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Research on the Relation between NPD Team Knowledge Integration and Performance of NPD: Data from China

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Abstract

This study aims to find out the relation between NPD team knowledge Integration and new product development performance. In order to achieve this goal, a questionnaire was designed and a structural equation model (SEM) was built based on the literatures. After analyzing the data from 245 usable questionnaires, this study proved that NPD team knowledge integration has direct and indirect influence to new product development performance.

Key words: New Product Development team; Knowledge Integration; New Product Development Performance

1 INTRODUCTION

The ultimate purposes of knowledge management are to make knowledge capital add value and improve company's core competence. In the team of new product development (NPD), the efficient knowledge sharing would be beneficial to the benign flowing and value adding of knowledge within the team. When team members share their knowledge, they would get some tips and the knowledges also would be consolidated. Knowledge sharing means rearrangement and fusion of knowledge within a team, which make these knowledges more flexible, well ordered and systematic. So, knowledge sharing within a team is the fundamental of knowledge integration. Based on some specific mechanism, knowledges and experiences were communicated in the broadest range, which make them show the best value. Since NPD is a complicated knowledge creation process, which make different organization with different functions or different knowledge subject on different geographical location knowledge integrated, so, it is meaningful work to emphasize NPD team knowledge sharing. Enterprises should support NPD team member's knowledge acquisition, and at the same time, they should also make knowledges sharable and applicable. With creating new knowledge, finally they developed new experiences and memories. With the cycling of these steps, enterprises would find a way to build their competitive advantages. (Gupta & Govindarajan, 2000).

2 MODELS AND HYPOTHESIS

2.1 Factors on performance of NPD team knowledge sharing

(1) Team member's intention to share knowledges.

When persons who owned knowledges didn't like to share their knowledges, it was unmeaningful for accepters who wanted to study. Meanwhile, even if the owners would be reluctant to share their knowledges, it was useful for them to finish the learning process, without accepters' willing to join in the sharing process. It was proposed by Davenport and Prusak (1998) that intention to share their knowledge should be measured in the knowledge owner's perspective, because buyers and sellers of knowledges thought that they could benefit from the transaction of knowledges, based on the definition of knowledge market. In order to improve the intention to share knowledge, organizations should foster and strengthen the motivations from both providers and demanders, and finally make them have high intention to join in the sharing process. So, we proposed the following hypothesis:

H1: there are positive relationships between the intention to share and performance of NPD team knowledges sharing.

(2) Team member's capacity to share knowledges. It was important for team members to have the capacity to transfer knowledges. If knowledges were stored only in database or one person, and not shared and circulated, then team members could not learned from the knowledges. As discussed before, although the intention to share knowledges formed team member's motivation to share, the capacity to share was also vital for team members to share their knowledges. The concept of the capacity to share knowledges could be explained as the following: capacity for team members to understand the knowledges on NPD thoroughly by searching, affirming, communicating, and assimilating relative knowledges. In fact, the higher the capacity to share was, the better the performance to share was.

H2: there are positive relationships between the capacity to share and performance of NPD team knowledges sharing.

(3) Construct the knowledge map of NPD. Knowledge map was a guide map, and it's also an integrated directory for all the knowledges within an enterprise. It was not a map for usual purpose, or a knowledge tank. But it was a navigator or compass for enterprise to search knowledges. Every staff had their own map about how and where to look for professional knowledges and solutions. Constructing knowledge map of NPD was to integrate all the staff's micro-map in their own minds. The method was to ask employees where knowledges that they needed could be found. And sharing of these micro-maps was also sharing of personal Knowledge Addressing Paths (KAP). If enterprises got hold of knowledge map, they would find relative knowledges and solutions easier. By constructing enterprise's knowledge map, they would improve the capability to search knowledges for NPD team, and promote enterprise knowledge transferring, and improve the performance of knowledge sharing in enterprises, and finally improve the NPD performance.

(4) Sharing solutions, to solve problems by open methods. In the process of NPD, there would be many unavoidable problems. At some times, to solve these problems, it was best time for team members to share their knowledges. With deep discussion and fully communication, team members would not only solve the problem, but also create some new knowledges and theories. Furthermore, with the deep discussion of these problems, not covered or solved by a supposed correct method by a researcher, team member could avoid the potential troubles in the process of NPD or losses that new products were put on markets. Through these method, not only internal knowledge sharing was promoted, but also knowledge integration within team and enterprise was enhanced. So, the performance of NPD was finally improved.

