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Impact of Manufacturing Dynamic Capabilities on Enterprise Performance-the Nonlinear Moderating Effect of Environmental Dynamism

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Abstract: The aim for this study is to explore the change of relationship between manufacturing dynamic capabilities and enterprise performance in different level of dynamism of the firm's external environment. Data from International Manufacturing Strategy Survey in 2009 was used to examine this relationship by hierarchical regression analysis. The results show that, dynamic capabilities can promote enterprise performance. A nonlinear, inverse U-shaped moderation is revealed, implying that the relationship between dynamic capabilities and enterprise performance is strongest under intermediate levels of dynamism but comparatively weaker when dynamism is low or high. These results improve the contingent relationship of dynamic capabilities and enterprise performance, providing theoretical and practical guidance to manufacturing enterprises for dynamic capabilities building.

Key words: Manufacturing, dynamic capabilities, enterprise performance, environmental dynamism

INTRODUCTION

Currently, organizations' survival environment has changed dramatically due to the globalization and technological change. This forced enterprises to continuously adapt, update, resets the internal resources and capabilities to cope with the increasingly complex and unpredictable market. Accordingly, the concept of dynamic capabilities has been proposed by Teece *et al.* (1997) as "the key role of strategic management in appropriately adapting, integrating and reconfiguring internal and external organizational skills, resources and functional competences to match the requirements of a changing environment (Teece *et al.*, 1997)."

However, dynamic capabilities perspective has been criticized for its ill-defined boundary conditions and its validity (Wang and Ahmed, 2007). Existing research about dynamic capabilities has been largely ignored exploring the boundaries of the environment, only focusing the highly dynamic environment. Volatile environment, nevertheless, is not the necessary conditions of dynamic capabilities which can exist in stable environments (Eisenhardt and Martin, 2000). In addition, the dynamic capabilities often been labeled as a successful organizational strategy. The value of dynamic capabilities is still unclear and conflicting (Helfat and Peteraf, 2009). Shamsie *et al.* (2009) believe that dynamic capabilities will not always improve performance. Rather than looking for

universal formula to enhance performance, it's better to define that under which conditions the value of dynamic capabilities will be maximization (Shamsie *et al.*, 2009).

LITERATURE REVIEW AND HYPOTHESES

Dynamic capabilities: Based on resource-based view, dynamic capabilities absorb and integrate the viewpoint that resources and capabilities continue to evolve in the environment. Teece *et al.* (1997) first proposed the dynamic capability framework. In this model, dynamic capabilities emphasize the transforming of environmental characteristics and how the firms manage to adapt, integrate and reconfigure the internal and external organizational resources to compete with the dynamic environmental conditions (Teece, 2007). Eisenhardt and Martin expand on Teece and Pisano's earlier view that dynamic capabilities are not vague but rather exhibit commonalities with "greater equifinality, homogeneity and substitutability across firms" (Eisenhardt and Martin, 2000). Wang and Ahmed (2007) draw from the existing empirical findings and identify three main elements of dynamic capabilities: adaptive capability, absorptive capability and innovative capability (Wang and Ahmed, 2007). Dynamic capabilities are organizational routines which must be obtained by learning with highly stylized, repeatable or quasi-repeatable. According to the ontological dimension of dynamic

capabilities and combining previous view, we believe that dynamic capabilities can be divided into three interlinked dimensions: Integrated capabilities, absorptive capacity and innovative capacity. Integrated capabilities emphasize the development potential through adjusting and reconfiguring internal and external resources to reach the state of coordination. Absorptive capacity is a firm's capability to recognize the value of new external knowledge, incorporate it and apply it to achieve its organization objectives. Innovative capability involves the firm's ability to develop, generate and implement new ideas, processes, products, or services through strategic innovative behaviors and processes which relate to a learning orientation.

