RESEARCH ON SOLUTIONS TO IMPROVE TECHNICAL PERFORMANCE AMONG TEXTILE INDUSTRIES IN ZHEJIAN, CHINA

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ABSTRACT

Taking Zhejiang textile enterprises in China as the research object had 500 selected managers from 30 textile enterprises from the Zhejiang province in China and presented its profile including the nature of the company, subdivision type, number of years of incorporation and enterprise scale. The study aimed to determine the technological performance among textile industries, test the difference of responses on the technological performance when grouped according to the business profile, with the aim of proposing a plan of action to improve technological performance of textile enterprises in Zhejiang province. Through data investigation and SPSS analysis, literature combing and logical deduction, findings revealed that there is good enterprise technological performance in Zhejiang textile industries. Furthermore, this study found out that there is a significant difference in technological performance when grouped according to the nature of the enterprise, specific industry, years of incorporation, and enterprise scale.

Keywords: Technological performance, Textile industries, Difference of response, Plan of action, SPSS analysis, China

INTRODUCTION

Technological innovation plays an important role in the sustainable development of enterprises. According to the data from the tracking survey conducted by Fortune magazine of the United States over the years, the average life expectancy of large conglomerates in China is 7-8 years, while that of small and medium-sized enterprises is three years. The average number of enterprises eliminated in the fierce market competition in China is about 4.5 million each year. That is, an average of about ten companies per minute close down and delist for a variety of reasons (Land, S., Engelen, A., & Brettel, M., 2012). The main reason for this phenomenon is that the performance level of technological innovation in small and medium-sized enterprises is weak, which leads to a lack of motivation for sustainable development.

Although Zhejiang has the advantage of industrial agglomeration, at the same time, the survival and development of small and medium-sized private enterprises require technological innovation very urgently, but due to the lack of capital, manpower and other factors, the potential of independent innovation of enterprises is insufficient. This is especially true for enterprises in the field of traditional industries. From the perspective of innovation research, scholars have experienced a dynamic transformation from static exogenous, static endogenous to internal and external integration (Guo Wei, Li Qiankun, Sun Yutong, Wu Changmin, 2017). Since the beginning of the 1980s, the technological innovation theory has been used to explain many enterprises and economic phenomena *(*Lin Ming, Ren Hao, Dong Birong*,* 2015*).* The research of technological innovation has gradually developed towards the direction of integration because it emphasizes on theory and practice.

The contribution of technological innovation to enterprise benefit is more and more obvious, which makes it more and more important in the development of the social economy. With the continuous accumulation of human knowledge and the development of social practice, scholars found that the result is not the only standard to explain the effect of innovation, innovation process and other elements also play an important role in it (Yang Jiao, 2017). Therefore, the measurement of technological innovation performance should consider a variety of factors. The subjective questionnaire was used to measure the data by self-assessment. Based on the needs of this study, the paper decides to use subjective performance measurement method to measure the innovation performance of textile enterprises by asking grass-roots employees or middle and senior managers of textile enterprises how to perceive the technological innovation performance of their enterprises. It is mainly composed of the number of new products, the number of patent applications per year, the speed of development and marketization of new products, the success rate of new products, the proportion of new product sales to the total sales volume. As traditional industries have a greater demand for technological innovation (Li Hui, 2019). This research takes Zhejiang textile enterprises as the sample to study the technical innovation performance level and its key factors quantitatively, to provide theoretical basis and reference for enterprises in the traditional industry field to improve the technological performance.

OBJECTIVES OF THE STUDY

This study was conducted to 1) present the textile industry profile, including the nature of the company, subdivision type, number of years of incorporation, and enterprise scale; 2) determine the enterprise technological performance and mean score in terms of technological performance; 3) test the difference of responses on the technological performance when grouped to nature of the enterprise, specific industry, years of incorporation and enterprise scale; and 4) propose the plan of action to improve the technological performance of textile enterprises in Zhejiang, China.

