New product development and its performance

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Abstract

Factors influencing new product development and its performance are examined through using data of Japanese firms as well as reviewing some main studies in this field.

Keywords

New product development, Attitude for new product development, New product success.

1. Introduction

Continuous development of new products is indispensable to the survival and growth of many companies, as evidenced by the large number of newly released products each year. However, development of new products is very risky, as reflected by the high failure rate. According to Booz, Allen and Hamilton, only 65% of new products introduced to the market during 1976-1981 were successful. In spite of big improvements in success rate during the last 20 years, almost half (46%) of the money invested in the development of new products was wasted because the products were failures [1]. The attitude towards new product development (NPD) varies widely among companies, with some companies being active and others being passive.

Although considerable studies have been made on the performance or success factors of NPD in North America and Europe, little research has been done based on data about Japanese firms. In this paper, we consider the activities of

Japanese companies towards NPD and investigate what factors or conditions contribute to the success or failure of the products.

2. Review of some studies on the performance of NPD

Many studies of success or failure of NPD have been carried out since the case studies of the 1960s and 70s. In particular, the SAPPHO project of the University of Sussex, which was started in 1972, promoted study of NPD. The project tried to explain differences between successful and unsuccessful practices [2]. The project used a pairwise comparison method, whereby a successful innovation is compared with an unsuccessful innovation, and differences between the pair are noted. Since then, pairwise comparison methods have been used in many new product success studies. SAPPHO found that market and organizational factors are important in the success of innovations.

Cooper's NewProd project is also well known. Cooper collected data of 195 cases of new products of Canadian industrial companies selected randomly and analyzed them statistically. He found three factors important for success: 1) product uniqueness and superiority, 2) market knowledge and marketing proficiency, 3) technical and production synergy and proficiency [3]. Though the SAPPHO and NewProd studies gave similar results, we have noticed some significant differences between them: SAPPHO emphasized organizational factors as well as market ones, whereas NewProd regarded product characteristics in addition to market and organizational factors.

Little research on the success of new products has been done in relation to Japanese companies. One notable study, however, was done by Song and Parry. They sent questionnaires to 500 Japanese listed non-service companies of which 404 replied. They found that cross-functional integration and product

competitive advantages were the most important factors behind the success of their new products [4].

3. An experimental study for Japanese firms

3.1 NPD activities and product environment

It is presumed that the faster technology and markets change, the more active the companies become in NPD. We confirmed this tendency by surveying Japanese listed companies in order to investigate NPD activities [5]. We asked twelve questions about the environment of the main product of the company and, by factor analysis, we found four significant factors, shown in Table 1: 1) market complexity, that is, change and diversity in the market, 2) technological innovation, 3) stability of demand, and 4) intensity of price competition. Of these, market complexity and technological innovation are particularly important. Based on these two, there are four product environments (Figure 1).

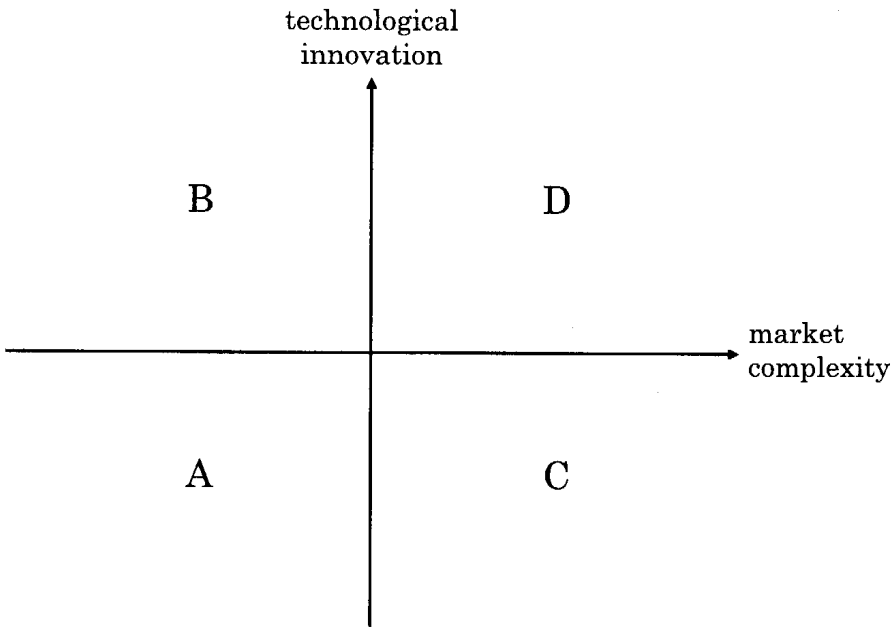
The relationship between products and their environments can be assessed using estimated factor scores. Although 43% of non-durable consumer products are in environment C, 24% of non-durable consumer products belong to environment D. As for durable consumer goods, many (41%) belong to environment D. Altogether, 60% of completed industrial products are in environments A and B. As for industrial parts and materials, although 41% are in environment A, 28% belong to environment D. Generally, the degree of market complexity is high for consumer goods, but low for industrial goods.