Dynamic capabilities and enterprise performance:

Dynamic capabilities can impact enterprise performance in a variety of ways: First, the dynamic capabilities create market value by matching the resource base in changing environment (Eisenhardt and Martin, 2000); Second, the dynamic capabilities support the mechanism of resource mining and capacities building (Makadok, 2001); Third, the dynamic capabilities enhance performance by promoting timeliness, speed and efficiency of organizational response to the market environment (Chmielewski and Paladino, 2007; Hitt *et al.*, 2001). Although the effects of dynamic capability of enterprise performance got wide attention in the field of academic, there are still differences (Cepeda and Vera, 2007). Teece analyzed the source of wealth through developing dynamic capabilities for enterprises to obtain and maintain the sustainable competitive (Teece *et al.*, 1997). The subsequent scholars continued the point of view and they think dynamic capabilities created resources that are difficult to replicate which bring high quality performance for enterprise. Eisenhardt and Martin think dynamic capability is heterogeneous on the details but there are also "common" which can make the enterprise obtain the same performance, therefore dynamic capabilities are inadequate for competitive advantage (Eisenhardt and Martin, 2000). In addition to the dynamic capabilities, there are other solution like emergency response which relatively cheaper (Winter, 2003).

This study argues that as the source of the change for organizational resources, operational practice and the functional capacity, dynamic capabilities play the irreplaceable and important role. First, dynamic capabilities create a new resource structure and implement performance improvement through the adjustment of external environment, with creation, expansion, resource

integration, reconstruction and renewal strategy. Second, dynamic capabilities can achieve performance improvement through continuous absorption and transformation of external resources. Finally, dynamic capabilities establish effective link between inherent innovation and new products to realize performance improvement. The paths of dynamic capabilities above explain the dynamic capabilities have positive effect to the enterprise performance:

H1: Dynamic capabilities will have a positive relationship on enterprise performance

H:1a: Integrated coordination capability will has a positive relationship on enterprise performance

H1b: Absorptive capacity will has a positive relationship on enterprise performance

H1c: Innovation capability will has a positive relationship on enterprise performance

Influence of environmental dynamism on relationship between dynamic capabilities and enterprise performance:

Supporters of contingency theory believe the value of dynamic capabilities not only rely on the existing organizational routines but also the environment (Sirmon and Hitt, 2009). Stable environment has little change and predictable. Highly dynamic environment can change quickly and discontinuous. Moderate fluctuation environment usually has regular changes, to some extent ,which can predict and with linear path. The research of environmental dynamism impact on the relationship between dynamic capabilities and performance is divided into two groups. One group is that dynamic capabilities in a volatile environment play better while in a stable environment cannot reflect their value. This is because building and using dynamic capabilities are costly. The enterprises with no urgent demand to change using dynamic capabilities may also break the ongoing learning behavior within the organization or weaken the ability of stable and reliable which can make the enterprise performance loss (Zollo and Winter, 2002). When enterprises face a highly dynamic environment, the application of dynamic capabilities can perceive the risk, adjust the allocation of resources in a relatively short time to adapt to the change in environment, achieving a high level performance (Teece, 2007). Another group is that, even in a highly dynamic environment, dynamic capabilities is not an effective way to transform (Eisenhardt and Martin, 2000). Routine-based, history dependent organizational change is typically very effective for adapting locally and incrementally based on past experiences but research on experiential learning argues that this type of organizational change may prove

Table 1: Reliability, validity and correlation matrix

Variables	Cronbach's α	Mean	SD	1	2	3	4	6	7
1Integrated capability	0.636	3.19	0.904	0.778					
2Absorptive capability	0.716	2.88	0.707	0.206**	0.767				
3Innovative capability	0.775	3.25	0.919	0.193**	0.215**	0.834			
4Environmental dynamism	0.619	3.72	0.882	0.085*	0.107*	0.278**	0.814		
5Enterprise Performance	0.883	3.21	0.771	0.209**	0.109*	0.116**	0.026	0.846	
6Industries		3.10	2.230	0.084*	0.101*	0.116**	0.015	0.024	
7Firm size		2171.70	10404.040	0.084*	0.023	0.044	0.056	0.033	0.032

N = 506, **p<0.001, *p<0.01, No. on the diagonal show square roots of AVE

problematic when previously unknown forces continuously alter the basis of competitive success. As routine-based capabilities, dynamic capabilities to a large extent depends on the results of previous organization activities (Schreyogg and Kliesch-Eberl, 2007). When the environment has discontinuous changes, large span repositioning need new solutions to improve competitive advantage, a partial integration of existing resources coordination is not adequate (Levinthal, 2000).