METHODS

This study on Zhejiang textile enterprises in China had selected 500 employee samples, mainly aimed at 30 textile enterprises of Zhejiang province in China, through on-site consultation, e-mail and telephone interviews to distribute questionnaires. In terms of geographical division, we mainly chose four cities, Hangzhou, Shaoxing, Ningbo and Jiaxing, which have a relatively concentrated distribution of textile enterprises in Zhejiang Province. Among them, 200 questionnaires (40%) were sent to textile enterprises in Shaoxing, with 150 questionnaires (30%) to Hangzhou textile enterprises, 80 questionnaires (16%) were sent to Ningbo textile enterprises and 70 questionnaires (14%) were sent to Jiaxing textile enterprises. From the point of view of the supply chain, this research carried on the data collection to the textile industry, such as cotton spinning industry, the hemp industry, woolen industry, silk industry, chemical fiber industry, knitting industry, dyeing industry, and the likes. For the enterprises with field research, the questionnaires were sent out at the same time of the interview and consultation. For the enterprises that cannot do field research, the data collection was in the form of email or telephone interview. The questionnaire mainly included the basic information and the item of measuring the performance of technological innovation. Considering that firms were generally reluctant to disclose specific data, this section was measured by non-quantitative indicators. Five items were put forward from the following aspects: the number of new products, the number of patent applications per year, the speed of development and marketization of new products, the success rate of new products and the proportion of new product sales to the total sales volume. This paper presented the textile industry profile, including the nature of the company, subdivision type, number of years of incorporation, and enterprise scale. The specific methods of data analysis included scrutinizing of literature and logical deduction, questionnaires and case

studies, qualitative and quantitative analysis were used in the research. Furthermore, this study utilized the use of SPSS in analyzing the data gathered to draw final scientific conclusions and served policy recommendations.

Table 1. Five Measurement Index of Technological Innovation Performance

Explained Variable	Measurement Index and Indicator Description
Technological Innovation Performance	1. Compared with the main competitors in the same industry, the enterprise has a large number of new products 2. Compared with the main competitors of the same industry, this enterprise applies for more patents each year 3. The development and marketization of new products in this enterprise is fast. 4. The success rate of new products in this enterprise is high. 5. The sales volume of new products in this enterprise is a high proportion of the total sales volume.

RESULTS AND DISCUSSION

1. Analysis of Essential Information of the Managers

Table 2 shows the profile distribution of the respondents. In terms of sex, the number of men in the respondents was 302, accounting for 60.4 percent; the number of women was 198, accounting for 39.6%. In terms of Age, the respondents aged between 36 and 45 was predominant, accounting for 38.6%; followed by the respondents aged 26 to 35 and 46 to 55, accounting for 29.8% and 21.8%, respectively, while the scale of those under 25 and over 55 were lower. According to the educational background, the education degree of the respondents was mainly in the undergraduate and the master's degree, accounting for 45.2% and 30.2%, respectively.

Table 2. Distribution of the Respondents' Profile

	Category	Frequency	%
Sex	Male	302	60.4
	Female	198	39.6
Age	20~25	27	5.4
	26~35	149	29.8
	36~45	193	38.6
	46~55	109	21.8
	above 55	22	4.4
Educational Background	Specialist and below	99	19.8
	Undergraduate	226	45.2
	Master	151	30.2
	Doctor	24	4.8
Working Life	Three years and below	28	5.6
	3~5 years	51	10.2
	6~10 years	133	26.6
	Over 10 years	288	57.6
Department	product department	125	25.0
	R&D department	55	11.0
	Sales Department	52	10.4
	Personnel Department	45	9.0
	Market department	51	10.2
	Financial Department	43	8.6
	Purchase Department	30	6.0
	Administration Department	43	8.6
	Else	56	11.2
Position	Basic level manager	88	17.6
	Middle Manager	129	25.8
	Senior Manager	208	41.6
	General Manager	75	15.0

According to their working life, 288 people (57.6%) have worked in their enterprises for more than ten years, accounting for 57.6 percent; and 133 people（26.6 %）have worked for six to ten years. In terms of the working department, 25.0% of respondents worked in the production department, 11.0% worked in the R & D department, and 10.4% worked in the sales department, ranking in the top three. In terms of

Position, in particular, the proportion of senior managers was 41.6%, the proportion of middle managers 25.8% and the proportion of general managers was 15%. Because the total proportion of middle and senior managers was as high as 82.4%, most of the respondents have a good understanding of their enterprises and the whole textile industry, which is helpful to improve the effectiveness of the questionnaire recovery.

