Chapter 88
The Study of the Impact of Knowledge Integration on New Product Development Performance

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Abstract The purpose of this study is to explore how external integrative capability (technical integrative capability and customer integrative capability) and internal integrative capability (across-function integrative capability and board-problem solving integrative capability) influence the new product development performance. We find that external and internal integrative capabilities have significant difference on new product development performance. The results demonstrate that higher levels of external integrative capability and internal integrative capability enhance new product development performance.

Keywords Knowledge integration • External knowledge integration • Internal knowledge integration • New product development performance

Introduction

Winners in the global marketplace have been firms that can demonstrate timely responsiveness and rapid and flexible product innovation, coupled with the management capability to effectively coordinate and redeploy internal and external competences (Teece et al. 1997). That is, to integrate internal and external knowledge is very important to gain the dynamic capability.

However, in the field of knowledge integration, some scholars suggested the mechanism of knowledge integration (Grant 1996). But others suggested that knowledge integration consists of the two dimensions: external knowledge integration and internal knowledge integration, and each of these different dimensions of

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knowledge integration should impact an organization's dynamic performance (Iansiti and Clark 1994; Petroni 1996).

This paper empirically shows how knowledge integration influences new product development performance. We have focused on two dimensions of knowledge integration, and discerned their influence on new product development performance.

Research Hypotheses

External Knowledge Integration

It is useful to subdivide the capacity for external knowledge integration into two sub-dimensions, customer integration and technology integration. Besides, external (customer and technology) integration capabilities impact the conceptualization stage of each project and therefore are critical drivers of the renewal of the firm's competence base (Iansiti and Clark 1994).

Also, a description of the organizational dimensions of integration (both internal and external) is provided, which represents the basic foundation for the renewal of the organization's dynamic capabilities (Petroni 1996). External integrative capability comprises two elements: internal investments that develop absorptive capacity and an external communication infrastructure to facilitate the transmission of external knowledge. In combination, these elements enable the firm successfully to identify and integrate knowledge outside its boundaries (Tripsas 1997). Our hypothesis was the following:

H1: High external integrative capability group will be better than low external integrative capability group in the new product development performance.

Furthermore, the review of previous studies revealed that the technical integrative capability could be linked with performance. Iansiti and Clark defined that technical integrative capability is the capacity to link the evolving base of technical knowledge (both inside and outside the firm) to the existing base of capability within the organization (Iansiti and Clark 1994). And, accumulated prior knowledge increases both the ability to put new knowledge into memory, and enhance the absorptive capability (Cohen and Levinthal 1990). That is, accumulated technical knowledge will not only influence absorptive capability and technical integrative capability but improve new product performance. Our hypothesis was the following:

H1-1: High technical integrative capability group will be better than low technical integrative capability group in the new product development performance.

Customer integrative capability will also affect performance on new product. Iansiti and Clark defined that is the capacity to link information and knowledge about future customers and their use of the product to the development process and the details of engineering (Iansiti and Clark 1994). And, capability for customer integration is rooted in the routines and mechanisms that allow the organization to forecast customer requirements (Fujimoto et al. 1991). It involves mechanisms that enable organizational members to interpret current market information and to construct visions of the future market. Moreover, that vision of the market must be translated into precise objectives and implemented in the existing organization. The competence base of the organization must be renewed to enable it to drive the creation of a product that matches future customer expectations (Iansiti and Clark 1994). Our hypothesis was the following:

H1-2: High customer integrative capability group will be better than low customer integrative capability group in the new product development performance.

Internal Knowledge Integration

Iansiti and Clark proved each of these different dimensions of knowledge integration should impact an organization's dynamic performance and defined that internal integrative capability is 'the capacity for extensive coordination between different specialized subunits within an organization, and explicitly targets the implementation of a given project concept' (Iansiti and Clark 1994).

Also, they had found two useful sub-dimensions, across-function integrative capability and board-problem solving integrative capability. Our hypothesis was the following:

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H2: High internal integrative capability group will be better than low internal integrative capability group in the new product development performance.

Across-functional integrative capability focuses on higher level integration processes such as mechanisms for achieving the coordination of tasks between different functional specialties (Iansiti and Clark 1994). The manufacturers develop across-function integrative capability will improve efficiency in implementation

and new product development performance. Other researchers found similar results, across boundaries integration (Clark and Fujimoto 1991a), system composition interface (Iansiti and Clark 1994), and different scientific knowledge base (Henderson and Cockburn 1994) would impact new product development performance. Our hypothesis was the following:

- H2-1: High across-function integrative capability group will be better than low across-function integrative capability group in the new product development performance.