Based on the above analysis, this study argues that dynamic capabilities have different effects in different levels of environmental dynamism. When environmental dynamism is low, the effectiveness of dynamic capabilities is restricted because of cost; When environmental dynamism is high, although the organization faces a lot of opportunities, organizational inertia will be enhanced and resistance to the implementation of the new scheme; When the environment is in moderate dynamic, dynamic capabilities have the strongest positive effect on performance. Moderate fluctuation environment creates enough space for the application of the dynamic capabilities and also make the dynamic capabilities have time to get suitable solutions from organizational memory:

H2: The relationship between dynamic capabilities and enterprise performance is strongest under intermediate levels of environmental dynamism but comparatively weaker when dynamism is low or high

DATA ANALYSIS AND THE EMPIRICAL RESULTS

Data source: The data comes from the fifth edition of the International Manufacturing Strategy Survey (IMSS-V) in 2009. This project which is launched by professor Voss and professor Lindberg in London business school, for the research of world manufacturing enterprise strategy, practice and performance. This investigation is mainly in the form of questionnaire with Likert five-point scale. There are 506 samples of eight industries in 20 countries after removing the missing values.

Variables measurement: This study measures dynamic capabilities from the integrated capability, absorptive capability and innovative capability three dimensions. For integrated capability, this study references the study of Teece and it measures from the view of the manufacturing flexibility and resource adjustment (Teece, 2007). For absorptive capability, based on (Wang and Ahmed, 2007) it was measured by manufacturing enterprises obtaining the capability of knowledge resources and material resources from the outside world (Wang and Ahmed, 2007); the measurement of innovative capability which is a reference for (Noble, 1997) measured from a view of quantity, scope, novelty of manufacturing enterprise production of new products (Noble, 1997). Environmental dynamism is measured through competition intensity and concentration. Enterprise performance is measured by Return on Sales (ROS) and Return on Investment (ROI). Industry type and enterprise scale are control variables. The industry type is measured through two ISIC code. Enterprise scale is measured by the number of employees.

Reliability and validity: IMSS-V questionnaire is designed by the experts in the field of manufacturing, through a lot of enterprise interview, small sample preliminary research and international research which ensure the validity of the questionnaire item. This study uses SPSS 17.0 to test reliability. Cronbach's Alpha coefficients of all variables are greater than 0.6, showing good reliability. Confirmatory factor analysis show fitting index as followed: Chi square/df = 1.92, RMSEA = 0.069, CFI = 0.93, GFI = 0.85, AGFI = 0.901. Model fitting results are good and at the same time the factor loading coefficient of each variable show good convergent validity. The square root of Average Extraction Variance (AVE) of each variable is greater than the correlation coefficient of this variable with other variables which has better discriminant validity. Reliability, validity of test results and the correlation matrix are shown in Table 1.

Table 2: Regression results

Variables	Model			
	1	2	3	4
Industries	0.029	0.028	0.026	0.033
Firm size	0.045	0.044	0.046	0.045
Integrated capability		0.348**	0.326**	0.364**
Absorptive capability		0.206**	0.217**	0.198**
Innovative capability		0.304**	0.341**	0.392**
Environmental dynamism		0.023	0.026	0.021
Environmental dynamism squared		0.013	0.014	0.012
Integrated capability×environmental dynamism			0.019	0.014
Absorptive capability×environmental dynamism			0.023	0.026
Innovative capability×environmental dynamism			0.011	0.035
Integrated capability×environmental dynamism squared				-0.159*
Absorptive capability×environmental dynamism squared				-0.172*
Innovative capability×environmental dynamism squared				-0.179*
Adjusted R ²	0.018	0.025	0.026	0.033
ΔR ²	0.023**	0.062**	0.002	0.019*

N = 506, **p<0.001, *p<0.01, standardized coefficients are reported

Empirical results: We analysis the nonlinear moderation of environmental dynamism by hierarchical regression model. If the moderator variable squared significantly moderate the relationship between independent variable and dependent variable, then the moderator variable has nonlinear effect. Regression analysis results are shown in Table 2.

In model 2, dynamic capabilities have a significantly positive relationship on enterprise performance (p<0.001), providing strong evidence for the hypothesis 1. In model 4, product term coefficients of environmental dynamism squared with dynamic capabilities are negative and significant (p<0.05). A nonlinear, inverse U-shaped moderation is revealed, implying that the relationship between dynamic capabilities and enterprise performance is strongest under intermediate levels of dynamism but comparatively weaker when dynamism is low or high. This conclusion verifies the hypothesis 2.

