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The role of innovative management on firm performance: A study of Chinese manufacturing firms

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Abstract

Firm competes on capabilities. Capability governs firm's efficiency to produce desirable outcomes by using business practices as input. Capability can be classified into different categories. A previous research also proposes a time sequence of $n + 1$ value of a variable suffices to compute the value of n^{th} order rate of change. In the context of the manufacturing industry, firm capability consists of functional-based capability reflects the ability to perform business to achieve its operational excellence or customer intimacy, network-based capability possesses the theme of dynamic improvements to enhance the operation linkage with customers and suppliers, and innovative capability of capability allows manufacturing firms to develop novel strategies for business development. Innovative capability can be consider as a high order level capability. Objective of this study is to use an input-output approach to investigate firm capability of manufacturing firms in China and its association with firm performance. The findings of this study imply the significant role of innovative management in the manufacturing industry.

1. Introduction

In the past few decades the volume of export from China to other countries has been increased, leading to the growth of manufacturing industry in China. However, the significant role of 'world factory' is reducing due to the increase in production cost and the decrease in supply of cheap labor in China. To remain competitive, many Chinese manufacturing firms make strategic decision to devote substantial efforts to deploy resources to strengthen their capabilities. Since 1970s, research on strategic choice is conducted (Peng 2003[1]). The strategic choice perspective can be used as a theoretical tool to examine how firm is designed and structured

[1] Peng M.W. (2003) "Institutional transitions and strategic choices", *Academy of Management Review*, 28(2): 572-296

according to its operational contingencies (Child 1972[2]). According to Child (1997[3]), strategic choice can be defined as "the process whereby power-holder within a firm decides courses of strategic action". Stacy (1995[4]) defined strategic choice as "a transformation process in which firms adapt to environmental change by restructuring themselves".

Firm capability governs firm's efficiency in transforming inputs into outputs (Collis 1994). Change in operating environment can lead to a change in the choice of business strategy to develop firm capability (Kelly and Amburgey, 1991). Firm capability includes functional-based capability, network-based capability, and innovative capability. The study on innovation can be traced by to 1960s, e.g., Burns and Stalker (1961[5]) and Hage and Aiken (1967[6]). Zaltman et al. (1973[7]), Kanter (1983[8]), Tushman and Nelson (1990[9]), Guth and Ginsburg (1990[10]), Leonard-Barton (1995[11]) and others set the stage for 50-year history of the study of innovation. Innovation has been investigated by various methods in different contents. These studies are examined around two core elements: (1) innovation is useful and productive and (2) contexts of innovation are organization-level features (Darin and Schoonhoven 2001[12]). Innovative capability is essential for firms to develop effective business routines or practice for business management. Hence, the role of innovation on firm capability is an important area to explore in organization-level.

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Winter (2003[13]) proposes a time sequence of $n + 1$ value of a variable suffices to compute the value of n^{th} order rate of change. The zero order level capability reflects the ability to perform business to achieve its operational excellence or customer intimacy. The first level of capability possesses the theme of dynamic improvements to enhance the operation linkage with customers and suppliers. The high order level of capability allows manufacturing firms to develop novel strategies for business development. Innovative capability can be consider as a high order level capability. As different level of capability exists, it's important for firms to make strategic choice to deploy resources to develop their capability.

In this study, firm capability is defined as 'a collection of business practices or routines for producing significant outputs'. It's essential for manufacturing firms to develop their capabilities for performance gain. The capability of a firm can be determined by its efficiency of transforming firm inputs to outputs (Collis 1994[14]). This study aims to use an input-output approach to investigate the capability of manufacturers in China and its association with firm performance.

2. Conceptualization and Hypothesis Development

Firm capability is embedded in business routines. According to Ray et al. (2004[15]) capability represents "resources accumulated over time that cannot be acquired instantly". On the other hand, firms can only maintain their advantage of holding the capability because their competitors can imitate their resources to develop effective capability. To remain competitive, manufacturing firms are required to take a dynamic approach to better understand the required capability. According to Teece et al. (1997[16]), dynamic capability can be define as "a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapid changing environment". In the context of manufacturing industry, better capability enables firms to produce their products more efficiently to gain higher level of sales growth and profit.

