment to upgrade the technology and product level to promote the development of industry.
Marketing innovation	• Seize the market opportunity by direct-sales model • Increase customer loyalty by quality • Attract new customers by NPD • Refresh products/services	• Shifting away from price to value • Exploring new business including network marketing based on new market trends. • Deepen depth of geographic market and widen the width of new market • Brand construction
Institutional innovation	• Mechanism of Dual-channel promotion • Innovation Fund and Target • Appraisal system to reward creativity and innovation	• Learning System: e-learning and job rotation • Ensure room for failure by institutions • Matrix organization and function allocation
Management innovation	• Enterprise reform, including Salary system, organization structure, Asset restructuring	• Based on information management, company changes management philosophy, management style, organizational structure and so on to improve the management capability.
Culture innovation	• Cooperative, votive and equal sprits and style of hard struggle	• Continuous innovation, the pursuit of speed, cost-focused, attention to detail, professional standards, competition-oriented. • Teamwork spirit
Entrepreneurship	• Openness to ideas • management style is participative, innovative and supportive • Learning Entrepreneurs with fresh and diverse thinking	

3. The enhancement of innovation capabilities of FPI via total innovation management

3.1 sales, profit and R&D

Figure 6.1 Sales, profits and R&D investment of Honyar (unit: 10,000yuan)

From 2003, the sales of Honyar have increased quickly. And the share of the new product accounted the major parts from 35% to 53%, but the R&D input increased little, the growth of sales and NPD was resulted in no-technology innovation.

3.2 The growth of NPD, R&D and profit

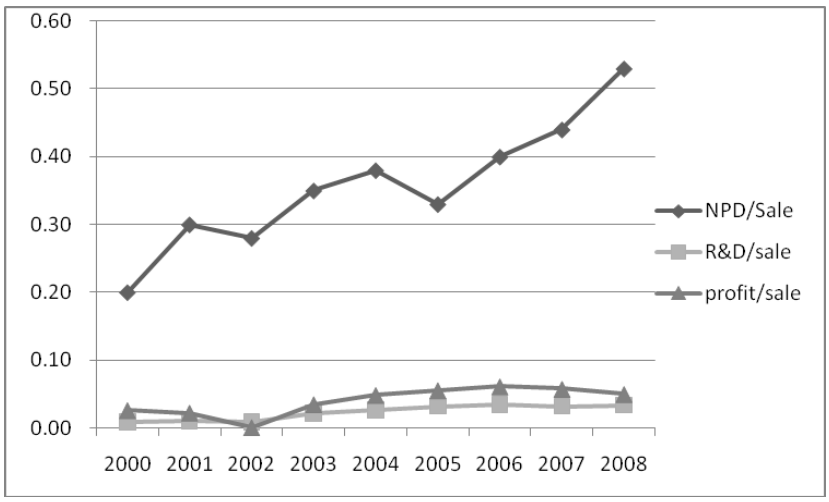


Figure 6.2 Rate of NPD, R&D and Profit (sales) of Honyar

The costs of R&D input generally accounted for about 3% of sales. Comparing to general corporate R & D ratios in the same industry, the R&D input was moderate levels. However, NPD has dramatically increased in recent years based on TIM.

Table 6.4 Some other data of Honyar

Item	Content
R&D input	About 3% of sales revenue
The number of firm employees	From 300(2003)~ 1100(2008)(included 120 technicians)
Product development cycle	From one new product/ 3 months (2003) to one/one months (2008)
Sale revenue	From203million (2003) to 507millions (2008)
Profit	From 7.11 millions(2006) to 28.5 millions(2008)
Patents	3 invention patents, 13 utility model patents, participating 9 items of national standards
Performance	occupied 65% of domestic market share and the sales of construction apparatus got the first place in the industry

4. Inspiration for TIM

First, the link between strategy and innovation is important to effective innovation management, a market-orientation strategy can guide the company to the right position in market.

Second, focusing on integration of product innovation and process innovation combination by IT platform, Honyar is focusing on the innovation capability based on information technology and has successfully built a platform for modern and comprehensive innovation management system by IT. At the same time, IT makes it possible to integrate learning about complex group interactions and thus promotes creativity and innovation.

Third, in accordance with the different characteristics of the existing various industries, company designs the corresponding systems of the commercial operation, and strengthen the analysis on value chain to improve industry competitiveness and profitability.

Appendix G Case of SUPCON

1. Introduction

SUPCON Group Co., Ltd. (SUPCON in short), established in 1993, is one of the leading high-tech enterprises in China focusing on R&D, manufacturing, marketing, engineering services and system integration for total industrial solutions with innovative industrial control and information technologies.

Business of SUPCON has widely spread to Asia, Middle East, Africa and Europe, etc. Its products and industrial solutions have been generally applied in process and manufacturing industries, such as chemicals, oil refining, petrochemicals, mining and metals, electric power, pulp, paper, robotics and public business systems, such as intelligent traffic, environment, water treatment, digital medical, building automation and education.

The core business of SUPCON is the development of innovative control and information technologies with hardware, software, system integration and total industrial solutions to provide its customers with great values under today's fiercely competitive global market.

2. Main investigation activities in SUPCON

Table 7.1 Main investigation activities in SUPCON

Date	Participants	Interviewees
November 1, 2008	Prof. XU Qingrui, CHEN Jin and ZHENG Gang Doctor Candidate LI Wangfang etc.	President ZHU Jiang Vice-president SHI Yimin
January 27, 2009	REN Zongqiang, ZHANG Jun, JIN Lu	Central research institute
January 29, 2009	ZHANG Jun, JIN Lu	Central research institute

3. Total innovation management of SUPCON

Table 7.2 TIM of SUPCON in different stages

Stage / Elements	Initial stage 1993-1996	Adjustment stage 1997-2000	Growth stage 2001-2006	Rapid development stage 2007-
Strategy innovation	Cost leadership strategy Core technology/capability construction	Brand strategy Building two brands: Zhongkong and SUPCON	Standardization strategy Establishing intellectual property system and formulating world's first R&D of next generation fieldbus standard EPA	Globalization strategy Driven by both technology and market
Culture innovation	People-oriented with professionalism, cooperation and innovation as soul	Sense of identity, accomplishment and belonging First-class image, first-class quality, first-class service	Third-class companies sell products Second-class companies sell technologies First-class companies sell standards	First-class companies sell idea (service innovation philosophy)

Stage / Elements	Initial stage 1993-1996	Adjustment stage 1997-2000	Growth stage 2001-2006	Rapid development stage 2007-
Technology innovation	China's first DCS with 1:1 hot redundancy technology World's first paperless recorder China's first fully digitized DCS system	China's first round card based on HART protocol China's first large-scale application of APC software China's first large-scale application of Profibus technology in highway tunnel	"Industrialization Base of the National High Technology Research & Development Program of China (863Program)" World's first R&D of next generation fieldbus standard EPA "Key enterprises of the National Torchlight Plan" China's first total automation solution for process industries China's first recognized international standard China's first famous brand in automation field "National Enterprise Technology Centre"	Application of DCS in China largest coal-based single synthetic ammonia unit (450,000 t/a synthetic ammonia and 800,000 t/a urea)
Organization innovation	Software development department Hardware development department	Software development department Hardware development department New technology development department Meter development department	Building technology center (Technology and product center) Integrating organizational structure (Adjusting subsidiary and business unit; Reallocating function)	Corporation research institute Brain trust of technology strategy Birthplace of research output Incubator of core technology
Management innovation	Project-based management Emphasizing on loose and self-discipline	Normalization and institutionalization management Project management Passing ISO9001 Fining of finance calculation (To project and individual) Individual economic responsibility system (Individual economic responsibility form)	Improving evaluation system (Classification evaluation) Implementing budget management Reinforcing centralized management control Pattern of configuration library management	Flexible management pattern for position innovation Rigid management pattern for position such as operation management
Market innovation	Low-cost market access Low end market positioning Customer service management	Specializing in petrochemical industry Portfolio of engineering and service	Outsourcing manufacturing Establishing subsidiaries Establishing international department	Providing solution for different industries
High-involvement innovation & All time-space innovation	Several functions for one employee Pooling the wisdom and efforts of everyone		User innovation Close connection to partners Establishing overseas office	National 863 Program-Major control system development and application in low cost National 863 Program-Distributed control system of large-scale equipment for domestic application