(5) Communication channels within team members. There were many channels for team member's communication, which could promote knowledge sharing such as training, formal or informal frequent interaction. As Weber (19) mentioned in *where is the new economy*, talking was the most important working method in the new economy. Otherwise, experiences communication would be useful for sharing knowledges. And Internet, cyber-meeting, telecommunication, visual telephone or other method would be helpful to draw the distance close for communicators, it was convenient for them to share knowledges.

(6) Cooperation and synergy among team members. In this paper, synergy was named that all the activities in NPD process would be arranged by some certain order and time, which means that 1) the scarce resources could be allocated to the activities needed, 2) the deadline would be set and communicated clearly, and every item's finish in time made the whole project be finished in the shortest period. PERT and CPM were still two popular tools. And the groups for designing different components in the NPD team would make sure all these components work coherent with others, which made the whole

products had high performance. Supposed that all departments and groups had tried their best to get right resources, finish scheduled tasks, submit working results in time and set objects and deadline properly, then synergetic degree would be good enough to guarantee the NPD progress smoothly.

Based on the above analysis, questionnaires were designed with consideration of cooperation and synergic demand. So two questions (no. 6 and 7) were proposed to express 'the degree of relation harmony among NPD team members' and 'the reward and punishment mechanism for good cooperation with NPD team members'. Other items would assign to only one question. So there are different characteristics for all the seven questions. Within the seven questions, no. 1 to no. 4 would focus on the willingness and capacity to share, and no. 4 to no. 6 would emphasis on whether there is some mechanism to promote knowledge sharing. All in all, the willingness and capacity to share and knowledge sharing mechanism have different impact on NPD performance.

2.2 NPD team knowledge sharing performance

Knowledge sharing performance was the effects and results of knowledge sharing, and it was the evaluation on the results that knowledge sharing achieved and also the measurement on the capacity to share knowledge for enterprises. NPD team knowledge sharing performance was the subjective estimate on the effect of NPD team knowledge sharing. Grant (1996) put forward efficiency, range and elasticity of knowledge integration to measure the performance of knowledge integration mechanism. Although there were some differences between the concepts of knowledge sharing and knowledge integration, it was reasonable that construct the evaluation index of the performance of knowledge sharing based on the spirit of knowledge integration. In this research, three aspects were considered to measure the NPD team's knowledge sharing performance, which were the synergic degree among subtasks, the degree that team members could combine the grasped knowledge and new knowledge and the degree that team members could assemble, synthesis and integrate their personal experiences into the process of NPD,

2.3 NPD performance

General speaking, most researchers used finance and non-finance index to measure NPD performance. (Cooper, 1994). Finance index was to measure NPD's market achievement, such as profit, market share, customer satisfaction, and so on. (Li & Calantone, 1998). And these indices could be compared with competitors or preset goals. For example, when discussing the NPD cross departments, Song, Thieme & Xie(1998) used success rate of NPD, range of product line, price and cost to measure NPD performance.

Compared with competitors, non-financial indicators mainly emphasize the efficiency pursued by new product projects in terms of development time.

(Hansen,1999; Sarin& Mahajan, 2001; Rindfleisch

& Moorman, 2001), For example, Rindfleisch & Moorman(2001) compared the completion time of new product development with the expected target and the development time of similar products in the same industry to measure whether the new product development has reached or exceeded the expected speed, which is called market performance in this study. Based on the above literature, we believe that there are many factors that affect the performance of new product development. As for the quality of the performance of new product development, this study draws on all the above research results to evaluate the performance of new product development from the project performance and market performance of new product development. Among them, the project performance we through project, senior director of satisfaction in the project, project time elapsed time satisfaction, product technical performance is good and the cost of the product development cost four indicators to evaluate the project performance, with the profit performance of new products, such as market share performance indicators to evaluate the market performance.

2.4 Analysis of the impact of knowledge sharing on the performance of new product development

Therefore, from conception, planning, testing to listing, a new product is not the knowledge collection of all knowledge workers, and the knowledge sharing performance of the new product development team has a significant impact on the performance of new product development.

First, when the degree of knowledge sharing within the organization is higher, members can acquire new knowledge at any time and constantly create new knowledge. When members of the organization have a high degree of willingness to share knowledge, it indicates that knowledge suppliers are willing to share knowledge related to the development of new products, while knowledge demanders are willing to learn the Shared knowledge. Therefore, it has a positive impact on the completion time of new product projects with no time to spare. Secondly, by improving the willingness and ability of knowledge sharing, members of the organization are more willing and easier to share market and technical knowledge about new product development, which is conducive to the improvement of product innovation

degree and the performance of the organization's new product development project. Finally, when the members of the new product development project have a strong knowledge sharing ability, they can conveniently search for the required knowledge and absorb and apply the market and technical knowledge they have learned to the new product development activities, which can promote the performance of the new product in the market. In general, the knowledge sharing of new product development team members is conducive to the improvement of the performance of new product development.