Firm capability can be classified into zero level order, first level order and high level order. Zero level order is the functional-based capability to allow a firm to "perform business to achieve its operational excellence or customer intimacy". Functional-based capability can be defined as to "use competitive method that focused on market domains, technologies, operational routines and management orientations related to the design, production, and delivery of products and services". The first level order is the network-based capability for firms to possess the theme of

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[14] Collis D.J. (1994) "Research note: How valuable are organizational capability*?",* *Strategic Management Journal*, 15: 142-152

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[16] Teece D.J., Pisano G. and Shuen A. (1997) "Dynamic capabilities and strategic management", *Strategic Management Journal*, 18(7): 509-533

dynamic improvements to"enhance the operation linkage with customers and suppliers". Network-based capability can be defined as to "strategic behavior that focused on developing and maintaining relationship that may be useful" (Danis et al., 2010[17]). The high level order is the innovative capability to allow manufacturing firms to "develop novel strategies for business development". Innovation capability can be defined as "adoption of business practice that is perceived to be new to meet market needs" (Rogers 1995[18] & Yong et al., 2001[19]). According to Collis (1994[20]), firm capability consists of two elements: (1) it is embedded in business routines or business practices, and (2) it involves the transformation of inputs into outputs inside the black box of the firm. Firm capability can be considered as the efficiency level in transforming inputs into outputs. Inputs of manufacturing are their business practices. Typical desirable outputs include profitability and sales growth. Manufacturing firms use their business practices to produce desirable outputs. Different categories of business firm capability exist. Firm capability consists of zero order level capability, first order level capability, and high order level capability.

Hypothesis 1: *There are different categories of business practices in the manufacturing industry*

The level of capability of a firm is determined by its efficiency level of transforming their inputs to desirable outputs. Hence, the capability of manufacturers can be examined through the variables of input (i.e., the business of practices or routines) and the desirable performance outcomes. In the context of manufacturing operations, capability of firm can be classified into zero order level of functional-based capability, first order level of network-based capability and high order level innovative capability. Manufacturing firms use their inputs to achieve their performance outcomes in terms of sales growth and profitability. The efficiency level of each capability may be different. As the computation of capability involves a "time sequence of n + 1 value", capability evolves over time. Lower level capability can be develop in a shorter period of time while it takes a longer period of time to develop higher level capability. As it takes longer time to evolve, high order level firm capability is expected to be more efficient. From the perspective of "evolution of firm capability", development paths of capability follow recognizable stages, i.e., functioning, network building, and operating innovatively.

Hypothesis 2: *Higher level firm capability is more efficient*

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[17] Danis M.W., Chiaburu D.S., Lyles M.A. (2013) "The impact of managerial networking intensity and market-based strategies on firm growth during institutional upheaval", *Journal of International Business Studies*, 41: 287-307

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[20] Collis D.J. (1994) "Research note: How valuable are organizational capability?", *Strategic Management Journal*, 15: 142-152

Capability is critical for manufacturing firms to achieve desirable outcomes. The association between business operations and firm performance has long been affirmed (Ward et al. 1995[21]). Performance can be conceptualized as the extent to which a firm's goals are achieved (Ellinger et al. 2000[22]). A desirable goal of a firm can be its long-terms performance in terms of return on investment, business development and customer satisfaction. A firm's performance depends on how efficiency it manage their operations to satisfy customers (Anderson and Sullivan 1993[23]). Satisfied customers continually support the firm making higher return on a firm's investment. It's essential for business firm possess to develop its business routines to meet customer expectation (Salanova et al. 2005[24]). In general, firm possesses better capability uses business routines more efficiently to produce their desirable outcomes. Hence, firm with better business practices achieve higher long-term performance in terms of customer satisfaction, return on investment and business development.