Board-problem solving integrative capability instead characterizes the 'micro' level integration of activities at the individual problem-solving level (Iansiti and Clark 1994). For example, the practice of 'integrated problem solving' (including a complex pattern of skills, routines and organizational processes aimed at the integration of problem-solving activities in subsequent sets of tasks) has been shown to underlie effective practice in the management of major development projects (Fujimoto and Clark 1989; Clark and Fujimoto 1991b; Bowen et al. 1994). Effective development of problem-solving routines has been essential in driving and framing capabilities and performances (Petroni 1996). Our hypothesis was the following:

- H2-2: High board-problem solving integrative capability group will be better than low board-problem solving integrative capability group in the new product development performance.

New Product Development Performance

When we look about the global electronic information industries, there are some uncertainly factors such as shorter PLC and faster product development process. Therefore, new product development (NPD) has become the main source of enterprises' core competitiveness, which makes improving NPD performance the focus of enterprises (Ling and Yang 2009). NPD is an organizational knowledge accumulation and value-added process which takes knowledge as resources and generate new products and new knowledge through knowledge activities such as knowledge acquisition, integration, application and new knowledge sharing (Jing and Hu 2008), so it is a knowledge combination and innovation process (Ling and Yang 2009). Thus knowledge integration is also a key effect factor of NPD performance.

Method

Framework

Based on the prior studies of Iansiti and Clark, the analysis framework is constructed (in Fig. 88.1) (Iansiti and Clark 1994). In this framework, knowledge integration consists of two parts: external knowledge integration and internal knowledge integration.

Measuring Variables

Independent Variables

Two independent variables are measured, including external knowledge integration and internal knowledge integration.

"External integration" was measured from two aspects: index of technical integrative capability and the index of customer integrative capability. Another variable, internal integration index was divided into two sub indexes, a cross-functional integrative capability and board-problem solving integrative capability, to provide consistency with previous work (Iansiti and Clark 1994). Every indicator was evaluated by 7- point Likert scale where 1 was equivalent to very low and 7 to very high.

Dependent Variables

According to the study of Cooper, Olson, Walker and Rueken, the dependent variable "new product development performance" was measured by three indicators: (1) overall relative performance of new product on each project; (2) success ratio of new product development; (3) effect of new product on a company (Cooper 1984; Olson et al. 1995). Every indicator was evaluated by 7-point Likert scale where 1 was equivalent to very low and 7 to very high.

Data

The data collected from electronic manufacturing industry in Taiwan Hsinchu Science Base Industrial Park. The main reason is that electronic manufacturing industry in Hsinchu Science Park is one of the earliest and most important in Taiwan, and its technical projects are most representative. Five hundred and thirty-two companies' data were collected. Excepting the undelivered and

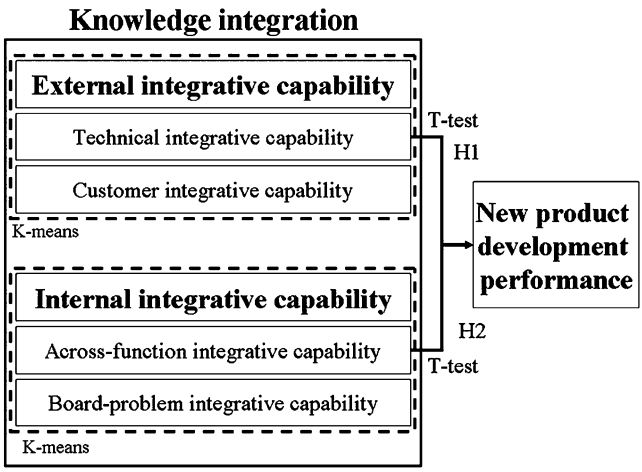

Fig. 88.1 Research framework

overlapped companies, valid questionnaires was 63, its effective rate was 10.1%. Cronbach's alpha value was 0.7.

Results and Analysis

The K-means cluster analysis procedure was adopted. This method requires the expected number of clusters to be input into the analysis. As it turned out, the number of companies was almost evenly divided between the two clusters, with 29 in the high external integrative capability group and 34 in the low external integrative capability group. A two cluster analysis is shown in Table 88.1.

External Integrative Capability Vs. New Product Development Performance

External Integrative Capability

The results of t-tests show (in Table 88.2) the difference between the two groups in the test was significant. The empirical analysis revealed that the manufacturers of higher external integrative capability, the new product development performance are better. This is consistent with the hypothesis H1.

Table 88.1 Cluster analysis for external integrative capability and integrative capability

		Samples	Means	*t*-value
External integrative	High	29	89.86	23.070***
	Low	34	67.74	
Internal integrative	High	24	74.92	22.391***
	Low	39	53.97	
Technical integrative	High	34	54.38	24.324***
	Low	29	41.59	
Customer integrative	High	28	35.21	22.889***
	Low	35	24.80	
Across-function integrative	High	23	47.65	22.325***
	Low	40	33.35	
Board-problem solving integrative	High	28	27.89	22.889***
	Low	35	19.77	

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 88.2 *t*-Test analysis of external integrative capability on new product development performance