2. Analysis of Essential Information of the Enterprises

Table 3. Distribution of the Business Profile

Business Profile		f	%
Enterprise nature	Private enterprise	386	77.2
	State-owned or state-controlled enterprises	99	19.8
	foreign enterprise	15	3.0
Specific Industry	Clothing industry	114	22.8
	dyeing industry	61	12.2
	Chemical fiber industry	55	11.0
	Cotton spinning industry	53	10.6
	Knitting industry	26	5.2
	Hemp spinning industry	13	2.6
	Wool spinning industry	19	3.8
	Silk industry	11	2.2
	Other industries	148	29.6
Years of incorporation	3-6	40	8.0
	6-10	71	14.2
	11-20	221	44.2
	Above 20	168	33.6
Enterprise Scale	100 and below	107	21.4
	100-300	105	21.0
	301-1000	173	34.6
	Above 1000	115	23.0

Table 3 shows the distribution of the business profile. This section carries on the analysis of the basic information of the textile industry profile including enterprise nature, subdivision type of specific industry, number of years of incorporation, and enterprise scale. In terms of enterprise nature, 77.2% of the sample enterprises were private enterprises, 19.8% were state-owned or state-controlled enterprises, and 3.0% were a foreign enterprise or Chinese-foreign joint ventures. It can be seen that private textile enterprises in Zhejiang account for the highest proportion of sample enterprises, which is closely related to the frequent activities of small and medium-sized private capital in the field of Zhejiang textile industry in recent years. As far as the subdivision type of Specific Industry is concerned, the Clothing industry accounts for 22.8%, the dyeing industry accounts for 12.2%, the chemical fiber industry accounts for 11.0%, which occupies the top four places in the textile industry, while the hemp spinning industry and the silk industry account for the lower proportion. In terms of the years of incorporation, 221 textile enterprises have a founding life of 11-20 years, accounting for 44.2% of the total, and 168 enterprises have been established for more than 20 years, accounting for 33.6% of the total. The total number of enterprises over ten years old accounted for 77.8% of the total sample. In terms of enterprise scale, the number of medium-sized enterprises with 100 to 1000 employees is 278, accounting for 55.6% of the total number of enterprises; large businesses with more than 1000 employees account for 23.0% of the total, and small businesses with fewer than 100 employees account for 21.4% of the total respectively.

3. Enterprise Technological Performance among Zhejiang Textile Industry

Table 4 depicts the enterprise technological performance of Zhejiang textile industry. The computed composite mean score of 3.28 implies that the managers have good level of response enterprise technological innovation performance of the textile industry. Generally speaking, the success rate of new products in the enterprise ranked first with the weighted mean of 3.36. The proportion of new product sales volume in gross sales volume ranked second with the weighted mean of 3.33. The number of new products compared with the main competitors in the same industry ranked third with the weighted mean of 3.28, followed by Speed of development

and marketization of new product with the weighted mean of 3.26.

Table 4. Enterprise Technological Performance of Textile Industry

Indicators	WM	VI
1. Success rate of new products in the enterprise	3.36	Good
2. Proportion of new product sales volume in gross sales volume	3.33	Good
3. Number of new products compared with the main competitors in the same industry	3.28	Good
4. Speed of development and marketization of new product	3.26	Good
5. Number of patents filed each year compared with the main competitors in the same industry	3.18	Good
Weighted Mean	**3.28**	**Good**