Hypothesis 3: *Business practices are positively associated with long-term firm performance*

3. Methodology

In this study, exploratory research was conducted through literature review and hypotheses were then developed. The purpose of the exploratory research process is to progressively transform discovered problems into defined problems. Through literature, we identified a list of business practices of manufacturing firms as inputs of manufacturing to produce desirable outcomes. A pilot study was done by interviewing executives in three manufacturing firms to validate the items of business practice. According to Zikmund (2003[25]), a pilot study can be defined as "a small-scale exploratory research technique that does not apply rigorous standards". The results of the pilot test indicate that the following 20 items are business practices of manufacturing firms:

- Reduce inventory cost
- Reduce operating cost
- Enhance the effectiveness in recruitment and training
- Use business model enables to enhance customer satisfaction
- Use business model enables to enlarge market share

[21] Ward P.T., Duray R., Leong G.K. and Sun C.C. (1995) "Business environment, operations strategy, and performance: An empirical study of Singapore manufacturers, Journal of Operations Management, 13:99-115

[22] Ellinger A., Daugherty P. and Keller S. (2000) "The relationship between marketing/logistics interdepartmental integration and performance in U.S. manufacturing firms: An empirical study", Journal of Business Logistics, 21(1): 1-2

[23] Anderson E.W. and Sullivan M.W. (1993) "The antecedents and consequences of customer satisfaction for firms', *Marketing Science*, 12(2): 125-143

[24] Salanova M., Agut S. and Peiro J.M. (2005) "Linking organization resources and work engagement to employee performance and customer loyalty: The mediation of service climate", *Journal of Applied Psychology*, 90(6): 1217-1227

[25] Zikmund W.G. (2003) *Business Research Methods*, Thomson

- Establish good corporate cultural
- Use business model enables to scalable operations
- Information are transparent (i.e. work flows and use of information can be verified)
- Establish business relationship with customers
- Utilize private connections with customers
- Establish business relationship with suppliers
- Utilize private connections with suppliers
- Utilize private connections with competitors
- Utilize private connections with government bodies
- Business strategies are developed from the perspective of customers
- Use innovative ways to enhance knowledge
- Product development and diversification
- Develop niche area products
- Develop international business
- Enhance corporate image

The next step was to develop questionnaire and request respondents to report the level of their adoption on the 20 items of business practices in a 5-point Likert scale rating. Respondents were also requested to judge their performance outcomes against the industry average on a 5-point Likert scale rating on: (1) two items (i.e., profitability and sales growth) as the outputs of the business practices and (2) three items (i.e., return on investment, business development, and customer satisfaction) of long-term performance indicators. To collect data, our researchers have visited 44 manufacturing firms selected from the Chinese Manufacturing Directory.

To empirically validate the three hypotheses, we performed the following steps: (1) conducted factor analysis to categorize the business practices for further examination, (2) conducted data envelopment analysis to determine efficiency of manufacturing firms in transforming inputs into output, and (3) conducted correlation analysis to examine the relationship between firm capability and firm performance.

4. Hypotheses Testing and results

4.1 Testing of Hypothesis 1

To examine the categories of business practices in the manufacturing industry, we conducted factor analysis to classify the business practices of manufacturing firms. A maximum likelihood method with a VARIMAX rotation was employed to categorize the 20 items of business practices adopted by manufacturing firms in China. The first guideline to interpret the data is related to ‘practical significance’ by making a preliminary examination of the factor matrix in terms of factor loadings. Factor loading is the correlation between the original items and the factors. The results of factor analysis are shown in Table 1. Goodness-of-fit (GOF) indicates how well the specific model reproduces the covariance matrix among the indicator

items. The results showed that Chi-square (x^2) was 123.624 and the number of degrees of freedom (*df*) was 85. A rule of thumb to assess the fit of the model is the ratio of the x^2 to the *df* should be less than 2.0 (while some researcher accepts the value of 3.0 as an acceptable level). In the factor model, the value of x^2/df is 1.454 indicating that it is a good-fitting model.

