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The Empirical Study of SMEs Innovation and Performance Factors in Sichuan

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Abstract
This article aims to assess the factors affecting the relationship between innovation and performance of SMEs, which has been subject to by SMEs Innovation Fund in 1999 and successfully passed the acceptance of funds to support SMEs innovation in Sichuan Province; Data from 174 SMEs in Sichuan Province and investigation of different properties ,factors influencing innovation and innovation performance; different ways of improving the performance of SMEs, all help the government to develop more targeted support of business development innovation policy. According to the research, SMEs innovation activities are mainly limited to family scales, focusing on improving quality, increasing output and technical standards. The study found that technology-based SMEs in Sichuan Province mainly purchase techniques from external sources. Their own innovation is not good. Innovation strategies are adapted to competition have better performance in business, as they have the capability to independently research and adapt to the new marketing economy.

Key words: Empirical study; Sichuan province; High-tech SMEs; Innovation factors; Innovation and performance

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INTRODUCTION
Technological innovation has played a vital role to improve competitiveness, boost business development, revitalization of the regional economy and enhance national competitiveness, it has become one of the goals in government policy decision-making (Cooke et al., 2003). Many government policies focus on innovation inputs and means of supply and support the development of formal public institutions (such as R&D center support by public funds), they often ignore the tendency of business innovation and strategy, digestion and absorption capacity as well as the special needs of different regions (Todtling Trippl, & Howells, 2005). The implementation results of the foundation, previous studies mainly evaluate the effect of the Fund of the economic indicators and the completion of the project schedule, and the data mostly come from the materials which are used for corporate project approval and acceptance turned over. The materials are written by the agency guidance or the agency staff. The goal is to pass inspection, and the data is processed. Business is the main body of technological innovation, thinking about motivation, factors affecting innovation projects, innovation, performance, etc. from their own, it has important practical significance for the development of setting a policy which fit the actual situation of the enterprise. Foundation is a child of technological innovation, the key influencing factors are sources of innovation, learning, innovation strategy, internal and external environment, the ability of the business, innovation mode and so on, which will play an important impact on fund innovation performance. From the business actual innovation situation, the purpose of innovation is to help companies to maintain and improve their competitive positions (Hart, 1996). From the general direction, if the corporate governance system is scientific and rational, or the business incentives

are enough, corporate behavior and increasing their innovation performance may be the same.

1. ENVIRONMENT FOR INNOVATION, INNOVATION STRATEGY AND BUSINESS PERFORMANCE

A large number of companies from a strategic perspective to study the performance of literature, environment becomes an important factor in business performance. Miller (1983) defined the environmental characteristics as dynamic, hostile and heterogeneity. Dynamic refers to growth opportunities, customers, competitors, the rate of market trends changing, innovation and the unpredictability of research and development; hostile refers to the degree of competition, the number of dimensions of competition and restrictive laws and regulations; heterogeneity refers to differences in market and product requirements for different market segments. Dynamic operating environment is expressed in many ways, such as political, economic, technological, cultural, competitive changes in the pattern development. With the accelerating process of globalization and information technology advances in technology to speed up the replacement cycle; changes in consumer demand, shorten cycle; competing for market share among enterprises more competitive, that is, the dynamic characteristics of the environment become apparent. The dynamic business environment reduces management's ability to predict future events, reduces the corporate management of the enterprise's ability to control, weaken the ability of management personnel decision making, resource allocation capability. Thus, in a dynamic environment, enterprises must establish a rapid response and innovative mechanisms, establish flexible production system, processes product and innovation in-house, in order to maintain or improve business performance. When an enterprise is the volatility of the environment, it needs continuous change and innovation, and explores the type of defensive strategy of combining; and in a stable environment, use defensive strategy, change the original product and process. Defensive strategy corresponds to the progressive nature of innovation; it can give full play to the potential of existing technologies, and often can strengthen the advantage, especially to strengthen the organizational capacity of existing