4. Innovation performance of SUPCON

4.1 Performance of SUPCON

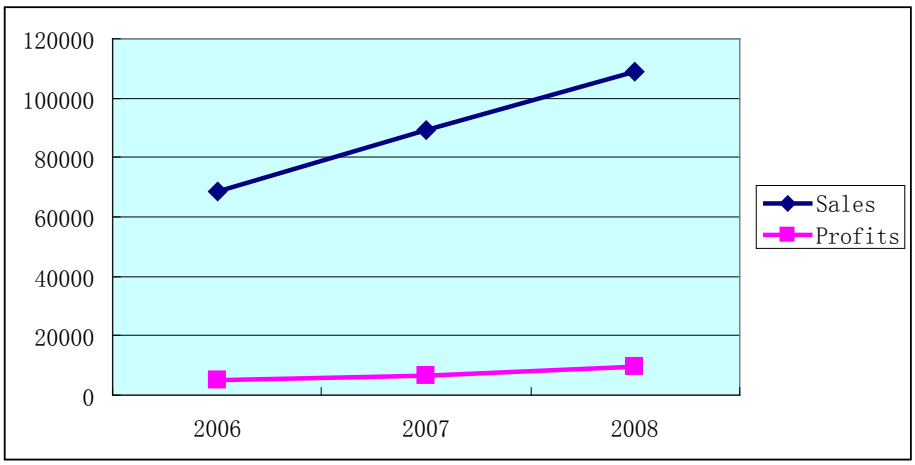


Figure 7.1 Performance indicators of SUPCON (Unit: ten thousand RMB)

4.2 Innovation performance of SUPCON

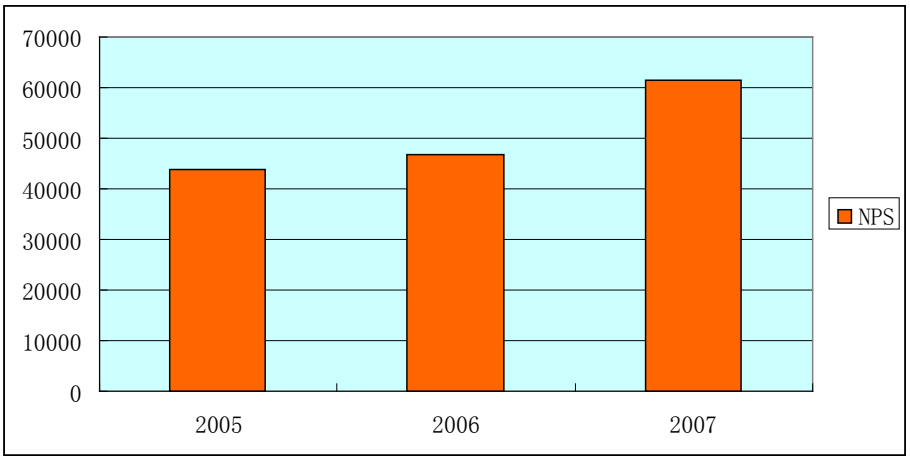


Figure 7.2 New product sales of SUPCON (Unit: ten thousand RMB)

Note: NPS is short for new product sales.

Table 7.3 Two relative indicator of innovation performance of SUPCON

Years / Indicators	2005	2006	2007
Labor Productivity (ten thousand RMB)	41.7	44.0	50.1
R&D Investment / Sales (%)	8.2	8.3	8.4

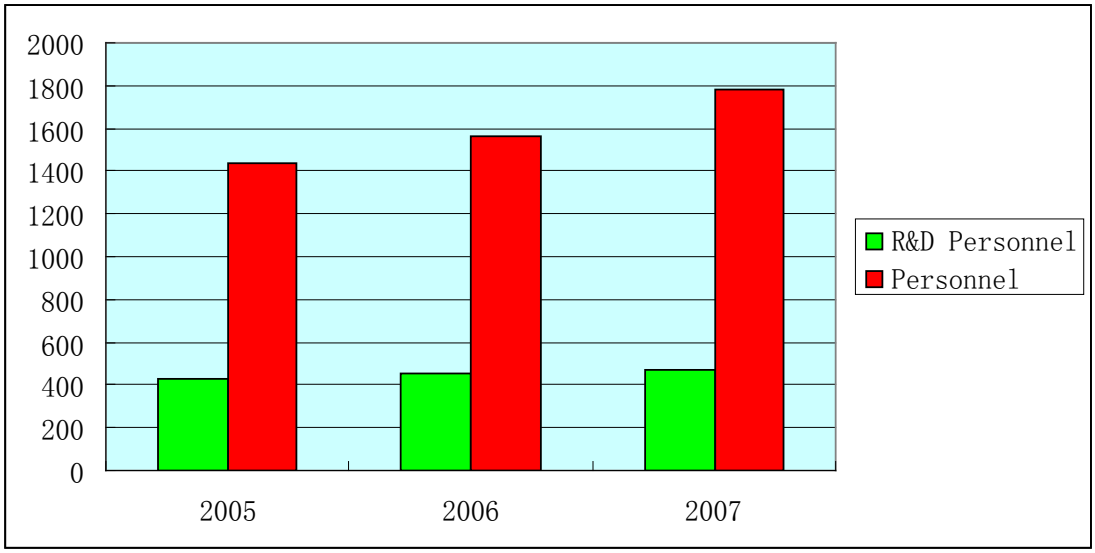


Figure 7.3 R&D personnel and personnel of SUPCON (Unit: person)

5. Experience of SUPCON and inspiration for TIM

(1) A specific objective and a great vision are needed for innovative firms.

SUPCON was established in 1993, when China's automatic control system and automatic instruments had largely been monopolized by foreign products. SUPCON had many rivals in world's top 500, including HONEYWELL, ABB, Siemens and so on. In the forming stage, SUPCON had been proposed to become China's HONEYWELL, and its philosophies are: if do, we must make the best; we can certainly do what foreigners can. Under the support of those philosophies, a group of young teachers of Zhejiang University and CHU Jian (CHU Jian is now the vice-president of Zhejiang University and is in charge of science and technology and industry), and began to engage in industrialization of automatic control systems and other industrial automation products, even though the material environment was very hard: 0.2 million was borrowed; researches were conducted in several offices of Zhejiang University; and young people are paid very low. Those were all attributed to the belief-to become China's HONEYWELL.

The process of entrepreneurship is very difficult. If there is no vision for an enterprise, the enterprise may be a mediocrity. But if there are beliefs and ideas supporting the process, innovation will certainly be successful.

(2) Perseverance for research is necessary because of arduousness of innovation process.

Once SUPCON was established, the business philosophy of "dedication, cooperation, innovation" was proposed. Under the guidance of that philosophy, young people were always working late into night in the laboratory in order to solve technical problems, which was a common affliction. The tradition of hard study has passed along, and until now the company's R&D center always worked late into night. Innovation is not always smooth and many difficulties and obstacles are encountered by SUPCON. For example, in 1996, a new generation of control system was launched, but because of lack of experience, many problems were emerged after the system was introduced, thus causing great difficulties to market promotion and after-sale service. At that time, several seniors tend to be as agent for foreign products instead, but the principal leader Professor CHU Jian strongly refused, saying that if there was no confidence to their own products, how could we be China's own DCS? How China's own automation industry could be

developed? And how could SUPCON become China's HONEYWELL? So Professor CHU strongly required withstanding the difficulties and refining their products, becoming the boutique in the industry. As a result, an upheaval took place in company executives and some executives left the company because of different understanding of innovation ideas. However, practice has proved that decision-making at that time was very right.

To achieve indigenous innovation, indigenous brand must be stick, products must be done by a good job and persistence must be needed; otherwise, it will only be reduced to the situation of working for foreign brands.

(3) Loose culture (climate) is needed for indigenous innovation and objective laws of indigenous innovation should be followed

Rigorous institutions are very important to make an enterprise full of the vitality of indigenous innovation. And the R&D system of SUPCON has got very strict institutions. From the research, approval to R&D, inspection, verification and accomplishment, the project are always very carefully controlled. But if there is no deep cultural heritage, the institutions often go rigid, causing pressure rather than motivation for employees. It is advocated in SUPCON that innovation tension should be formed in indigenous development, that is, every one is working in a tense atmosphere and have a mind of innovation, and R&D team has the passion for innovation, keeping the spark of innovation continuously bursting out. However, it doesn't mean the tension can be turned into a kind of pressure, making employees suppressed to develop. Innovation has its own objective rule, that is, the possibility of failure is relatively high, and so it is necessary to construct a relaxed culture to stimulate employees to generate innovative ideas. SUPCON also has a lot of institutions, including some innovation fund. Once employees have good ideas or innovative spark, he or she could apply for the funds to implement their own ideas. It still does not matter if the result is a failure, because failure is regarded as another kind of experience. As a result, an innovative culture and climate is formed among the youth in SUPCON.