Furthermore, the managers also agreed that the number of patents filed each year compared with the main competitors in the same industry contributes to the enterprise technological innovation performance of Zhejiang textile industry, which obtained the least weighted mean score of 3.18. With the increasingly fierce competition and the rapid development of science and technology, the insufficient ability of technological innovation has seriously restricted the sustainable development of textile industry in Zhejiang Province (Stam, Arzlanian, & Elfring, 2014). The textile industry has become the first pillar industry in the economic development of Zhejiang Province. However, with the continuous change of market demand and the double pressure of rising domestic production costs, the textile industry in Zhejiang Province appears the phenomenon of "first-class equipment, second-rate technology, third-class products" in the process of development. The characteristics of extensive growth and the slow upgrading of the industrial structure are becoming more and more prominent, and many textile enterprises with the labor-intensive mode of production are struggling. In recent years, Zhejiang Province has implemented a plan of action to upgrade the traditional manufacturing industry (S.X. Zeng, Xie, Tam, 2010). Through active and effective reform and innovation, Zhejiang textile industry has made a certain breakthrough in the success rate of new products in enterprises and the proportion of new products sales to total sales. In the future, Zhejiang textile industry should further speed up the development and marketization of new products, and strive to make breakthrough progress in the patent application of new products.

4. Enterprise Technological Performance among Zhejiang Textile Industry

Table 5. Mean Score in Terms of Technological Performance

Business Profile	Indicators	Composite Mean
Nature of Enterprise	Private	3.19
	State-owned	3.63
	Foreign	3.29
Years of Incorporation	3-6	2.87
	7-10	2.60
	11-20	3.18
	>20	3.81
Specific Industry	Clothing industry	3.26
	dyeing industry	3.81
	Chemical fiber industry	3.54
	Cotton spinning industry	3.35
	Knitting industry	2.42
	Hemp spinning industry	2.43
	Wool spinning industry	3.74
	Silk industry	2.02
	Other industries	3.23
Enterprise Scale	<100	2.73
	100-300	2.89
	301-1000	3.54
	>1000	3.78

Table 5 presents the mean score in terms of technological performance from four different business profiles, including the nature of the enterprise, years of incorporation, specific industry, and enterprise scale. Firstly, the nature of the enterprise is closely related to the technological performance of Zhejiang textile industry. First in rank was state-owned textile enterprise with weighted mean of 3.63, next rank is foreign enterprises with the weighted mean of

3.29, and the lowest in the obtained composite mean is a private enterprise with the weighted mean of 3.19. Secondly, the earlier the enterprise is established, the better the technological innovation performance of the enterprise is. The technical performance of enterprises that have been established for more than 20 years is significantly higher than that of enterprises under 20 years with the weighted mean of 3.81. However, if an enterprise has been established for less than ten years, its technical performance level is relatively close, and both of them are relatively low. Thirdly, dyeing industry has the highest technological innovation performance with the weighted mean of 3.81, followed by wool spinning industry with the weighted mean of 3.74 while chemical fiber industry was with the weighted mean of 3.54, which are in the top three. Nonetheless, the lowest in the obtained composite mean is silk industry with the weighted mean of 2.02. Fourthly, the scale of enterprises is positively related to the technological performance of textile enterprises. The technological performance of enterprises with more than 1000 employees with the weighted mean of 3.78 is better than that of small enterprises with less than 1000 employees.

5. The difference of responses on the technological performance among Zhejiang Textile Industry

Table 6. Difference in Responses on the Technological Performance when grouped according to Business Profile

Technological Performance	X^2	p-value	Interpretation
Nature of Enterprise	21.737	.000	Significant
Specific Industry	101.040	.000	Significant
Years of Incorporation	120.735	.000	Significant
Enterprise Scale	119.300	.000	Significant