enterprises, the company's technical capabilities and scale requirements are lower (Nelson and Winter, 1982). In manufacturing enterprises, mainly incremental innovation to improve product performance, streamline production processes, reduce waste, etc. (Samson & Terziovski, 1999). These activities have continued small innovative technologies to improve the status of enterprises, with a huge cumulative effect, and promote improved business performance (Jha et al., 1996). Exploratory strategy corresponds to the breakthrough innovation, which will bring businesses new product features, improving existing features at least five times more indicators, significantly reduce the product cost (Leifer, 2000), it is built on a diverse set of science and technology principles above, can often open new markets and potential applications (Dewar & Dutton, 1984).

Hypothesis 1: Innovation strategy and competitive environment to adapt to the company with a higher innovation performance.

2. SOURCES OF TECHNOLOGY AND INNOVATION PERFORMANCE

Sources of technology companies simply divided into two, one from outside the enterprise, such as universities, independent research institutes, suppliers and even competitors, etc.; the other from within the enterprise. The enterprise's R&D out-sourcing or licensed the technology from outside enable enterprises to benefit, but the technology-based SMES in the relevant fields is not lack of technical capacity for technology transfer and technology licensing from the benefit (Girma, 2005; Kessler et a1., 2000). Enterprise core competencies for the supplier to determine the accuracy and definition of business through R&D contracts was the basis of expertise, find the "right" suppliers in order to obtain the technology to meet their needs to carry out its innovative programs. In addition, if companies do not have enough reserves, digestion and absorption of foreign technology-related expertise, then it cannot adopt a similar frame of reference and terminology exchange with suppliers, made in line with the requirements of the target. Therefore, purchases from the market for technology-based learning for those who lack the technical performance of the businesses want to make a discount.

Malmberg (1999), Piore and Sabel (1984) and other studies suggest that organizational learning can be divided into four types. First, learning by doing /learning by using, corresponding to the purchase of this technology learning. Second, professional learning, refers to a company within the industry downstream from the upstream businesses access to advanced technology. Part of the SMEs provides support for the core business. Its core business will focus on innovation carried out, and it can get from the core business and information technology. Third, knowledge spillovers, when businesses are close to the source of knowledge, more access to universities, independent research institutions, enterprises, suppliers, customers and other organizational knowledge. Fourth, the coding of science and technology based learning, that this mode of learning of its own technology . Which make science and technology, patents and other codified knowledge as the main source of innovation, with the scientific method

to get the production and use of science and technology throughout the innovation process to dominate? Enterprises develop a formal R& D activity, recruit highly educated employees, and maintain close ties and knowledge belong to such learning behavior. Different technologies have their mode of learning to match; we believe that companies can adapt better absorption and higher performance when learning and sources of technology.

Hypothesis 2: Learning to adapt with the technology source companies can obtain a higher innovation performance.

3. AN EMPIRICAL STUDY

The purpose is to study the impact of China's science and technology innovation in SMES the impact of factors on the innovation performance of Fund to support the evaluation of the effects, summarized the main factors and to explore the mechanism, put forward policy recommendations. Sub-project began in April 2010, as the world's fastest growing economies in the economy in nearly two decades, China has developed economic rapidly, and technological factors which have very prominent role in promoting, and therefore the study of factors affecting innovation in Chinese enterprises to explore the mechanism of innovation and reform has a positive practical significance on economic progress of China and the world. This research is lagging behind China's economic development in Sichuan Province, a survey conducted study, and it represents an important technological innovation in China in the areas of innovation and performance of a miniature. This article is from Sichuan Province, had been financial support for SMES innovation and successfully passed the acceptance angle of the Sichuan Province High-tech SMES innovation and performance for empirical research.

Our company's innovation activities have three main aspects of the survey, the innovation goals, innovation factors, innovation and performance.