(4) Intellectual property and standard are critical to indigenous innovation.

In 1994, world's first paperless recorder was launched by SUPCON, but SUPCON did not form a monopoly position. What's more, although market share of SUPCON was first in the domestic, but its share still was compressed to only 40% because of competition from many imitations of paperless recorder. The key reason of SUPCON missing a monopolistic situation is that it ignored the protection of intellectual property rights. After 1995 or 1996, similar products were emerging and market share was occupied by others, although SUPCON owned the most advanced technology, developing series of products both the small and the large, both the black and white and the colorful. After recognizing the importance of intellectual property rights, since 2000, SUPCON developed a series of system: rewarding 30,000 RMB for invention patent and all signed are inventors, in order to encourage all the technological staff to innovate. Now SUPCON has owned a total of 201 patents (including 134 invention patents), authorized by 104 patents (including 51 invention patents), which is very beneficial to the further development of SUPCON.

Meanwhile, SUPCON also recognized the importance of the standard. Since 2000, it had begun to study the Ethernet standard. To 2003, the standard was put up to become the national standard - EPA standards and SUPCON still struggled to become international standard with International Organization for Standardization. At the beginning, International Organization for Standardization simply did not give a chance based on the belief that the Chinese people could not develop their own standards. However, through their effort, by 2004, EPA standard was finally

incorporated into the discussion of international standards, and in 2005, EPA standard was officially accepted by IEC of International Organization for Standardization.

(5) Indigenous brand and indigenous innovation are indispensable to each other.

If a company loses its brand, it would become an OEM corporation. For instance, during “the seventh five-year”, “the eighth five-year” and “the ninth five-year” planning periods, automation was still relatively high inputted by government. At that time, West Meter, Sichuan Meter and Shanghai Automatic Meter are China's three major bases and government invested huge amounts of money to introduce the production line from abroad. In 90th, their pressure transmitter of 1151 was in short supply, but no indigenous innovation was conducted for their indigenous brand after the introduction of production lines while high-end products were always imported goods. So after gradually occupied the market with technology, Americans began to launch more advanced products of their own brands, while domestic brands were gradually squeezed out because of lack of indigenous innovation, so indigenous brand was the important support point for indigenous innovation. For example, if indigenous brand is 1, indigenous innovation is 0. Without the previous 1, all the 0 followed would be meaningless. With this 1, the more 0, the more innovative companies will be. From the beginning, SUPCON has attached great importance to build up own brand, following “brand positioning strategy”, “Trademark operating strategy”, “Trademark protection strategy”. As a result, SUPCON has not only created the brand “Zhongkong · SUPCON”, which now has become a “Famous Chinese Trademark” and “Zhejiang Famous Brand”, but it has pushed out brands such as “Webfield”, “APC”, “Multif” and so on, which have obtained titles of famous trademarks.

At the aspect of “brand positioning strategy”, SUPCON had determined to “be the most well-known automation company” in its, thus named “Zhongkong” and hoping to build China's own national brand of industrial automation. So SUPCON was still pushing its own products and brands in its most difficult period instead of becoming the agent of large international companies. Because of that reason, SUPCON grows into a closely-watched private enterprise at present.

At the aspect of “brand operating strategy”, according to its own characteristics, SUPCON formulated a “sub-brand” strategy, that is, forming Zhongkong • SUPCON as main trademark and different trademarks in various products in order to make users of different levels and different objects to have a more full understanding of products and to better explore and capture the market.

“Trademark Protection Strategy” is take active measures to protect registered trademarks. For examples, a full-class registration for protection has been conducted for the main trademark “Zhongkong • SUPCON”; “Fieldweb”, similar to “Webfield”, has registered for protection; tort for infringement of “APC” has acquired compensation of 5 million RMB. Those are all conducive to the protection of market reputation of enterprise’s trademarks.

Appendix H Peer-reviewed Articles (journal and conference papers)

Table 8.1 Peer-reviewed Articles

No.	Title	Author(s)	Publication	Type
1	From Secondary Innovation to Total Innovation Management – with the Case of Small and Medium Enterprises	XU Qingrui, CHEN Jin, GUO Bin and CHEN Litian	International Journal of Chinese Culture and Management,2009,2(1): 83-103	Journal
2	Entrepreneurial Orientation of New Entrepreneurial Firms: Dimensions, Measurement and Validation	LIU Jingjiang	Journal of Dialectics of Nature, 2009,4	Journal
3	How to Win Competitive Advantage through Disruptive Innovation	LI Qing, ZHENG Gang, CHEN Jin	Journal of Xidian University(Social Science Edition), 2008,18(6)	Journal
4	Three-level Model for All Elements Innovation Mechanism and Its Empirical Research	SHUI Changqing, MAO Guoping, XU Qingrui	2008 International Conference on Wireless Communications, Networking and Mobile Computing, WiCOM	Conference
5	Innovation Competence Building of China's High-tech SMEs Based on TIM:Two Case Studies	CHEN Jin, YU Xianzhen, XU Qingrui, FU Xiaozhou	ICMIT2008, September 21-24, 2008, Bangkok Thailand	Conference
6	Total Innovation Management Competence and Innovation Performance in SMEs: An Empirical Study Based on SME Survey in Zhejiang Province	XU Qingrui, CHEN Jin ,CHEN Litian, JIN Lu, LOU Dong	IEEM2008, December 8-11,2008,Singapore	Conference
7	Leverage Innovation Capability via Culture	XU Qingrui, CEHN Feng, REN Zongqiang, BAI Yunfeng	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
8	The Relationship between Market Orientation and Innovation Capability—An Empirical Study on the SMEs of Zhejiang Province	JIN Lu	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
9	Organizational Structures Changing with Capabilities Dynamization in SMEs: A Case Study in JGST	XU Qingrui, ZHANG Jun	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
10	Based On TIM to Leverage the Technological Innovation Competence with the Case of SMEs	REN Zongqiang, WANG Micheng, WU Haiping, LI Lixin	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
11	Innovation All-the-Time: A Case Study based on Haier Group	ZHENG Gang, LI Fei, XU Qingrui, WU Guohao	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
12	The research of Fostering Persistent Innovative Chain in Industrial Agglomeration of Cross-strait	YANG Tianliang, ZHU Bin	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
13	The Exploration of Path from Technology Import to Technological Leapfrogging-Case Analysis of a Group Based on the Theory of TIM	FANG Jincheng, ZHU Bin	ISMOT09,October 23-25,2009,Hangzhou,China	Conference
14	Research on applying TIM theory to	ZHU Bin, FANG	ISMOT09,October	Conference

	Improve the innovation Capability of SMEs in Fujian	Jincheng	23-25,2009,Hangzhou,China	
15	The Mechanism of Innovation Capability Leveraging via Strategy in SMEs	CHEN Litian, XU Qingrui	IEEM2009,December 8 -11,Hong Kong, China	Conference
16	A Research on the Mechanism of Leveraging Innovation Capabilities via Entrepreneurs in SMEs	ZHANG Suping, XU Qingrui	IEEM2009,December 8 -11,Hong Kong, China	Conference
17	The Pathway on Implementation of Total Innovation Management: with the Case of SMEs	XU Qingrui, ZHU Jianzhong	International Journal of Learning and Intellectual Capital (IJLIC) Special Issue（will be published on January of 2010,7 (3/4)）	Journal
18	Total Innovation Management Paradigm for SMEs – An Empirical Study Based on SME Survey	ZHENG Gang, JIN Lu, YU Xiangzhen, LI Wangfang, DING Xiao	IJLIC Special Issue（will be published on July of 2010,7 (3/4)）	Journal
19	Non-R&D –based Innovation: A New Way for SMEs	XU Feng, ZHENG Gang	Journal of Xidian University (Social Sciences Edition)	Journal
20	The Choice of Technology Acquisition Modes and Its Influential Factors	LIU Jingjiang,TAO Yi	International Conference on Management and Service Science, MASS 2009	Conference

Appendix I Non-peer-reviewed Articles (Special Issue of Journal of IEEM)