Table 1: Factor matrix

	Factor					
Item	C01	-	C03	C02	-	-
1	-.263	**.956**	-.003	.124	-.005	.033
2	.136	-.150	-.114	-.055	.172	**.761**
3	.214	.009	.107	.048	**.816**	.427
4	**.854**	-.115	.163	-.056	.369	-.135
5	.220	.000	**.609**	.038	.222	-.258
6	.546	-.063	.353	-.133	**.653**	-.050
7	.382	.040	.218	.345	.024	.302
8	**.707**	-.080	.208	-.530	.059	.087
9	**.733**	-.127	.266	-.167	.044	.327
10	.017	.271	.165	**.441**	.189	-.011
11	**.828**	-.165	-.114	.151	.050	.107
12	-.050	.293	-.013	**.444**	-.174	-.205
13	.007	.336	.061	**.712**	.211	.017
14	-.010	-.109	.096	**.455**	-.131	.013
15	**.504**	-.157	.350	-.206	.224	.263
16	.093	.192	**.547**	.174	.015	-.009
17	.537	-.218	**.709**	.243	.101	.304
18	-.167	**.774**	.144	.221	-.070	-.305
19	**.560**	-.379	.282	-.015	-.212	.014
20	**.737**	-.026	.261	.172	.305	.057

(Goodness-of-fit statistics: x^2 = 123.624, *df* = 85, x^2/df = 1.454)

Using practical significance as a criterion, factor loading in the range of 0.30 to 0.40 are considered to meet the minimum level to interpret the construct and factor loading of 0.50 or greater are considered practically significant. The interpretation started with the first item on the first factor move horizontally from left to right, looking for the highest loading for that item on any factor. The highest loading (with a value of 4.0 or above) was highlighted when it was identified. This procedure was continued for each item when all items have been reviewed. In the factor model, 6 factors are shown in the factor matrix. The numbers of item have a significant loading on the first, third and fourth columns are 7, 3 and 4 respectively. As only one or two item(s) are given to the other three factors, these three were removed.

The results suggest that there are three categories of business practice in the manufacturing industry in China. The three categorizes of business practice are shown in Table 2. The first category to use to produce firm outputs, i.e.CO1, is zero level business practice which allows a firm to "perform business to achieve its operational excellence or customer intimacy". The second category of business practice to produce firm outputs, i.e. C02, is the first level business practice which allows a firm "to enhance the operation linkage with customers and suppliers". The third level of business practice to produce firm outputs, i.e. C03, is high level business practice which allows firms to "develop novel strategies for business development". Our results suggest that business practices adopted by manufacturing firms can be classified into three categories. Hence, our hypothesis 1 was supported.

Table 2: Categories of firm capability

Business practices	**Level of capability**	**Number of items**	**Cronhach Alpha**
Use business model enables to enhance customer satisfaction	C01: Functional-based capability	7	0.901
Information are transparent (i.e. work flows and use of information can be verified)			
Establish business relationship with customers			
Establish business relationship with suppliers			
Business strategies are developed from the perspective of customers			
Develop international business			
Enhance corporate image (such as social responsibilities and ethic standard)			
Utilize private connections with customers	C02: Network-based capability	4	0.762
Utilize private connections with suppliers			
Utilize private connections with competitors			
Utilize private connections with government bodies			
Use business model enables to enlarge market share	C03: Innovative capability	3	0.724
Use innovative ways to enhance knowledge			
Product development and diversification			

4.2 Testing of Hypothesis 2

The next step was to use an input-output approach to examine firm capability of manufacturing firm. Data envelopment analysis (DEA) was selected as the tool to calculate DEA score to determine firm efficiency in transforming inputs into outputs. According to Cooper et al (2007[26]), DEA score is defined as "the ratio of outputs of production of an operating system". DEA assigns an efficiency score between 0 and 1. The DEA score of 1.00 represents the most efficient firm. Relatively inefficient firms receive lower scores depending on how they transform their inputs into outputs.