3.1 Innovation Goals

Innovation activities of enterprises can be reflected from the economic goals of both products and markets. The research data collection and interpretation of major technological innovation to the OECD "Oslo Manual" (OSLO Manual, 1992) as a guiding principle, it is clear and innovation-related goals. Through literature review and full discussion, the subject group with the experience made in China SMES technical innovation 12 key objectives:

(1) The development of low-cost innovative new products

(2) Develop a new generation of upgraded product

(3) Develop new science and technology

(4) Develop new markets

(5) Speed up the production process of preparing

(6) Meet existing customer demand for the product

(7) Improve the quality of existing products,

(8) Improve production systems on the market demand, ability to adapt quickly to changes

(9) Reduce material consumption

(10) Lower production costs

(11) Improve product development speed of

(12) Accelerate the commercialization rate of

Goal (1), (3) is based on innovation and exploration results, target (2), (4), (5), (6), (7), (8) and enterprises through innovative products, expand or upgrade the existing goals, (9), (10), (11), (12) for the market environment and the diverse needs of customers, reflecting the resilience and competitive market conditions.

3.2 Factors Affecting Innovation

Competitive environment mainly for companies to answer the feel of the degree of competition in the following areas, using the 7-point Likert scale, 1 almost no competition, 7 means the competition heated up

(1) Low-cost, innovative products

(2) Products with low price

(3) Quality

(4) Innovative products

(5) Product customization

(6) Product development speed

(7) Commercial speed

Sources of innovation

(1) Purchase of technology

(2) Own technology

(3) A combination of independent research and development enterprises that purchase technology

Technology learning This study has two main business learning models: Learning to buy and innovation model, self-learning and innovative research mode.

3.3 Innovation Performance

According to the"OsloManual" (OECD, 1992), this paper uses three indicators of innovation performance, one is through technological innovation to improve product quality; second is the number of patents that companies have obtained, the number of patent application, including invention patent, utility model patents and so on; The third is through improved technology, the use of new materials to save production costs.

Investigation and study methods adopt a method that combined subjective measure and objective methods of real data aimed at response a comprehensive technological innovation picture. Subjective measurement method is Likert scale method, using a 7-point Likert scale to evaluate the above-mentioned objectives of the importance of each innovation and business performance indicators and the advantages and disadvantages compared to competitors. The higher the score, the more important or on behalf of innovative business performance objectives

as possible (1 = ”not important” and 7 represents ”very important”).

3.4 Questionnaire

The questionnaire consists of five parts: (a) innovation goals; (b) innovation factors; (c) innovation performance; (d) competitive environment; (e) Company features. Company characteristics include type (high-tech companies or other), size, and age and so on. Prior to conducting large-scale survey, it conducted in eight companies pre-test. Modified the questionnaire according to pre-test questionnaire, including questions of form, reducing jargon, so Tianda can understand the issues more clearly, and avoid ambiguity or ambiguities, then the questionnaire would be the target enterprise.

3.5 Survey and Sample

The target group for the investigation is more than 300 technology-based SMEs in Sichuan Province; they are governed by SMEs innovation fund and successfully passed the acceptance, with a high degree of homogeneity. In:

First, F the sample of enterprises is SMEs, and the vast majority is small businesses;

Second, F the sample companies all complete an innovative project according to the “SMEs Technology Innovation Fund management approach”, achieve a technological innovation;

Third, F sample business innovation projects are implemented in accordance with “SMEs Technology Innovation Fund Management”, the project type, project technical field have a high concentration.

Questionnaire are distributed by innovative fund management center of Sichuan Province High-tech SMEs, maintaining a high recovery rate, recovery rate was 64.7% (release 300, 194 recovery), and there are174 valid questionnaires.

Because of the majority of questions in the questionnaire are multiple-choice questions, the number of companies in the form may be more than the total of the sample companies. But it dose not affect on the meaning of the options combination represent (such as the part of innovation strategy, 2, 3, 4, 5, 7 options show the companies to be in the growth is not very fierce competition environment, the total of companies which chose the four options are 205).