Table 9.1 Non-peer-reviewed Articles

No.	Title	Author(s)	Publication	Type
1	A Study on Leverage Innovation Capability in SMEs by Application of TIM	Xu Qingrui	Journal of Industrial Engineering and Engineering Management (IEEM), Special Issue, 2009, 12.	Journal
2	The Innovative Status, Problems and Causes in Zhejiang Provincial SMEs	ZHANG Jun	Journal of IEEM, Special Issue, 2009, 12.	Journal
3	The Framework of Total Innovation Management and Typical Models in SMEs	ZHENG Gang, REN Zongqiang	Journal of IEEM, Special Issue, 2009, 12.	Journal
4	A Study on the Mechanism of Innovation Capability Leveraging via Vision and Strategy in SMEs	CHEN Litian	Journal of IEEM, Special Issue, 2009, 12.	Journal
5	Leveraging the Technology Innovation Competence of SMEs by Management of Technology	REN Zongqiang, DING Xiao	Journal of IEEM, Special Issue, 2009, 12.	Journal
6	Explore the mechanism of promoting innovation capability in SMEs via market orientation	JIN Lu, LOU Yangyi	Journal of IEEM, Special Issue, 2009, 12.	Journal
7	The Mechanism of Organization Innovation to Leverage Innovation Competence	CHEN Lu, FANG Jing, MEI Liang	Journal of IEEM, Special Issue, 2009, 12.	Journal
8	The Study of Leveraging Innovation Capability via Corporate Culture	CHEN Feng	Journal of IEEM, Special Issue, 2009, 12.	Journal
9	A Study on the Paths of Leveraging Innovation Capability via Entrepreneurs in SMEs	ZHANG Suping	Journal of IEEM, Special Issue, 2009, 12.	Journal
10	Study of Leveraging Innovation Capability via High-Involvement Innovation	CHEN Feng, ZHANG Suping, WANG Lihua	Journal of IEEM, Special Issue, 2009, 12.	Journal
11	To Leverage the technology innovation competence in innovation networks	REN Zongqiang, WU Haiping	Journal of IEEM, Special Issue, 2009, 12.	Journal
12	Relationship of Innovation Sources, Technological Capability and Innovation Performance of Clustered Firms	SHOU Yongyi, SUN Yu	Journal of IEEM, Special Issue, 2009, 12.	Journal
13	Strategic Pathway for leveraging innovative capabilities of SMEs via TIM	ZHANG Jun	Journal of IEEM, Special Issue, 2009, 12.	Journal
14	Research on the Key Dimensions of SMEs Total Innovation Management Model	CHEN Jin, LI Fei	Journal of IEEM, Special Issue, 2009, 12.	Journal
15	Analysis of innovation capability in SMEs based on questionnaire survey	DING Xiao	Journal of IEEM, Special Issue, 2009, 12.	Journal
16	Statistical Analysis of innovation capability in SMEs in Machinery Industry of Zhejiang Province	JIN Lu, DING Xiao, LOU Yangyi	Journal of IEEM, Special Issue, 2009, 12.	Journal
17	Statistical Analysis of innovation capability in SMEs in Electron Industry of Zhejiang Province	ZHAO Xiaoqing, ZHENG Linying	Journal of IEEM, Special Issue, 2009, 12.	Journal
18	Empirical Study of Total Innovation Capability Building of Small and Medium-sized Enterprises in the Textile Industry	SHOU Yongyi,WU Lubin	Journal of IEEM, Special Issue, 2009, 12.	Journal
19	The Mechanism of Innovation Capability Leveraging: A Longitude Case Study in Sunyard	CHEN Litian, CHENG Kailin	Journal of IEEM, Special Issue, 2009, 12.	Journal
20	The Mechanism of Innovation Capability Leveraging: A Longitude Case Study in Honyar	MEI Liang	Journal of IEEM, Special Issue, 2009, 12.	Journal

Appendix J The Outline of the Forthcoming Book in English

Leverage Innovation Capability-- Application of Total Innovation Management (TIM) in China SMEs' Study

(draft)

Preface: Framework of Total Innovation Management (TIM) and its effect on leveraging Innovation Capabilities of Chinese Small & Medium Sized Enterprises (SMEs)

Part I Status of SMEs and Implementation of TIM in SMEs

1 Status and significance of SMEs in transition, and cause of obstacle for innovation in SMEs
- 1.1 Significance of SMEs to the developing China
- 1.2 Difficulties being faced by SMEs
- 1.3 Profound reasons of obstacle for innovation in SMEs

2 Framework and access to TIM in SMEs
- 2.1 Applicability of TIM in SMEs
- 2.2 Empirical study of applicability of TIM in SMEs
- 2.3 Framework and characteristics of TIM in SMEs
- 2.4 Comparative analysis of TIM in large enterprises and SMEs

3 Leveraging innovation capability by all elements innovation
- 3.1 Connotations of all elements innovation in SMEs
- 3.2 Factors and enablers to leverage innovation capability of SMEs
- 3.3 Mechanism of all elements to leverage innovation capability of SMEs

4 Leveraging innovation capability by all innovation & culture innovation
- 4.1 Impetus of culture innovation to HII/all innovators
- 4.2 Leveraging innovation capability by culture innovation
- 4.3 Leveraging innovation capability by HII/all innovators

5 Leveraging innovation capability by entrepreneurs and entrepreneurship
- 5.1 Entrepreneurs' special role in SMEs
- 5.2 Impetus of entrepreneurs to HII/all innovators
- 5.3 How entrepreneurship leverage innovation capability

6 Leveraging innovation capability by all time-space innovation
- 6.1 Importance of outsourcing to SMEs
- 6.2 Importance of networking to SMEs
- 6.3 Experience of SMEs in outsourcing & networking
- 6.4 Problems and difficulties of SMEs in outsourcing & networking

7 Leveraging innovation capability by cluster innovation
- 7.1 SMEs have to rely on cluster innovation to overcome its weakness of capability
- 7.2 Supportive effect of cluster innovation on leveraging innovation capability of SMEs

8 Implementation of TIM in SMEs in different stages
- 8.1 Characteristics of innovation capability of SMEs in different stages
- 8.2 Mode of TIM in SMEs in different stages
- 8.3 TIM on leveraging innovation capability
- 8.4 Competitive advantages and their source of SMEs in different stages

9 Leveraging innovation capability by TIM in different industries and regions
  9.1 Leveraging and application of innovation capability by TIM in different industries
  9.2 Leveraging and application of innovation capability by TIM in different regions
10 Strategic way to leverage innovation capability by TIM
11 Policy recommendation in leveraging innovation capability by TIM

Part II Case studies of leveraging innovation capability of SMEs in different industries and regions

12 Innovation and capability leverage of SMEs in mechanical & electronic industries, including case of HY, FPI, SUPCON., etc
13 Innovation and capability leverage of SMEs in software & service industries, including case of Sunyard
14 Innovation and capability leverage of SMEs in light & textile industries, including case of Queping Textile Finishing Co and Jinfuchun Silk Co, etc
15 Comparative studies on Innovation and capability leverage of SMEs in different regions (as Fujian and Shangdong Province)

Appendix K Main Content of Ten Policy Briefs

Policy brief 1: Strengthening industries-universities-institutes strategic alliance to promote Chinese indigenous innovation capability-building

This proposal has analyzed the current situation of current industries-universities-institutes strategic alliance and finds out that the current industries-universities-institutes strategic alliance has three features: The level of industries-universities cooperation is low; the momentum of industries-universities cooperation is deficient; the industries-universities cooperation lacks a appropriate benefit share mechanism.

In order to accelerate the development of the industries-universities-institutes strategic alliance, some suggestions are given as follows:

(1) Choosing the industries-universities-institutes strategic alliance as the strategic path to improve the indigenous innovation capability and establish a innovative country.

(2) Working out a Chinese characteristic way of technology transferring.

(3) Implementing an open science and knowledge system and establish the academic priority and reputation system

(4) Implementing a dual intellectual property system and soften the control of intellectual property

Policy brief 2: The global manufacturing network and indigenous innovation of the Chinese large and medium sized enterprises: current situation, bottleneck and solution

Through analyzing the global manufacturing network and the indigenous innovation of Chinese large and medium sized enterprises, this proposal has proposed three suggestions as follows:

(1) From the micro perspective, the innovative large and medium sized enterprises should guide the direction and progress of indigenous innovation, from the technology and strategic views.