**Significant at p-value<0.01*

Table 6 presents the difference of responses on technological performance when grouped according to the business profile. Results showed significant difference in the technological performance when grouped according to business profile as denoted by the computed p-values, which were less than 0.01 alpha level. Further, findings revealed that state-owned/controlled textile enterprises have a significantly higher response in technological performance compared to private textile enterprises. Meanwhile, those textile industries with more than 20 years of incorporation have a significantly higher response in technological performance than those less than 20 years. Dyeing industry has a significantly higher response in technological performance than other industries. Furthermore, those textile industries with more than 1000 employees as enterprise-scale have significantly higher response in technological performance. It can be seen that enterprises with more than 1000 employees not only have good social capital, and better dynamic ability but also have higher technical performance. Similarly, the social capital, dynamic ability, and technical performance of the long-established enterprise are better than those with shorter founding years (Zhang Jiarui, 2018). Also, compared with private enterprises, state-owned/controlled enterprises have higher social capital, dynamic capability, and technological performance than private enterprises. Simply put, there is a significant difference in the technological performance when grouped according to the nature of the enterprise, specific industry, years of incorporation, and enterprise scale.

6. The Proposed Plan of Action to Improve the Technological Performance among Zhejiang Textile Industries

Table 7 shows the proposed plan of action to improve the social capital, dynamic capability, and technological performance of textile industries in Zhejiang, China. The following measures can be taken to optimize and improve the level of technical performance of Zhejiang textile industry. The number of patents filed each the highest proportion, with year compared with

the main competitors in the same industry obtained the lowest weighted mean.

Table 7. Proposed Plan of Action to Improve the Technological Performance of Textile Industries

Key Optimized Area	Program and Activities	Persons Involved
Technological performance		
➢ Number of patents filed each year compared with the main competitors in the same industry	1. Formulate the patent development strategy and establish & improve the patent management system. 2. Focus on training high-end professional technical talents, and establish patent technology research and development center. 3. Strengthen technical cooperation with universities and scientific research institutions, promote commercialize operation of patent projects. 4. Formulate the assessment and evaluation system of the patent target, increase the material and spiritual incentive to the technical researchers and operating personnel.	1. R&D department 2. Product department 3. Financial department 4. Administration department

The following program and activities can be taken: Firstly, the textile enterprises should formulate the patent development strategy, and establish and improve the patent management system. Secondly, the textile enterprises should focus on training middle-and high-end professional technical talents, and establish patent technology research and development center. Thirdly, the textile enterprises should strengthen technical cooperation with universities and scientific research institutions, to promote commercialize operation of patent projects. Fourthly, the textile enterprises should formulate the assessment and evaluation system of patent target, and increase the material and spiritual incentive to the technical researchers and operating personnel for patent technology research and production.

CONCLUSION

Results show that private enterprises account for the majority of the textile industry in Zhejiang, but the scale of private textile enterprises is generally smaller than that of state-owned or state-controlled enterprises. Clothing, dyeing, and chemical fiber ranked among the top three textile industry in the specific sub-industry. Textile enterprises with 11-20 years of incorporation years accounted for nearly 1/3 textile enterprises in a medium-sized range of 300 to 1000 employees. There is good enterprise technological performance in Zhejiang textile industries. The success rate of new products in the enterprise, the proportion of new product sales volume in gross sales volume and the number of new products compared with the main competitors in the same industry are in the top three key factors determining the technical performance of Zhejiang textile Industry. Furthermore, the managers also agreed that the number of patents filed each year compared with the main competitors in the same industry contributes to the enterprise technological innovation performance of Zhejiang textile industry, which obtained the least weighted mean score. Lastly, there is a significant difference in the technological performance when grouped according to the nature of the enterprise, specific industry, years of incorporation, and enterprise scale.

RECOMMENDATION

Zhejiang textile industry should increase the number of patent applications each year through a series of policies to improve the contribution to the technological performance of enterprises while maintaining the success rate of new products, the proportion of new product

sales to total sales and the number of new products with major competitors in the same industry. Also, while maintaining the advantage of dynamic capability in dyeing industry, Zhejiang textile industry should pay attention to the cultivation of enterprise social capital and dynamic capability of knitting industry and silk industry to improve the technical performance level of these weak textile industries. Furthermore, Zhejiang textile industry must identify, acquire, allocate, and utilize resources such as social capital through stable adjustment, rich refinement, and creation, so that the textile enterprises can use these resources. The enhancement of resource acquisition capability and resource integration capability will bring innovation capability to enterprises, to promote the further technological innovation activities of Zhejiang textile industry.

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