DISCUSSION AND CONCLUSION

In the past 20 years, the relationship between dynamic capabilities and enterprise performance is always an important research in the field of strategic management. Unfortunately, due to the dynamic capabilities rooted in resource-based view are difficult to measure, it has rarely been systematically studied dynamic capabilities whether, when and how to influence enterprise performance.

This study strives for progress in these aspects. The results show that, dynamic capabilities can promote enterprise performance. A nonlinear, inverse

U-shaped moderation is revealed, implying that the relationship between dynamic capabilities and enterprise performance is strongest under intermediate levels of dynamism but comparatively weaker when dynamism is low or high. As shown in Fig. 1.

These results have been clear about two premises of the valuable dynamic capabilities: necessity and feasibility. In a stable environment, return of dynamic capabilities may be small. When the task remains the same, coordination procedure can be effective, such resources integration and obtaination was not so important. In addition, the enterprise need not often redesign or adjust the product when the market strategy stable. In this case, the dynamic capabilities may do more harm than good. This result is consistent with the conclusion of Winter and others. In the drastic environment, a fundamental change for the organization is very difficult. Strong organizational routines will stop resource transformation. "Simply" innovation or resource integration is not enough. New technology may require organizational learning new rules, procedures, practices and organizational routines, abandoning the old tradition. However, reprogramming resource is extremely difficult, especially when the new change does not adapt the original ideas, norms, knowledge and culture (Levitt and March, 1988). Dynamic capabilities as a kind of organizational routines, are source of transformation and stability which are consistent with organizational routines duality viewpoint. Based on the necessity of implement of dynamic capabilities, the adjustment time of the changes is needed. Only then can organizational inertia and delay be solved, also the performance can be significantly increased.