To determine the input of our DEA models, we calculated the mean values of the 7 items of C01, 4 items of C02 and 3 items of C03. The mean values of C01, C02 and C03 are 4.3945, 4.1742, and 3.712 respectively. The results indicate that functional-based business practices are the most popular in the manufacturing industry. On the other hand, the score of innovative business practice is relatively low (i.e., 3.71) indicating that the use of innovate is not widespread in the manufacturing industry. On the other hand, the outputs of the DEA models were the desirable outcomes of firm profitability and sales growth. The input and output of the DEA models are presented in Table 3.

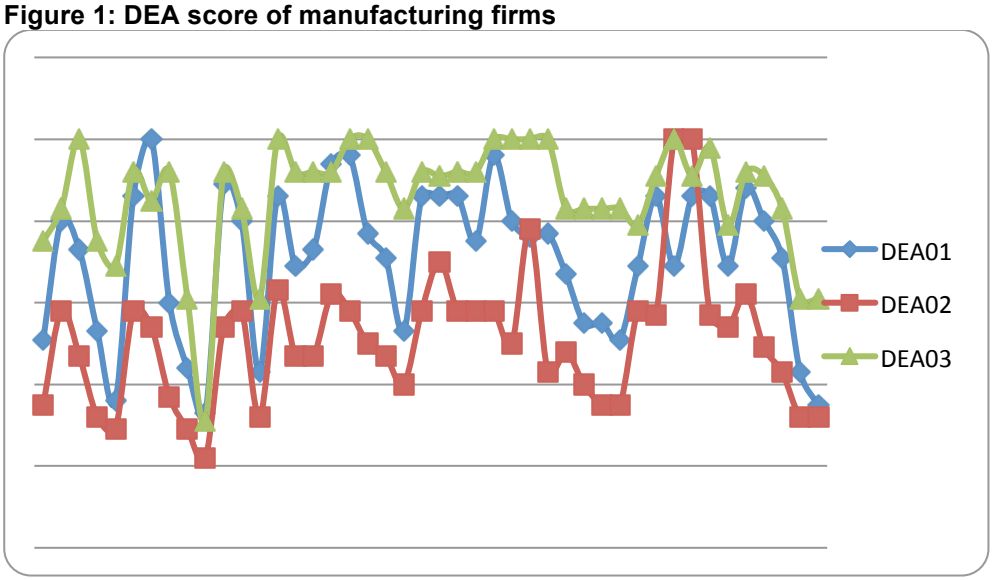
Table 3: Input and output of DEA models

Model	Input	Output
DEA01	C01	(1) Profitability and (2) Sales growth
DEA02	C02	(1) Profitability and (2) Sales growth
DEA03	C03	(1) Profitability and (2) Sales growth

The DEA score of manufacturing firms for the three DEA models are shown in Figure 1. DEA01 is the zero level order functional-based capability, DEA02 is the first level order network-based capability and DEA03 is the high level order innovative capability. The mean values of DEA01, DEA02 and DEA 03 are 0.7080, 0.5079 and 0.8567 respectively. The results suggest that the efficiency level of DEA03 is the highest. The findings indicate that high level firm capability is the most efficient. However, the efficiency level of DEA02 is lower than that of DEA01. Therefore, our hypothesis 2 is partially supported.

[26] Copper W.W., Seiford L.M. and Tone K. (2007) *Data Envelopment Analysis*, Springer

Figure 1: DEA score of manufacturing firms



4.3 Testing of Hypothesis 3

To examine the association between business practices and firm performance, we collected data on respondents' perception of their firm performance (i.e., FP01, FP02 and FP03) against the industry average. The results are shown in Table 4. FP01 represents return on investment, FP02 represents business development and FP03 represents customer satisfaction. Correlation analysis was used as a tool to examine the relationship between firm performance and business practices adopted by manufacturing firms. The results suggest that C02 is positively associated with return on investment but is not associated with business development and customer satisfaction. On the other hand, C01 and C03 are positively associated with firm performance. Hence, our hypothesis is partially supported.