3.5.1 The Regional Distribution of High-Tech SMEs and R&D to Build

In the 174 effective questionnaires, the distribution of is Deyang is the most, the ratio was 14.9%; followed by Chengdu, 13.8%; the following is Mianyang, Lanchong, Yibijn, in Table 1.

Table 1
The Regional Distribution of Sample Companies

Area	Area total number of samples
Mianyang	23
Guangyuan	14
Deyang	26
Lanchong	22
Qinhuangda	18
Chengdu	24
Luzhou	14
Yibijn	22
Zhiyang	11
Total	174

Whether the enterprise has an external universities, research institutions build their R&D unit of the composition is a measure of its technological innovation, or purchase an indicator of innovation. 73 (42%) companies and research institutions established a cooperative relationship, implement a self-developed technology, this ratio is relatively high. a considerable number of companies? Sources of technology consistent with learning in Table 2.

Table 2
Sources of Technology and Learning Consistent With the Percentage of Enterprise

Its own technology companies	Purchase of technology companies	Purchase of technology combined with own technology companies	zz companies	gg companies	Others
73	98	3	47	66	61

Sources of technology innovation project findings consistent with our expectations, the domestic enterprises is relatively weak R&D, innovation and more from the outside world, through the purchase of access, the percentage accounted for 58%.

3.5.2 The Competition of Enterprises Are Facing

SMEs have different levels of experience for our list of eight aspects, industry products accelerateding, indicating technology-based SMEs are facing relatively new market of the market and developing more space, in order to narrow the gap and main- tain edge, the majority of enterprises adopt Exploratory strategy and have more emphasis on technology development. High degree of product homogeneity is one of the hallmarks competitive, companies seek changes in order to survive and develop into its primary strategic choice in the rapidly changing environment and situations.

Table 3
Enterprise Perception to Competition

Competition enterprises facing	Companies	Proportion strategy	Defensive	Exploratory strategy
1. High degree of product homogeneity	49	16.40%	38	11
2. Price of similar products at lower	18	6%	4	14
3. Similar products with higher quality	22	7%	7	15
4. A more comprehensive product	23	7.70%	3	20
5. Industry enterprises to adopt new technology	37	12.40%	9	28
6. Products and services successfully imitated by competitors	29	9.70%	22	7
7. Faster product development	105	35.20%	26	79
8. Services provided for clients serious homogenization	15	5%	12	3

3.6 The Results

One high degree of product homogeneity, six products and services successfully imitated by competitors eight provide for the customer service seriously homogeneous these three aspect reflect the serious competition. In this situation, most enterprises take a defensive type of innovation strategy; similarly, in the product updates, technical and production processes rapidly changing environment, enterprises are many take exploratory innovation strategy.

Table 4
Companies Patent Case

Area	Own technology (company)	Authorized number of patents	Number of patents for invention	Proportion of patent	Purchase of technology (company)	Authorized number of patents	Number of f patents for invention	Proportion of patent
Mianyang	6	2	1	51.50%	17	34	10	29.50%
Guangyuan	8	6	5	84%	6	22	10	45.50%
Deyang	4	4	3	75%	22	27	11	40.70%
Lanchong	12	13	5	38.90%	10	9	4	44.40%
Suining	7	14	4	28.50%	11	3	1	33%
Shijiahzuang	11	7	4	56.30%	13	12	5	41.30%
Luzhou	6	15	7	45.90%	8	1	0	0
Yibijn	12	21	3	14.30%	10	26	5	19.20%
Zhiyang	7	7	2	29%	4	7	0	0
Total	73	84	34	40%	101	146	46	31%

Table 5
Sources of Technology and Learning Consistent With the Mode of Innovation Performance