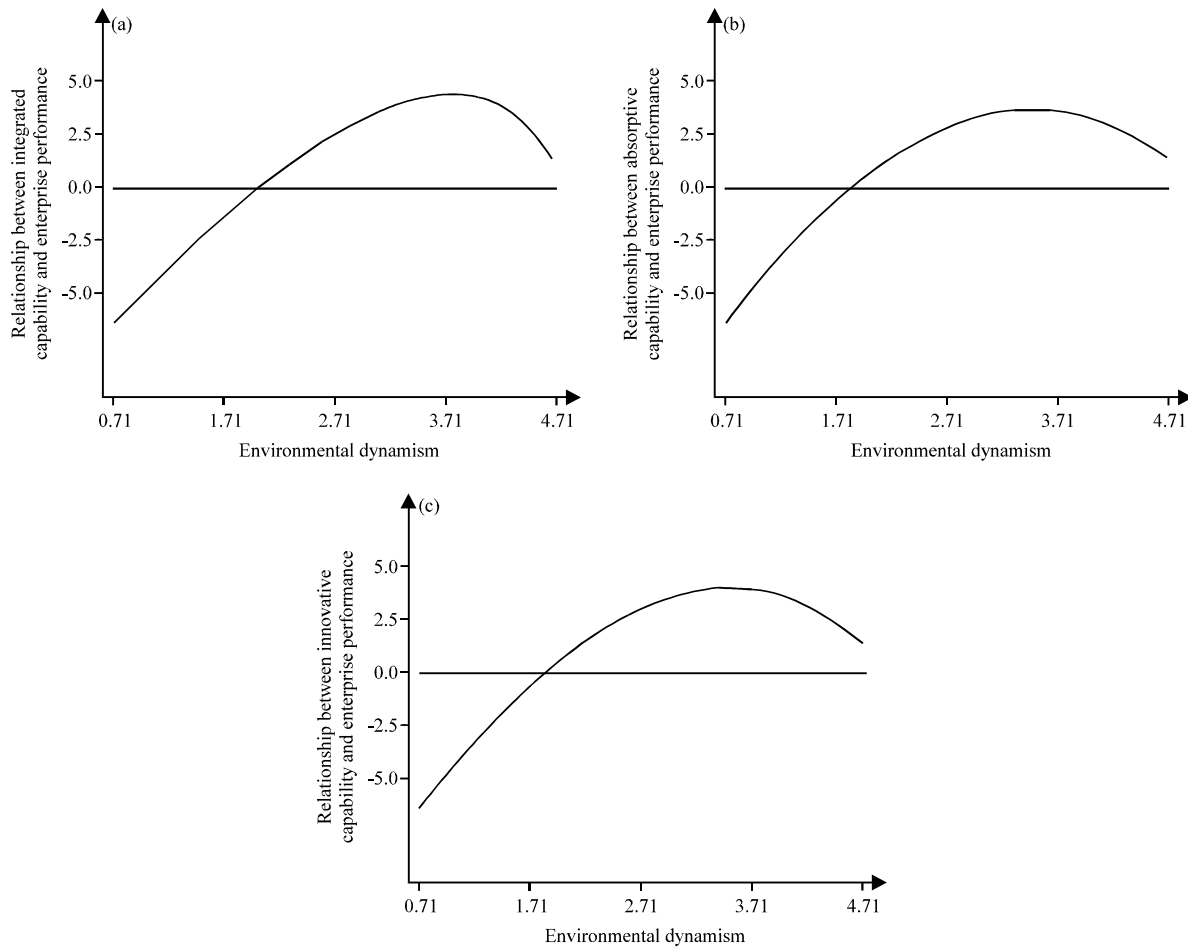


Fig. 1(a-c): Relationship between dynamic capabilities, (a) Integrated, (b) Absorptive and (c) Innovative enterprise capability and performance as a function of environmental dynamism

The data used in study belong to cross-section data, we failed to study dynamic capabilities' impact on enterprise performance in a temporal dynamic way. These limitations need discussion in future research.

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REFERENCES

Cepeda, G. and D. Vera, 2007. Dynamic capabilities and operational capabilities: A knowledge management perspective. *J. Bus. Res.*, 60: 426-437.

Chmielewski, D.A. and A. Paladino, 2007. Driving a resource orientation: Reviewing the role of resource and capability characteristics. *Manage. Decis.*, 45: 462-483.

Eisenhardt, K.M. and J.A. Martin, 2000. Dynamic capabilities: What are they? *Strategic Manage. J.*, 21: 1105-1121.

Helfat, C.E. and M.A. Peteraf, 2009. Understanding dynamic capabilities: Progress along a developmental path. *Strategic Organiz.*, 7: 91-102.

Hitt, M.A., R.D. Ireland, S.M. Camp and D.L. Sexton, 2001. Strategic entrepreneurship: Entrepreneurial strategies for wealth creation. *Strategic Manage. J.*, 22: 479-491.

Levinthal, D., 2000. Organizational Capabilities in Complex Worlds. In: *The Nature and Dynamics of Organizational Capabilities*, Dosi, G., R.R. Nelson and S. Winter (Eds.). Oxford University Press, UK., ISBN: 9780191530227, pp: 363-379.

- Levitt, B. and J.G. March, 1988. Organizational learning. *Ann. Rev. Sociol.*, 14: 319-340.
- Makadok, R., 2001. Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Manage. J.*, 22: 387-401.
- Noble, M.A., 1997. Manufacturing competitive priorities and productivity: An empirical study. *Int. J. Oper. Prod. Manage.*, 17: 85-99.
- Schreyogg, G. and M. Kliesch-Eberl, 2007. How dynamic can organizational capabilities be? Towards a dual-process model of capability dynamization. *Strategic Manage. J.*, 28: 913-933.
- Shamsie, J., X. Martin and D. Miller, 2009. In with the old, in with the new: Capabilities, strategies and performance among the Hollywood studios. *Strategic Manage. J.*, 30: 1440-1452.
- Sirmon, D.G. and M.A. Hitt, 2009. Contingencies within dynamic managerial capabilities: Interdependent effects of resource investment and deployment on firm performance. *Strategic Manage. J.*, 30: 1375-1394.
- Teece, D.J., G. Pisano and A. Shuen, 1997. Dynamic capabilities and strategic management. *Strategic Manage. J.*, 18: 509-533.
- Teece, D.J., 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Manage. J.*, 28: 1319-1350.
- Wang, C.L. and P.K. Ahmed, 2007. Dynamic capabilities: A review and research agenda. *Int. J. Manage. Rev.*, 9: 31-51.
- Winter, S.G., 2003. Understanding dynamic capabilities. *Strategic Manage. J.*, 24: 991-995.
- Zollo, M. and S.G. Winter, 2002. Deliberate learning and the evolution of dynamic capabilities. *Org. Sci.*, 13: 339-351.