New product development performance	External integrative capability clustering		
	High external integrative capability (n = 29)	Low external integrative capability (n = 34)	*t*-value
	33.0345	26.2059	−7.008***
	Technical integrative capability clustering		
	High technical integrative capability (n = 29)	Low technical integrative capability (n = 34)	
	32.5882	25.5517	−7.408***
	Customer integrative capability clustering		
	High Customer integrative capability (n = 29)	Low Customer integrative capability (n = 34)	
	32.9643	26.4571	−6.411***

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Technical Integrative Capability

Also, results of this experiment have shown (in Table 88.2) that, all technical integrative capability groups (high technical integrative capability and low technical integrative capability) demonstrated significantly difference between the two groups. The *t*-value (=32.5882) of high technical integrative capability group is higher than low technical integrative capability group (t = 25.5517). It means the manufacturers have stronger technical integrative capability will perform better new product development performance. This is consistent with the hypotheses H1-1.

Customer Integrative Capability

Then we check the value of two customer integrative capability groups. Results are also presented of empirical tests showing that the difference between the two

groups in the test was significant. Higher customer integrative capability will brings better new product development performance. This is consistent with the hypothesis H1-2.

Internal Integrative Capability vs. New Product Development Performance

Internal Integrative Capability

Table 88.3 presents the results of a study that provides support for the hypothesis H2. This result could be explained by the fact that the data shows significantly difference between the two groups (high internal integrative capability and low internal integrative capability). And the score of high internal integrative capability group is much higher than low internal integrative capability group. This study proves that, for company, stronger internal integrative capability will brings high new product development performance.

Across-Function Integrative Capability

Results showed (in Table 88.3) the significant differences in the across-function integrative capability between the two groups. In our survey, the group has higher across-function integrative capability get better performance of new product development and also is consistent with the hypothesis H2-1.

Board-Problem Solving Integrative Capability

The findings show (in Table 88.3) gives us the evidence to prove that the difference between the two groups in the test was significant. Also, the result is consistent with the hypothesis H2-2. Table 88.4 shows that all Hypothesis of this study had been supported.

Discussion and Conclusions

It should be concluded, from what has been said above, that each of these different dimensions of knowledge integration should impact an organization's NPD performance. Analysis revealed significant differences among the six groups. Obviously, high external integrative capability group had better NPD performance than low external integrative capability group; high technical integrative capability group had

Table 88.3 *t*-Test analysis of internal integrative capability on new product development performance

New product development performance	Internal integrative capability clustering		*t*-value
	High internal integrative capability (n = 24)	Low internal integrative capability (n = 39)	
	33.2500	26.9487	−5.864***
	Across-function integrative capability clustering		
	High across-function integrative capability (n = 23)	Low across-function integrative capability (n = 40)	
	32.6087	27.4750	−4.331***
	Board-problem solving integrative capability clustering		
	High board-problem solving integrative capability (n = 28)	Low board-problem solving integrative capability (n = 35)	
	32.3214	26.9714	−4.775***

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 88.4 Research hypothesis and results

	Hypothesis	Outcome
H1	High external integrative capability group will be better than low external integrative capability group in the new product development performance.	Fully supported
H1-1	High technical integrative capability group will be better than low technical integrative capability group in the new product development performance.	Fully supported
H1-2	High customer integrative capability group will be better than low customer integrative capability group in the new product development performance.	Fully supported
H2	High internal integrative capability group will be better than low internal integrative capability group in the new product development performance.	Fully supported
H2-1	High across-function integrative capability group will be better than low across-function integrative capability group in the new product development performance.	Fully supported
H2-2	High board-problem solving integrative capability group will be better than low board-problem solving integrative capability group in the new product development performance.	Fully supported

better NPD performance than low technical integrative capability group; high customer integrative capability group had better NPD performance than low customer integrative capability group; high internal integrative capability group had better NPD performance than low internal integrative capability group; high across-function integrative capability group had better NPD performance than low across-function integrative capability group; high board-problem solving integrative capability group had better NPD performance than low board-problem solving integrative capability group. Our results agree with those obtained by Iansiti et al.,

Clark, Petroni, Tripsas, Cohen et al., Fujimoto et al., etc. (Iansiti and Clark 1994; Petroni 1996; Tripsas 1997; Cohen and Levinthal 1990; Fujimoto et al. 1991; Clark and Fujimoto 1991a; Henderson and Cockburn 1994; Fujimoto and Clark 1989).

Company should set up the integration mechanism to link internal R&D and external technical knowledge, also make the connection with information and knowledge about future customers and their use of the product to the development process and the details of engineering.

Furthermore, achieving the coordination of tasks between different functional specialties, and improving efficiency in implementation and new product development performance.

Despite of these meaningful conclusions and implications for Taiwan enterprise, the study still has several limitations. First, the sample size is small. It's obvious that a larger sample would be more representative, and some meaningful conclusion could be verified. Second, because of the resource constraints, we do not deal with these statistical methods of SPSS in this study, but leave them for further research. Finally, future studies could further investigate the effects of few other established moderating variables such as strategic flexibility, absorptive capability, market orientation etc...

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