(2) From the macro perspective, the large and medium sized enterprises should fully take account of the total innovation, based on the existed business ecosystem.

(3) From the perspective of the healthy development of the regional innovation system, the government should provide platform to stimulate the indigenous innovation practice of the large and medium sized enterprises.

(4) From the perspective of the global and open innovation, Chinese large and middle sized enterprise should participate in the innovation practices of the global manufacturing network positively and autonomously.

Policy brief 3: Correcting the understanding about the connotation and new trends of innovation

Based on TIM, the proposal has proposed the following suggestions:

(1) Emphasizing the concept of “total innovation system” rather than “pure technological innovation system”

(2) Because of the continuous emerging of open innovations, Chinese enterprises should establish R&D centers abroad and strengthen the industries-universities-institutes strategic alliance.

(3) Because of the importance of designing function, Chinese government should increase the investment on the industrial design, accelerate the cultivation of inter-disciplinary talents, who master in the industrial design and R&D.

(4) Because of the importance of customer, Chinese government should design policies, which encourage more and more customers to participate in the innovation. What's more, policies need to be designed to leverage the market research capability of Chinese enterprises.

Policy brief 4: Policies to promote indigenous innovation and the innovation environment

This proposal has suggested that:

(1) Chinese government should reinforce the education on innovation.

(2) Chinese government also need to establish a completed national innovation system, strengthen the cooperation between organizations, and build up a industries-universities-institutes strategic alliance.

(3) Chinese government should recognize the measuring standard of innovation investment rightly, and cultivate innovative talents, especially the scientists and innovative technological experts.

Policy brief 5: Five misunderstandings about indigenous innovation

This proposal has suggested that:

(1) Reinforcing the education on the connotation of indigenous innovation. Through the propaganda on media, organizing relative studying and training, compiling relative textbooks and handbooks, choosing some typical cases of indigenous innovation as examples and editing indigenous innovation readings.

(2) Making clear all current policies, regulations and rules relative to indigenous innovation and improve the current indigenous innovation policies.

(3) Organizing experts to develop a completed evaluation system about the innovative country, innovative city and innovative enterprise which shows the real content of indigenous innovation. Meanwhile, the government should improve the authorization standard of national enterprise technology center and modify some original edition which only emphasizes the technological innovation.

Policy brief 6: Choosing the correct indigenous innovation model by using mixed innovation resources integration model

The obstacles of indigenous innovation are mainly expressed as the shortage of resources and stimulation. Currently, technological leapfrogging, the upgrading of value chains and disruptive innovation are hot topics in current indigenous innovation area.

Mixed innovation resources integration model determines that the Chinese indigenous innovation applied a mixed model in real practice, which means the three basic models of indigenous innovations will exist and develop together.

Thus, for some strategic industries that matters vital to national well-being and the people's livelihood, the government should apply the technological leapfrogging model. The resources will be optimized by two ways: collected integration and scared integration.

Policy brief 7: Five major trends of Chinese indigenous innovation capability-building

during “12th Five-Year Plan”

This proposal has pointed out five major trends of Chinese indigenous innovation capability-building during “12th Five-Year Plan”.

(1) The accelerating of global technological activities provides a precious opportunity for the integration of global technological resources in China

(2) The low-carbon economy, energy conservation and emission reduction proposed new challenges for the indigenous innovation capability leveraging.

(3) The adjustment of international trading structure and in-depth development of Industrial division provides new space for the indigenous innovation capability leveraging.

(4) The project of building innovative country arise new requirements for the indigenous innovation capability leveraging.

(5) Solving the economic and social difficulties provides new driven for the indigenous innovation capability leveraging.

Policy brief 8: Pomoting indigenous innovation of industry cluster, and accomplish Industrial economic transformation and upgrading

This proposal has proposed that industry cluster is an important carrier for the transformation and upgrading of Chinese industry and economy. The innovation capability became a main factor constricted the development of Chinese industry cluster.

The suggestions for Chinese government are as follows:

(1) Paying more attention on the industry cluster’s indigenous innovation

(2) Carrying forward the pioneering spirit of innovation further

(3) Investing more resources on the industry cluster’s indigenous innovation

(4) Further developing the service industry, establish a public platform for the industry cluster’s indigenous innovation, encourage the establishment of industry cluster’s indigenous innovation system. The system, integrating the manufacturing, studying and researching, was lead by the enterprise and oriented by the market.

(5) Establishing a completed intellectual property system

Policy brief 9: Enterprises of Zhejiang Province need to build a local network of indigenous innovation, promote development of small and medium enterprises

The question proposed in this proposal: as large enterprises neglecting the establishment of the indigenous innovation network, the driving force on the local SMEs’ innovation was weakened. Thus, the sustainability of enterprise’s indigenous innovation and the cluster’s innovation capability are blocked.

The suggestions for Chinese government are as follows:

(1) The government should lead and encourage leading enterprise to build up cluster matching network with its cooperators, suppliers and consumers. The leading enterprise should work together with SMEs when formulating and modifying the industry standard. On one hand, this activity can encourage the leading enterprise and SMEs to build up a coordinated manufacturing standard. On the other hand, through this activity, the government wants to improve the quality of “made in Zhejiang”, accelerate the upgrading of industry structure which aims at “high technology, high value add and low resource consumption”.

(2) For large enterprises, they should reinforce the win-win sense of industry chains,

strengthen the overall competitive capability of industry chains and form a regional and stable strategic thinking constituted by supply alliance and innovation alliance. Experiences shows that if the leading enterprise pay attention on cultivating and developing a stable and local suitable innovation network, eventually, it will be beneficial for the development of enterprise's innovation capability and technology absorbing capability, which improves the enterprise's performance and reinforce its international competitive capability and anti-risk capability.

(3) For SMEs, they should accelerate the building up of their own indigenous innovation capability. Meanwhile, SMEs should reinforce their capability of embedding in the cluster network. The government should provide communication channels and platforms to help SMEs to match the leading enterprise in the start-up stage.

Policy brief 10: Some suggestions for the development of productive services in Zhejiang Province

The proposal has pointed that there are three shortages of the service industry in Zhejiang Province .First, the development of service industry become the vulnerable point of the provincial economy development. Second, the productive services hinder the development of service industry. Third, technology-intensive and knowledge-intensive service industry constrict the development of productive services.

In order to obtain the development path of the productive services of Zhejiang province, the proposal has given suggestions as follows:

(1) The modern logistics industry was the most critical one of the productive services, which was supporting the interactive development of modern manufacturing industry.

(2) The different stages, during the upgrading of manufacturing industry, need relative supporting from the key fields of productive services.

(3) The different types of productive services have an interdependent relationship. The productive services should develop coordinately and balanced. Based on the development path chart of Zhejiang province productive services, in the "12th five year plan" or the following long time, the logistics industry, the financial service industry and business service industry, were the key objects of the development of productive services. Meanwhile, based on the development level of the manufacturing industry and service industry in Zhejiang province, the government should apply a practical and efficient development model for the productive services in Zhejiang Province.

Appendix L ISMOT2009 and ISMOT IDRC TIM-SME Workshop

The 6th International Symposium on Management of Technology （2009）and IDRC-Workshop

The RCID with IDRC project team jointly organized the 6th International Symposium on Management of Technology （ISMOT2009）with NIIM & School of Management of Zhejiang University, which was held in Hangzhou,P.R. China, 23-25 October 2009. The theme of this conference is Open Network and Total Innovation toward Innovative Country. With this ever more dynamic and open society, new elements are emerging with innovation activities, following the track of last 5 successful ISMOT held in 1995, 1998, 2001, 2004, and 2007, ISMOT2009 attracted participants from academics, industries and governments all over the world. She continues her tradition which strongly links academic, industry and government, brilliant scholars, CEOs, CTOs have been invited as keynote speakers. The theme of ISMOT2009 can be divided into 23 topics, such as total innovation management, open innovation, indigenous innovation capability and national /regional innovation system.

Accepted papers have been published in the conference proceedings which will indexed by Index to Scientific & Technical Proceedings (ISTP)/Index to Social Sciences and Humanities Proceedings (ISSHP).