2.5 Research hypothesis

Based on the above analysis, we propose the following hypotheses:

H1: the willingness and ability of team members to share knowledge can promote the knowledge sharing performance of the new product development team

H2: the knowledge sharing mechanism of team members can promote the knowledge sharing performance of the new product development team

H3: knowledge sharing performance of team members has a positive impact on the performance of new product development projects

H4: knowledge sharing performance of team members has a positive impact on market performance of new product development

H5: the willingness and ability of team members to share knowledge have a positive impact on the performance of new product development projects

H6: the willingness and ability of team members to share knowledge have a positive impact on the market performance of new product development

H7: the knowledge sharing mechanism of team members has a positive impact on the performance of new product development projects

H8: the knowledge sharing mechanism of team members has a positive impact on the market performance of new product development

2.6 Model

Based on the above assumptions, we established a structural equation model of the impact of knowledge sharing of new product development team on the performance of new product development, as shown in **Figure 1**. This model embodies the above assumptions and concepts and is the "suggested model" of the research work in this paper.

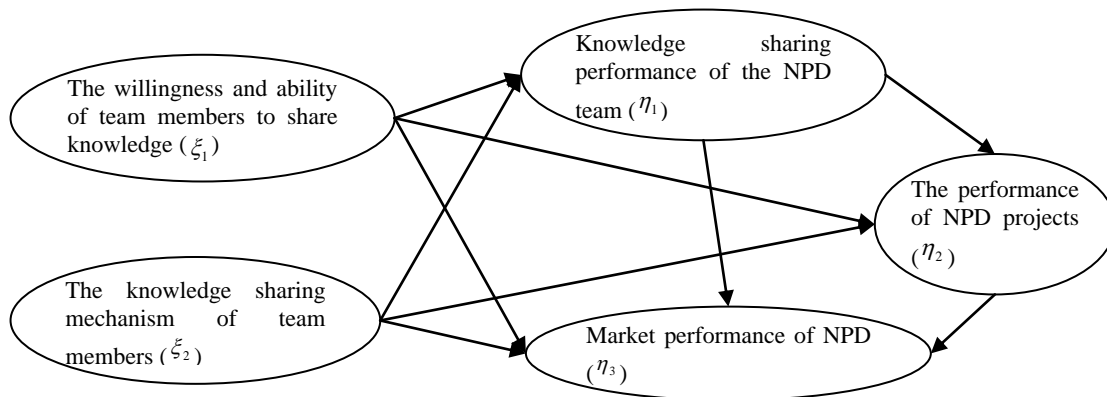


Figure 1 SEM of the impact of knowledge sharing on the performance of NPD team

3 RESEARCH DESIGN AND METHODOLOGY

3.1 Questionnaire

Based on the literature and the analysis of this paper, this study first designed a questionnaire on the impact of knowledge sharing of new product development team on the performance of new product development. This questionnaire is divided into three parts, the first part of "new product development team knowledge sharing" 2, "team knowledge sharing willingness and ability of 4 items," team knowledge sharing mechanism, a total of three questions, the second part is the "new product development team knowledge sharing performance", a total of three questions, the third part is the "new product development performance", a total of two, among them, the "new product development project performance" four topics, "market performance of new product development, a total of 4 items. The questions are expressed as "strongly disagree" to "strongly agree" from 7 feet Likert. We conducted exploratory questionnaire survey in Zhanjiang high-tech park in Pudong of Shanghai by convenient sampling method. 100 questionnaires were sent out,

51 of which were recovered with a recovery rate of 51%. To this part of the questionnaire we fix the questionnaire by identifying degree analysis method, we deleted "team knowledge sharing willingness and ability of a title," team knowledge sharing mechanism "in one subject and new product development and market performance of the two topics, and using confirmatory factor analysis, get the final formal research of the questionnaire are shown in **Table 1**.

3.2 Data collection

We used systematic sampling method to conduct formal questionnaire survey on enterprises in industrial parks in Shanghai, Nanjing, Hangzhou and other places. In the formal study, we used random sampling method. The questionnaire is distributed through the assistance of the local tax administrator, the management committee of the industrial park, the door-to-door questionnaire, the finance bureau of high-tech zone, and the massive list of enterprises. A total of 1000 questionnaires were sent out. By September 2017, 245 valid questionnaires had been received, with an effective recovery rate of 24.5%.