Table 4: Correlation matrix

		C01	C02	C03	FP01	FP02	FP03
C01	Pearson Correlation	1					
	Sig. (2-tailed)						
C02	Pearson Correlation	.440**	1				
	Sig. (2-tailed)	.003					
C03	Pearson Correlation	.394**	.184	1			
	Sig. (2-tailed)	.008	.231				
FP01	Pearson Correlation	.409**	.310*	.847**	1		
	Sig. (2-tailed)	.006	.043	.000			
FP02	Pearson Correlation	.415**	.194	.774**	.576**	1	
	Sig. (2-tailed)	.005	.207	.000	.000		
FP03	Pearson Correlation	.366*	.049	.742**	.442**	.422**	1
	Sig. (2-tailed)	.015	.752	.000	.003	.004	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5. Discussions and conclusions

Firm capability governs the efficiency in producing desirable outcomes by using business practices. In this study, we classified the business practice of manufacturing firms in China into three main categories, i.e., functional-based, network-based, and innovative. Functional-based capability can be considered as the 1st level capability for manufacturing firms in China to perform business to achieve its operational excellence or customer intimacy. Network-based capability can be considered as the 2nd level of capability for manufacturing firms in China to enhance the operation linkage with other organizations for dynamic improvement. Innovation capability can be considered as the 3rd level of capability for manufacturing firms in China to develop novel strategies for business development. When examining the average score of business practices, the mean value of C01, C02 and C03 are 4.3942, 4.1742 and 3.7121 respectively. According to the findings, the adoption of C01 is the highest and adoption C03 is the lowest in manufacturing operations. The results indicate that C03 is not in a mature stage and the adoption rate is relatively low.

In this study, a DEA "input to output" approach is used to examine the efficiency in transforming inputs into outputs. According to the result, the mean values of DEA01, DEA02, and DEA03 are 0.7080, 0.5079, and 0.8567 respectively. The findings indicate that DEA03 is the most efficiency capability in the manufacturing industry. Firm capability governs the level of efficiency in transforming inputs into outputs. Development paths of capability follow recognizable stages from low level capability to high level capability. Innovative capability is a high level capability consists of the inputs of use business model to enlarge market share, use innovative way to enhance knowledge, and apply product development and diversification in production operations. On one hand, the adoption of innovative business practices is low with the mean value of 3.7121 while the mean values for functional-based business practices and network based business practice is 4.3942 and 4.1742 respectively. On the other hand, the innovative capability is the most efficiency with the average DEA score of 0.8567 while the average DEA scores for functional-based business practices and network based business practice is 0.7080 and 0.5079 respectively. The results suggest that innovative management is an efficiency approach for manufacturing firms to achieve the desirable outcomes of profitability and sales growth. However, the adoption of innovative management in the manufacturing industry is relatively low. The findings imply that manufacturing firms in China needs to put more effort to develop this high level capability.

To cope with contemporary operating environment, the use of innovative approach in business operations is essential in contemporary manufacturing management. According to the results of correlation analysis, both C01 and C03 are positively associated with all three long-term performance indicators (i.e., return on business, business development and customer satisfaction). On the other hand, C02 is positively association with return on business but it has no relationship with business development and customer satisfaction. When comparing the correlation coefficients, the relationship between CO3 and the three long-term performance

indicators (i.e., 0.847, 0.774 and 0.742 respectively) is stronger than the relationship between C02 and the three long-term performance indicators (i.e., 0.409, 0.415 and 0.336 respectively). Hence, innovative management is an effective business practice to gain long-term firm performance.

Our findings indicate the importance innovative management in the manufacturing industry. It's essential for manufacturing firms to further explore the adoption of innovative management. However, there are three limitations of our study. First, the data was collected from manufacturing firms in China. Future study may conduct to collect data in other countries to generalize the results. Second, this study did not content longitudinal data. Capability may evolve over time. It's desirable to conduct future study to track the development of firm capability in the manufacturing industry. Third, the performance outcomes of this study focused on respondents' perception. Future study may include objective data, e.g. operating costs and earnings before interest and tax (EBIT) to examine the relationship between inputs and outputs of firms.

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