Innovation performance	zz companies(*N*=47)		gg companies(*N*=66)		*T*-test
	Mean	Var	Mean	Var	
The number of the authorized patent	1.19	1.143	1.56	1.308	2.535**
The number of the invention patent	0.55	1.239	0.52	1.396	3.185**

Table 6
The Performance of Technological Innovation Produced (Production Cost and Quality)

Option	Number of enterprise	Proportion
Aupdate the raw materials to reduce production cost	44	9%
AImprove the process equipment to reduce cast	54	12%
AImprove product design	50	11%
Anew production technology to reduce cast	45	10%
ADevelopment and production of new products to increase competitiveness	61	13%
AUpdated materials to improve product quality	28	6%
AImprove the process equipment to improve product yield or quality	47	10%
AImprove product design to improve product quality	64	14%
Anew production technology to improve product quality	54	12%

Table 7
Comparison Table of Technological Innovation Performance

Option	Own technology (company)	Purchase of technology (company)	Proportion
1. Update the raw materials to reduce production cost	17	27	62/100
2. Improve the process equipment to reduce cast	22	32	68/100
3. Improve product design	22	28	78/100
4. new production technology to reduce cast	20	25	80/100
5. Development and production of new products to increase competitiveness	55	6	916/100
6. Updated materials to improve product quality	13	15	86/100
7. Improve the process equipment to improve product yield or quality	22	25	88/100
8. Improve product design to improve product quality	29	35	82/100
9. new production technology to improve product quality	24	30	80/100

4.6.1 Innovation Performance

4.6.1.1 The Patent Situation

174 companies Participated in the survey received a total of 230 patents, including patent number 79. License its own technology companies an average of 1.15 the number of patents, invention patents accounted for 40%; companies that buy technology to obtain patents for the average of 1.44, but the invention patents accounted for 31%. The purchase of technology companies in their R&D results have build a good companies units, but the quality is not as good as its own proprietary technology, companies, technology-based SMEs to obtain the ”brain” to assist R&D, significantly enhance the role of innovation performance.

4.6.1.2 Production Costs and Quality

Table 6 shows, the survey by selected companies ”Update raw materials, improved process equipment, improve product design and process technology used in production line” to reduce the production cost of companies are 44, 54, 50 and 45, respectively, by technological innovation projects to reduce production costs of enterprises accounted for 43%; through technological innovation projects to improve the product quality of enterprises accounted for 43%; success through technological innovation to develop new products, increase competitiveness of enterprises accounted for 13%, indicating that technological innovation to enhance business performance has a profound impact.

Innovation performance of enterprises in its own technology and the purchase of technology companies showed a larger difference, as shown in Table 6 of the innovation performance, in addition to develop and produce new products to increase com- petitiveness, the performance of its own innovation technology companies was significantly higher than the number of enterprises purchased technologies, the other eight are the number of its own technology business technology business than purchase fewer, the aforementioned patent to obtain the same situation also reflects the law. We believe that this does not explain its own technology, innovation performance is better to buy technology companies, the reason for this phenomenon, perhaps because of this reaction we have chosen the innovation performance indicators.

It can be seen, sources of technology consistent with the learning model to obtain a patent of its technology-based SMEs is better than the overall sample of companies, and reduce production costs and improve product quality two indicators, sources of technology and learning consistent with the mode of business was also significantly higher than the overall sample, assuming *t*2 is verified (see Table 8).

Table 8
The Business Innovation Performance That Sources of Technology Consistent With the Learning Mode

Innovation performance	Own technology company (N=73)		zz company (*N*=47)		Ttest	Purchase of technology company(N=101)		gg company (*N*=66)		*T* test
	Mean	Var	Mean	Var		Mean	Var	Mean	Var	
Reduce production cost	4.96	0.894	5.32	1.432	2.197	4.98	1.423	5.11	1.735	3.018
Improve product quality	5.26	1.238	5.68	0.895	2.331	5.21	0.927	5.46	1.112	2.025
Development of new product	5.79	1.175	6.82	1.078	4.416	5.51	1.294	6.42	1.087	3.218

Note. In 7 zz that independently developed its own technology and learning; gg said the purchase of technology and the purchase of technology learning; *N* is the size of sample; **p* < .01, ***p* < .01.