(1) Team members gave presentations, which focused on leveraging innovation capability via TIM

Prof. XU gave a presentation titled “Toward Innovative Firm via Application of TIM to Leverage Innovation Capabilities of SMEs”.He held that because of the economic globalization, the focus of enterprise management transforms from efficiency to innovation sustaineously. Becoming an innovative firm is the only target for enterprises to adapt to today’s fierce market competition and avoid crisis. During our research, it was found that in most firms the importance of establishing an innovative firm is ignored because of their short-sighted strategy. Typically, this phenomenon lies in: first, some enterprises do not know the significance of innovative firm, which greatly inhibits their understanding about the importance of becoming an innovative firm; second, even after understanding the importance of becoming an innovative firm, most enterprises don’t know the way toward innovative firm. Therefore, suitable strategy guidance is needed. In order to address this problem, our team intends to make an exploration about the connotation and features of innovative firm. Under the guidance of total innovation management (TIM) theory, after summarizing the development paths of four innovative firms, a general development path toward the innovative firm is concluded, that is from single factor innovation to portfolio innovation, and then to the total innovation. There is a close relationship between TIM and the innovative firms.

REN Zongqiang, the Ph.D candidate student in IDRC project team, gave a presentation based on the paper titled “Based on TIM to Leverage the Technological Innovation Competence with the Case of SMEs”. He said: “innovation is vital for development of small and medium enterprises (SMEs). Recently, our study also found that a lot of SMEs of China have developed innovation strategies or planning. Nevertheless, two prominent issues facing the SMEs lead to stagnancy in their innovation course: one is their shortage of resource; the other is inefficiency of resource utilization. According to what both theory and observation suggest, at present, that building a dynamic systemic capability for innovation is now inescapable imperative for every SME. This

paper aims to solve the innovation dilemma by total innovation management (TIM), and build a technological innovation system well- matched for company's growth. Firstly, we redefine or understand the management of technological innovation from a strategic perspective. Secondly, through summarizing the innovation models and paths in the surveyed SMEs, they propose a technology innovation framework based on TIM. Three of these main mechanisms are (1) strengthening the relationship between technological innovation and market innovation to maintain the right direction and reduce the risk of innovation, (2)constructing an integrated innovation architecture to enhance innovation elements synergy or interaction, so as to improve the efficiency of resource utilization, (3) filling the resource gaps by open innovation. The mechanism architecture and the operational mode will finally be illustrated through a case study. "

ZHANG Jun, the Ph.D candidate student in IDRC project team, gave a presentation based on the paper titled "Organizational Structures Changing with Capabilities Dynamization in SMEs: a Case Study in JGST". She said: "How to obtain a synergistic effect between the organizational structure changing and capabilities leveraging has become a key problem. Most literatures focus on organization forms, designs on the organization level. Few literatures pay their attentions to the intra-organization. Therefore, taking a high-tech SME named JGST as an example, this paper analyzed JGST's structures of different stages. Then the elemental capabilities' development taken as a cline, this paper analyzes the interaction between organizational structures' changing and capabilities' leveraging. We find that during an organization's development, (1) the elemental capabilities in an organization develop in an asymmetric way; (2) the more mature of an enterprise, the higher involvement of more elements in innovative activities; (3) an organization structure evolutes endogenously based on knowledge dividing and organizational elements capabilities developing, but influenced by the strategy and its implement. Finally, the implication for management is discussed. "

FANG Jincheng, the team member in Fuzhou University, which located in Fujian province, gave a presentation based on the paper titled "Research on Applying TIM Theory to Improve the Innovation Capability of SMEs in Fujian Province". This paper used TIM theory as theoretical basis. It firstly studied innovation characteristics of small and medium sized enterprises (SME) in Fujian province, and then analyzed the bottleneck problem existing in innovation of SMEs in Fujian province. At the end, it proposed the countermeasures from three improve the innovation capability of SMEs in Fujian province by applying TIM theory.

CHEN Feng, a Master candidate in IDRC project team, gave a presentation based on the paper titled "Leveraging Innovation Capability via Culture". He said: "Corporate culture has become critical factor in leveraging innovation capability. But in our survey on 20 small and medium enterprises in Zhejiang Province, we found that only a few part of them emphasize on the construction of corporate culture. That is mainly because entrepreneurs do not deeply realize the mechanism of corporate culture in leveraging enterprises' innovation capability. So this paper focus on how corporate culture leverage innovation capability by case study, expecting to have more entrepreneurs aware of the importance of corporate culture."

(2) Organizing the ISMOT workshop to evaluate our research outcomes

The ISMOT workshop was held by IDRC project team on October 24, 2009. The aim of this workshop is to introduce the activities and main research findings of our project team and ask for suggestions from scholars.

Firstly, Professor XU Qingrui gave a brief introduction of the process of the project

implementation. He said, “In the first year, we started from the literature review, and then we began the case study. We investigated more than 16 cases in Zhejiang Province, Fujian Province and Shandong Province. But what is the deep reason of the weak capability in SMEs? The main reasons lie in two aspects. One is management. The support system is the local area is not good, especially the local budget. The other one is the insight reason, that’s, about the innovation (idea, entrepreneurs, employees). It is known that creator is important, but the question that how to change it is not clear. So we have to find that. Ling Yun, a senior official of Zhejiang SMEs Bureau, came to our ISMOT. He said that, “I agree with you. The deep reason is from the concept.” The second problem we found is what kind of a model could be used here. In many literature reviews we still can’t find a complete review concerned innovation capability. In the second year’s study, we make a framework. We found there are many factors that give impact on the capability. But we find the main factors are the nine elements that I mentioned this morning. The main four are strategy, technology, organization and marketing. The other one is the mechanism that can be used in leveraging innovative capabilities of the firms. After the second year’s study, we concentrate on both the model and the mechanism. In order to solve the problems, we will hold more training on SMEs. This is the main introduction of these two years’ study. We are glad that there are so many colleagues and friends here to comment our project.”

Then, scholars held a heat discussion about the research findings. Scholars were interested in the research of our team. For example, Bent DALUM, the professor of Aalborg University in Denmark, thought the experience of leveraging SMEs’ innovation capability by TIM is quite interesting and worthy of promotion in Europe. He said that, “When we analyze the specific development of Chinese system, we have to understand about our own. Because we are heavily explored in period about the US and Europe, the really stars are Sweden and Finland, the very small country. So the firm must built confidence that we need to make some indigenous things so that we can fight back. It is very important to a company’s success. You want to fight back and have to, in order to become leaders.”

What’s more, scholars also gave suggestions for our further study. The importance of industries-universities-institutes cooperation was emphasized by many scholars. Professor ASHEIM Bjorn, from Lund University in Sweden, said, “We need to look at SMEs innovation policy. Generally SMEs are not very innovative, which don’t make them really safe, don’t see the problem, don’t see the potentials and don’t tend to cooperate with universities.”

Appendix M The International Conference The Project Team Attended

Attending the 4th International Conference on Management of Innovation & Technology (ICMIT2008)

Professor XU Qingrui attended the 4th International Conference on Management of Innovation & Technology (ICMIT2008), which was held in Bangkok, Thailand, September 24 2008.

ICMIT2008 is the 4th International Conference on Management of Innovation and Technology, first initiated by the IEEE Engineering Management Society Singapore Chapter in 2000. ICMIT2008 intends to bring together scholars, industrialists, and entrepreneurs interested in improving their research and development, and business applications in innovation and technology management across a global network of diverse platforms. The theme of the conference can be clarified into 19 topics, such as technology strategy management, innovation policy management, entrepreneurship and so on. Accepted papers have been published in the conference proceedings which will appear in IEEEXplore database and indexed by Engineering Index (EI).

Professor XU gave a presentation about the paper titled “Innovation competence building of China’s high-tech SMEs based on TIM: two case studies”. He held that Chinese SMEs’ innovation competence based on total innovation management. The IDRC project team chose two high- tech SMEs as the initial evidence to demonstrate our TIM model. It was believed that innovation is a process so that SMEs should improve their innovation competence in the following six dimensions to obtain excellent performance: 1) strategic innovation, 2) technologic innovation; 3) marketing innovation; 4) cultural innovation; 5) organizational innovation and 6) mechanism innovation. And these dimensions should be managed coordinately in order to improve firm’s TIM competence. Finally, he put forward some suggestions to SMEs in every dimension.

Attending the 4th IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2009)

Professor XU Qingrui, Professor WEI Jiang and five Ph.D students of IDRC project team attended the IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2009), which was held in Hongkong, 8-11 Dec 2009.

The IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) aims to provide a forum to disseminate, to all branches of industries, information on the most recent and relevant research, theories and practices in IEEM. This conference has been hosted by leading universities in Asia and has grown over the years in tandem with the rising importance of industrial engineering and applications. In 2009, this conference attracted more than 500 scholars from more than 40 countries to attend in Hongkong. The theme of this conference can be clarified into 20 topics, such as technology and knowledge management,human factors, global manufacturing and management and so on. Accepted papers have been published in the conference proceedings which will appear in IEEEXplore database and indexed by Engineering Index (EI).

In the conference, our team members gave seven presentations, and discussed with scholars all around the world. According to the topics, the presentations can be divided into two groups. The photo taken in the conference is shown in page 28.

(1) Presentations focused on the topic of "leveraging innovation capability via strategy and entrepreneur"

There were four presentations given by our team members focused on the topic of "leveraging innovation capability via strategy and entrepreneur".

First, ZHANG Suping, a Ph.D student in IDRC research team, presented her paper co-authored with professor XU Qingrui, titled "A Research on the Mechanism of Leveraging Innovation Capabilities via Entrepreneurs in SMEs. She proposed two paths by which entrepreneurs leverage innovation capabilities. One is direct; referring that entrepreneur should strengthen himself. The other is a relatively indirect one, nurturing employees to leverage the whole enterprise's innovation capabilities. A case study of the innovation capability development at UPG, a small financial service company in Zhejiang Province, found the mechanism how entrepreneurs leverage innovation capabilities.

Second, DING Wanling, a Ph.D student in research team, presented her paper, which titled "Outward Foreign Direct Investment Strategy and Technological Capabilities Accumulation: A Case Study". During her presentation, the relationship between developing country firms' outward FDI strategy and their technological capabilities accumulation was analyzed. This relationship was examined through a case study of a Chinese automotive components manufacturer. This study found out that outward FDI strategy has positive effects on developing-country firms' technological capabilities accumulation. And these effects were positively associated with firm's absorptive capacity.

Third, DOU Wei, a Ph.D student in IDRC research team, presented the paper titled "Prominent Network Position: Value Creation and Value Protection". He held that the challenge of inter-firm network management has prompted firms to design a dedicated alliances network with desirable properties in order to deliver maximum value. By using a longitudinal case study, his paper shows strategic action that a firm may take to construct and motivate a prominent network position through alliance with multiple well endowed partners. More specifically, it discusses networking strategies regarding network membership, tie modality and network structure in terms of value creation and value protection.

CHEN Litian, a Ph.D student in IDRC research team, presented her paper co-authored with Professor XU Qingrui, titled "The Mechanism of Innovation Capability Leveraging via Strategy in SMEs". She held that in some enterprises, the main problem that hinders the leverage of innovation capability is lacking the absorptive capability, which is usually caused by the high turnover rate of R&D talent. The root cause is the variance in strategic direction, which actually has negative effects on technological innovation. However, the research of enterprises' innovation capability leverage is still in the exploration. Concerning the problems in enterprises, based on the previous study at home and abroad, her paper focuses on how to leverage innovation capability through strategy. From the previous studies and two explorative case studies, a problem-oriented model was established, which focuses on how to leverage innovation capability through strategy. The hypotheses were proposed and tested by data from 420 small and medium sized enterprises that respond to our questionnaire. At last, some suggestions about how to leverage enterprises' innovation capability were proposed.

(2) Presentations focused on the topic of "leveraging innovation capability via network cooperation"

There were three presentations given by our team members focused on the topic of

“leveraging innovation capability via network cooperation”.

First, Professor WEI Jiang, gave a presentation titled “The Role of Knowledge-intensive Business Service in the Evolution of Cluster Network Structure: An Empirical Study from China Socks Cluster”. His paper employed longitudinal case study research to investigate why and how KIBS embeddings impact the evolution of industrial cluster’s network structure. His paper answers these intrinsic research questions by examining how network structure of Datang socks cluster located in southeast China, evolutes under the influence of KIBS embedded from 2003-2007. Initially, in order to explore the functional mechanism, KIBS embedding process of each development phase has been analyzed. Next, SNA and UCINET software have been used to unveil the process of the change of cluster network structure, such as network density, network between centrality and network agglomeration. Finally, Professor WEI Jiang summarized the KIBS’ functional mechanism by KIBS’ ability to influence some important variables and optimize cluster network structure, which provides solid advice to policy makers.

Second, DOU Wei, a Ph.D student in IDRC project team, presented her paper co-authored with Professor WU Xiaobo, titled “Strategic Technology Alliance and Rapid Accumulation of Technological Capabilities in Emerging Economies”. This paper examined strategic technology alliance from the perspective of technological catching-up in emerging economies. We developed a conceptual model for describing the phenomenon that strategic technology alliance can effectively improve the absorptive capacity for firms in emerging economies. We used a case study of housing industrialization strategic technology alliance in China to explore the causal relationships between variables in this model. We found that through the mechanisms of technology outsourcing and knowledge sharing strategic technology alliance may effectively improve the absorptive capacity of the firms as a whole. By building up strategic technology alliance, it is possible for firms in the emerging economies to overcome the obstacle that individual firm cannot effectively acquire and internalize the advanced technology in developed economies due to their lack of absorptive capacity.

Third, DOU Wei presented the paper titled “Information Sharing Based on Social Network Construction under Dynamic Alliance Environment: A Simulation Study”. This paper examined the social network construction mode based on connected network component under dynamic alliance environment. They assumed that firms in one industry participant in alliances dynamically and simulation results show how the alliance network factors influence the social network information sharing performance. Four propositions in a long-term and no extreme value context are built: first, the probability an incumbent was chosen to become a member of a new alliance has a inverted U-shape effect on information sharing performance; second, the probability that the alliance being assembled will include a previous collaborator of an incumbent on the alliance has a inverted U-shape effect on information sharing performance; third, the initiate alliance size has a positive effect on information sharing performance; fourth, the max time during which a firm was not in any alliance has a positive effect on information sharing performance.

Appendix N Some Typical Evidence of The Impacts on Policy

The government document titled “Policy to support IDRC project team implementing investigation in enterprises” issued by Bureau of SMEs in Zhejiang Province, December 11, 2007

浙 江 省 乡 镇 企 业 局
浙 江 省 中 小 企 业 局

各相关企业：

为了贯彻落实省委“创业富民，创新强省”总战略，进一步推进中小企业自主创新能力，我局与浙江大学联合开展全面创新管理重大课题研究。浙江大学创新与发展中心 IDRC 项目调研小组成员将前去贵企业进行深入调研，重点针对企业全面创新管理、商务模式创新、产品/服务创新、以及在研发、生产、营销、体制、人力资源、工艺与业务流程等方面的状况，结合企业相关方面的成功经验，分析研究企业在创业创新中碰到的问题、困难，提出企业需要在研发、培训、服务上的意见与建议，课题组将为企业提供跟踪服务。

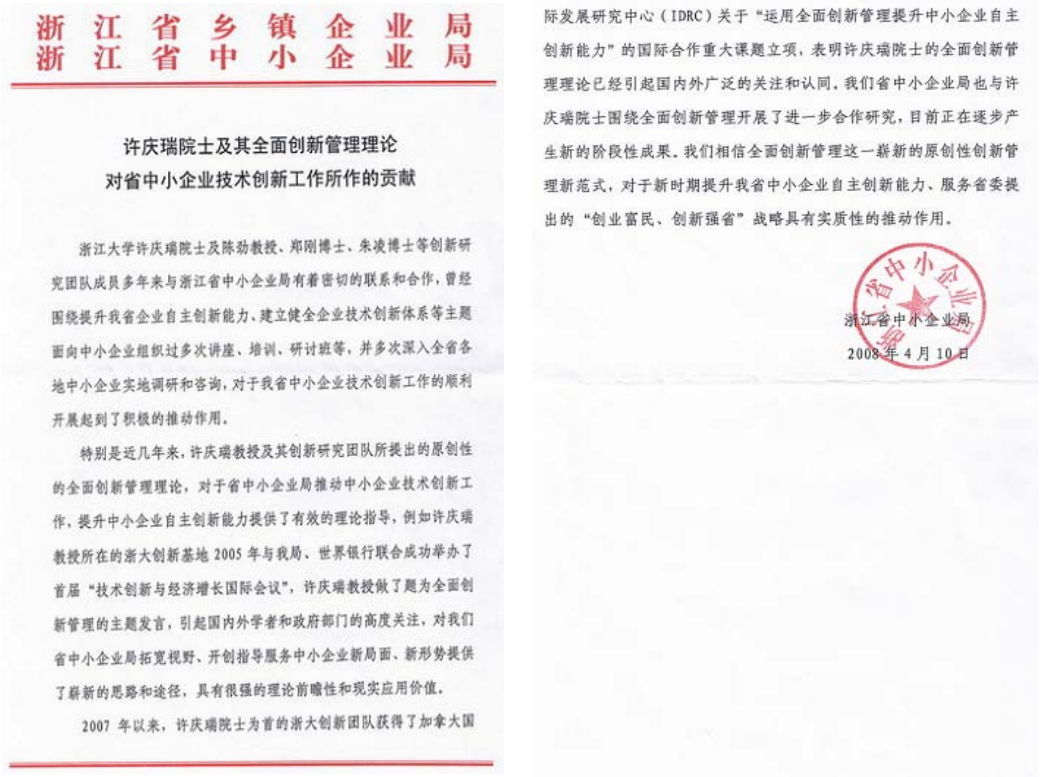
多年来，浙江大学创新与发展中心在海尔、杭氧、中集等大企业实施全面创新管理中，取得了很好的成功经验。为此，创新与发展中心愿为浙江中小企业提高创新能力与市场竞争力精诚合作，为企业解决发展中的实际问题。