Table 1 Questionnaire of the impact of knowledge sharing on the performance of NPD team

Variable	item	Question
the willingness and ability of team members to share knowledge (ξ_1)	X1	Product development team members are willing to share knowledge and experience
	X2	Product development team members have the ability to absorb the knowledge and experience of other team members
	X3	Team members know who or where to go when they need something
the knowledge sharing mechanism of team members (ξ_2)	X4	The team often carries on the product development knowledge, the experience communication and the exchange through the experience exchange meeting, the bar, the canteen or the network and so on channel
	X5	The relationship between new product development team members is harmonious and good
knowledge sharing performance of the NPD team (η_1)	Y1	There is a good degree of synergy between various sub-tasks in the process of new product development
	Y2	Team members can creatively combine old knowledge and new knowledge related to new product development projects
	Y3	During the course of the product development project, team members were able to assemble, synthesize, and integrate their personal knowledge and experience into the new product
the performance of NPD projects (η_2)	Z1	Senior executives of new product development projects are highly satisfied with the project
	Z2	The new product development project can be completed according to the expected time
	Z3	The technical performance of the product is good, and it can achieve the expected function and quality requirements
	Z4	This project is more cost effective than previous product development projects
market performance of NPD (η_3)	Z5	The profit realized by the new product will meet or exceed the expected target
	Z6	The market share of this new product will meet or exceed the expected target

In this study, SPSS was used for factor analysis and data reliability analysis, and LISREL software was used for structural equation model analysis to find the correlation between independent variables and dependent variables in the research framework, so as to verify whether the research hypothesis is correct.

4 DATA ANALYSIS

4.1 Descriptive analysis

Our analysis of the 245 returned questionnaires is as

follows:

(1) Factor analysis: after our analysis, we found that the knowledge sharing mechanism of the loose new product development team, the knowledge sharing mechanism of the compact new product development team, the knowledge sharing mechanism of the new product development team, the performance of the new product development project and the market performance of the new product development only belong to one factor.

Table 2 Reliability analysis of exploratory research

Potential variable	items	Cronbach α
Knowledge sharing mechanism of loose new product development team	3(X1,X2,X3)	0.8473
Tight new product development team knowledge sharing mechanism	2(X4,X5)	0.7830
knowledge sharing performance of the NPD team	3(Y1,Y2,Y3)	0.8731
the performance of NPD projects	4(Z1,Z2,Z3,Z4)	0.8602
market performance of NPD	2(Z5,Z6)	0.8940

(2) Data reliability analysis: data reliability refers to whether a group of measurement items are measuring the same concept, which is an important indicator to evaluate the quality of data. In empirical studies, the internal consistency coefficient (Cronbach alpha value) is commonly used in academic circles to test the reliability of data. American statisticians Joseph f. Hair Jr., Rodolph e. Anderson et al pointed out that Cronbach alpha value greater than 0.7 indicated high reliability of the data. When the measurement scale was less than 6 items, Cronbach alpha value greater than 0.6 indicated that the data was reliable. Cronbach values calculated by us are shown in Table

2. As shown in Table 2, in this study, the internal consistency coefficient of all measurement scales is between 0.7830 and 0.8940, indicating that the reliability of each measurement scale is relatively high.

4.2 Analysis on structural equation model

According to the structural equation model in Figure 1, LISREL8.7 was used for verification. The standardized estimates of Table 3 are obtained.

Table 3 standardized estimates of the impact of knowledge integration of new product development team on the analysis of structural equation model of new product development performance

Table3 Standardized estimates of the impact of new product development team knowledge integration on structural equation model analysis of new product development performance

links	ecoefficiency	Standardized estimates	T	links	ecoefficiency	Standardized estimates	T
$\xi_1 \rightarrow \eta_1$	$\gamma_{1,1}$	0.30	3.04	$\xi_2 \rightarrow \eta_3$	$\gamma_{3,2}$	0.27	2.04
$\xi_1 \rightarrow \eta_2$	$\gamma_{2,1}$	0.00	0.03	$\eta_1 \rightarrow \eta_2$	$\beta_{2,1}$	0.68	4.87
$\xi_1 \rightarrow \eta_3$	$\gamma_{3,1}$	-0.17	-1.71	$\eta_1 \rightarrow \eta_3$	$\beta_{3,1}$	0.08	0.15
$\xi_2 \rightarrow \eta_1$	$\gamma_{1,2}$	0.60	6.54	$\eta_2 \rightarrow \eta_3$	$\beta_{3,2}$	0.61	7.64
$\xi_2 \rightarrow \eta_2$	$\gamma_{2,2}$	-0.01	-0.09				

According to the structural equation model in Figure 1, LISREL8.7 was used for verification. The standardized estimates of Table 3 are obtained. By observing the parameter estimation among the latent variables in Table 3, we found that the absolute value of the T value of $\xi_1 \rightarrow \eta_2$, $\xi_1 \rightarrow \eta_3$,

$\xi_2 \rightarrow \eta_2$ and $\eta_1 \rightarrow \eta_3$ is less than 1.96, not significant. We gradually adjusted the model to get the final model, and the causal relationship is shown in Figure 3, and the values of relevant parameters are shown in Table 4.