In general the time that when High-tech SMEs faced with fierce competition is in its flagship product maturity or decline phase, when, to take defensive innovation strategy, its innovation performance is significantly better than those based explore innovation strategy Similarly, when the company is growing, due to the development of space, the main purpose of business innovation is to maintain a competitive advantage or reduce the gap with industry leader, so the explore innovation strategy was significantly better than the defensive strategy (Table 9). Hypothesis *t*1 is verified.

Table 9
The Business Innovation Performance That Sources of Technology Consistent With/the Learning Mode

Degree of competition	Number of enterprise	Defensive strategy	The average patent	Reduce production cost	Improve product quality	Exploratory strategy	The average patent	Reduce production cost	Improve product quality
Very intense	93	72	1.52	54	39	21	1.39	12	6
Not intense	81	20	1.19	8	17	61	1.46	36	42

5. DIFFERENT TECHNOLOGY INNOVATION PERFORMANCE

SMEs innovation fund reporting guidelines" pointed out that a total of six technical areas need to focus on: Electronic information, electromechanical integration, bio-pharmaceuticals, new materials, resources and environment, new energy and energy-effcient. The survey of enterprises in the six areas of distribution and Innovation Fund projects through patents obtained are given in Table 10.

Table 10
Innovation Performance of Different Areas of Business

Technology	Number of enterprise	Proportion	The average patent	Patent number	Proportion of patent	Reduce production cost	Improve product quality
Electronic information	16	9.20%	2.19	1.09	50%	29	18
Electromechanical integration	21	12.10%	2.24	0.52	23.20%	39	37
Bio-pharmaceuticals	16	9.20%	0.56	0.44	78.60%	37	40
New materials	38	21.80%	1.37	0.61	44.50%	32	22
Resources and environment	52	29.90%	0.9	0.35	38.90%	84	33
New energy and energy-efficient	31	17.80%	1.42	0.55	38.70%	23	24

The average electromechanical integration industry gets the most authorized patents; an average of 2.24, followed by 2.19 of the electronic information field, at least in the patent license is biomedical technology, with an average of only 0.56. Patents in the electronic information field is the highest, the average is 1.09, indicating the degree of development of electronic information field is narrowing the gap with foreign countries. The patent of Resources and environment is less, from another angle shows that the field is still emerging in the domestic industry, requires a certain accumulation will produce research, there is more room for development.

CONCLUSION

The survey is based on the 174 SMEs of Sichuan Province to study the relationship between technological factors affecting innovation and performance are subjected to SMES Technology Innovation Fund support and successfully passed the acceptance of innovation from different technical areas. The results showed that, in Sichuan Province of SMES innovation activities mainly aimed at improving product quality and reduce costs. Technological innovation to reduce costs and improve the quality of both products is almost as important. This survey comprehensibly shows the six key areas of technology innovation performance supported by SMES innovation funds. Some of that is to be expected, such as optical and electrical integration, and electronic information, these two areas are older, innovation performance should be better. Some findings are unexpected, such as its own technology innovation performance does not better than the companies which need to buy technology, we hope to focus on this .in the future In addition, the results show that two areas of bio-medicine, resources and the environment, innovation performance is relatively poor, it need the government to give priority attention and policy support in the future to help the two areas development rapidly as soon as possible. The main limitation of this article is: innovation indicators are not set number or proportion

of new products, mainly taking into account that the questionnaires need to know the survey data that impacted greater by the time interval and the diffculty of calculating and professionalism, which that suggest that in the future carry out related training and regularly data, survey and the timely amendment of policies. We hope that in future studies we can collect more comprehensive data on fully reflect the scenario of SMEs innovation.

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