敬请大力支持。

浙江省乡镇企业局 浙江省中小企业局 办公室

二〇〇七年十二月十一日

A government document titled “Contributions of TIM Theory on SMEs’ Technological Innovation in Zhejiang Province” issued by Bureau of SMEs in Zhejiang Province, April 10, 2008



浙 江 省 乡 镇 企 业 局
浙 江 省 中 小 企 业 局

许庆瑞院士及其全面创新管理理论
对省中小企业技术创新工作所作的贡献

浙江大学许庆瑞院士及陈劲教授、郑刚博士、朱凌博士等创新研究团队成员多年来与浙江省中小企业局有着密切的联系和合作，曾经围绕提升我省企业自主创新能力、建立健全企业技术创新体系等主题面向中小企业组织过多次讲座、培训、研讨班等，并多次深入全省各地中小企业实地调研和咨询，对于我省中小企业技术创新工作的顺利开展起到了积极的推动作用。

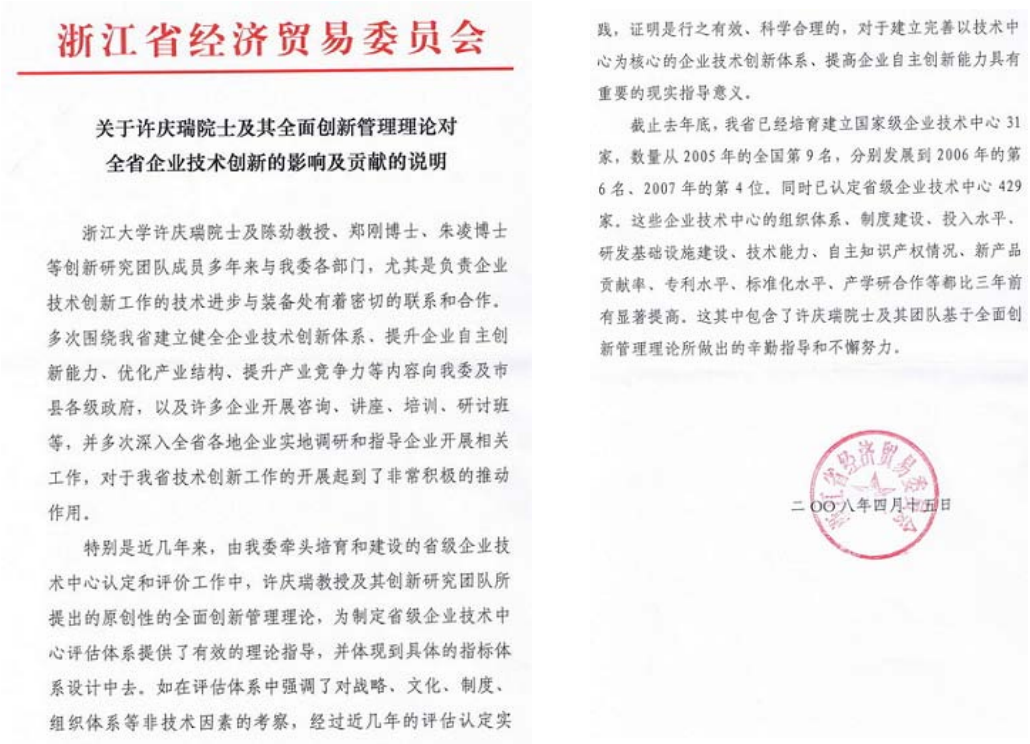
特别是近几年来，许庆瑞教授及其创新研究团队所提出的原创性的全面创新管理理论，对于省中小企业局推动中小企业技术创新工作，提升中小企业自主创新能力提供了有效的理论指导，例如许庆瑞教授所在的浙大创新基地 2005 年与我局、世界银行联合成功举办了首届“技术创新与经济增长国际会议”，许庆瑞教授做了题为全面创新管理的主题发言，引起国内外学者和政府部门的高度关注，对我们省中小企业局拓宽视野、开创指导服务中小企业新局面、新形势提供了崭新的思路和途径，具有很强的理论前瞻性和现实应用价值。

2007 年以来，许庆瑞院士为首的浙大创新团队获得了加拿大国际发展研究中心（IDRC）关于“运用全面创新管理提升中小企业自主创新能力”的国际合作重大课题立项，表明许庆瑞院士的全面创新管理理论已经引起国内外广泛的关注和认同。我们省中小企业局也与许庆瑞院士围绕全面创新管理开展了进一步合作研究，目前正在逐步产生新的阶段性成果。我们相信全面创新管理这一崭新的原创性创新管理新范式，对于新时期提升我省中小企业自主创新能力、服务省委提出的“创业富民、创新强省”战略具有实质性的推动作用。

浙江省中小企业局

2008 年 4 月 10 日

A government document titled “A Statement about Contributions of TIM Theory on SMEs’ Technological Innovation in Zhejiang Province” issued by Economic and Information Commission in Zhejiang province ,April 15, 2008



浙江省经济贸易委员会

关于许庆瑞院士及其全面创新管理理论对全省企业技术创新的影响及贡献的说明

浙江大学许庆瑞院士及陈劲教授、郑刚博士、朱凌博士等创新研究团队成员多年来与我委各部门，尤其是负责企业技术创新工作的技术进步与装备处有着密切的联系和合作。多次围绕我省建立健全企业技术创新体系、提升企业自主创新能力、优化产业结构、提升产业竞争力等内容向我委及市县各级政府，以及许多企业开展咨询、讲座、培训、研讨班等，并多次深入全省各地企业实地调研和指导企业开展相关工作，对于我省技术创新工作的开展起到了非常积极的推动作用。

特别是近几年来，由我委牵头培育和建设的省级企业技术中心认定和评价工作中，许庆瑞教授及其创新研究团队所提出的原创性的全面创新管理理论，为制定省级企业技术中心评估体系提供了有效的理论指导，并体现到具体的指标体系设计中去。如在评估体系中强调了对战略、文化、制度、组织体系等非技术因素的考察，经过近几年的评估认定实践，证明是行之有效、科学合理的，对于建立完善以技术中心为核心的企业技术创新体系、提高企业自主创新能力具有重要的现实指导意义。

截止去年底，我省已经培育建立国家级企业技术中心 31 家，数量从 2005 年的全国第 9 名，分别发展到 2006 年的第 6 名、2007 年的第 4 位，同时已认定省级企业技术中心 429 家。这些企业技术中心的组织体系、制度建设、投入水平、研发基础设施建设、技术能力、自主知识产权情况、新产品贡献率、专利水平、标准化水平、产学研合作等都比三年前有显著提高。这其中包含了许庆瑞院士及其团队基于全面创新管理理论所做出的辛勤指导和不懈努力。

二〇〇八年四月十五日

A government document titled “Policy to Speed up Innovation and Entrepreneurship for SMEs” issued by Bureau of SMEs in Zhejiang Province, December 18, 2009

浙江省人民政府
常务会议材料

第 44 次第 3 号

2009 年 12 月 18 日

《浙江省人民政府关于促进中小企业加快创业创新发展的若干意见》（审议稿）起草工作情况汇报

浙江省中小企业局

附：浙江省人民政府关于促进中小企业加快创业创新发展的若干意见

（送审稿）