Table 4 standardized estimates of the influence of knowledge integration of new product development team on the performance of new product development

links	ecoefficiency	Standardized estimates	T	links	ecoefficiency	Standardized estimates	T
$\xi_1 \rightarrow \eta_1$	$\gamma_{1,1}$	0.31	3.61	$\eta_1 \rightarrow \eta_2$	$\beta_{2,1}$	0.67	9.92
$\xi_2 \rightarrow \eta_1$	$\gamma_{1,2}$	0.60	6.63	$\eta_2 \rightarrow \eta_3$	$\beta_{3,2}$	0.62	8.63
$\xi_2 \rightarrow \eta_3$	$\gamma_{3,2}$	0.19	2.83				

Table 5 is the goodness of fit index of the whole structural equation. -----The chi-square value (χ^2) of the model was 163.13 and χ^2/df was 2.298, and the approximate root mean square residual (RMSEA) was 0.073 and less than 0.08. At the same time, NFI is 0.97, NNFI is 0.98, CFI is 0.98, and GFI is 0.98. These fitting indexes are all greater than 0.90, AGFI

is 0.87, slightly less than 0.9, but it can still be said that the goodness of fit of the model is good.

Therefore, we get the causal relationship between knowledge integration of new product development team and new product development performance, as shown in **Figure 3**.

Table 5 goodness of fit of structural equation correction model of influence of knowledge integration of new product development team on new product development performance

Parameter	df	χ^2	P	NFI	NNFI	CFI	IFI	GFI	AGFI	RFI	RMSEA
Value	71	163.13	0	0.97	0.98	0.98	0.98	0.91	0.87	0.96	0.073

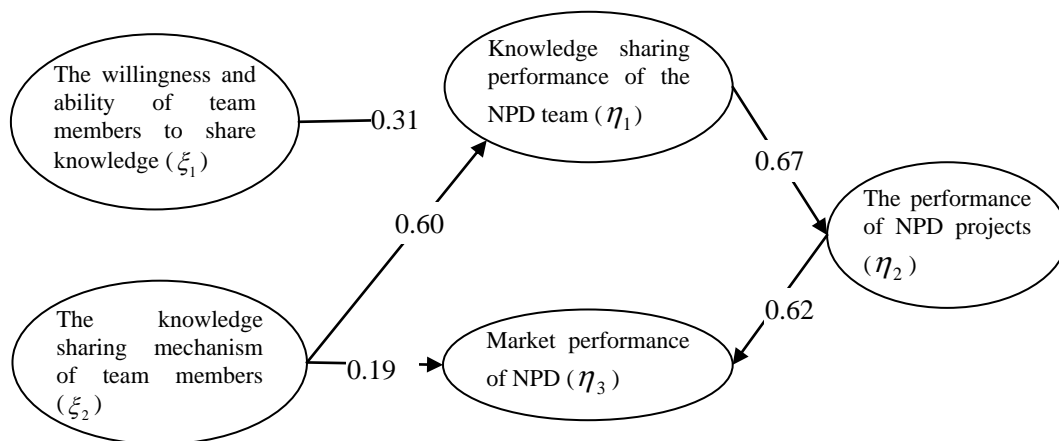


Figure 3 SEM between knowledge integration of NPD team and NPD performance

5 CONCLUSIONS

As can be seen from table 6, both members' willingness to share and mechanism promote the performance of knowledge integration, so the knowledge integration mechanism of new product development team can promote the knowledge integration performance of new product development team. The knowledge integration performance of the development team promotes the project performance and market performance of the new product development, so the knowledge integration performance of the new product development team has a positive impact on the project performance and market performance of the new product development. The willingness and mechanism of knowledge sharing of members have a positive impact on the project performance and product performance of new product development, so the knowledge integration

mechanism of new product development team has a positive impact on the project performance and market performance of new product development. However, we have also noticed that the role of knowledge sharing mechanism on the performance of new product development is greater than the willingness and ability of knowledge sharing, which indicates that it is not enough to cultivate only one idea and ability. It is important to establish mechanisms and systems.

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