Table 1　Factor Analysis of Product Environment

Variables	Factor 1	Factor 2	Factor 3	Factor 4
degree of product development	0.042	0.931	0.029	- 0.006
degree of process innovation	0.104	0.903	0.004	0.068
frequency of NPD	0.522	0.289	- 0.362	0.043
length of PLC	- 0.440	- 0.005	0.639	0.074
intensity of price appeal	0.024	- 0.042	0.062	0.866
intensity of fashion appeal	0.600	- 0.049	- 0.377	- 0.030
intensity of quality appeal	0.237	0.297	0.573	0.384
variety of user needs	0.753	0.013	0.066	0.235
change in user needs	0.713	0.227	- 0.122	0.172
effect of brand power	0.710	0.128	0.244	- 0.129
stability of demand	0.138	- 0.062	0.665	- 0.195
intensity of competition	0.205	0.320	- 0.197	0.593
Eigenvalue	2.54	2.03	1.58	1.40
PCT of VAR	21.1%	16.9%	13.1%	11.7%

※ principal factor analysis with varimax rotation

Figure 1　Market and Technological Environment of Products



To what degree is a company eager in carrying out NPD? The degree of the will or eagerness was evaluated on a five-point scale (very active—very passive) by each company compared with other companies in the same industry. To find out the relationship between will or eagerness of companies towards NPD and the product environments, we performed regression analysis using factor scores of each product environment as independent variables. The results are given in Table 2.

The final variables left using the stepwise method were market complexity and technological innovation. The former was highly significant, but the latter was not significant, though its sign was positive. Therefore the result seems to support the hypothesis.

Table 2 Results of Regression Analysis

Dependent Var. / Independent Var.	will or eagerness for NPD	
	compulsory	stepwise
market complexity	.265(3.34)**	.265(3.36)**
technological innovation	.104(1.32)	.105(1.37)
stability of demand	.002(0.02)	
intensity of price competition	- .057(0.72)	
F Value	3.31*	6.43**

※ BETA(t value) ** $p<0.01$ * $p<0.05$

3 . 2 Factors and conditions relating to new product success

What kinds of conditions or factors influence the performance of NPD? As an indicator of the performance, the ratio of products attaining their goals could be used. From this, we can calculate the percentage of new products, introduced in the last five years, which attained their sales or profit goals. It is

presumed that the performance of new products depends upon the behavior or the attitude of companies, the market and technological environment in which the company behaves, and the competence or resources of the company. The following three groups of variables are taken up here as factors for the performance of NPD: (1) environment, (2) company ability or competence, and (3) company attitude toward NPD. Attitude relates to whether a company is a challenger or follower in NPD. Below are the hypotheses on which these variables are based:

1) Environment:

a) Companies in sectors requiring product innovation to be high must put more importance on NPD because new products are more important for their growth or survival. Such companies must succeed in NPD.

b) When the market is competitive, companies are more active in NPD. When the main product of the company is in a stage of maturity or decline, the company has to push the development of new products to survive.

2) Company ability or competence:

a) Generally firms in higher market positions have much more and richer resources available for NPD, and therefore such companies tend to be more active, and to succeed, in NPD.

b) Companies with high-levels of technological know-how tend to be more active in NPD, and therefore such companies are more likely to succeed in NPD.

3) Company attitude toward NPD:

a) Companies with a strong enthusiasm for NPD tend to be more active, and to succeed, in NPD.

b) Competing companies tend to be more daring in developing activi-

ties, and therefore such companies are more likely to succeed in NPD.

An analysis was performed using Hayashi's Quantification Theory I in which the external criterion is a performance indicator, namely, the ratio of new products attaining goals. Except for the performance indicator, data are all categorical. Hayashi's Quantification Theory can be used to analyze categorical or qualitative data. The contribution of each variable to the external criterion (degree of performance) is evaluated through the size of the partial correction coefficient and the range of category scores. The results are shown in Table 3.

The effects on the performance of NPD are stronger in order of the degree of product innovation, the stage in PLC, the will and attitude toward product development, the intensity of competition, the ability of technological development, and market position from the point of view of the size of partial correlation coefficient. These results agree with the above hypotheses, though there is some difference.

1) As for the degree of product innovation, the category scores in 'average' and 'very high' are higher, while those in 'very low' and 'slightly low' are lower with negative signs. Therefore the result supports the hypothesis.

2) As for the degree of competition, the score of 'slightly keen' is positive, while the categories of 'slightly loose' and 'average' have very high absolute values with negative signs. Therefore, performance in more competitive markets tends to be higher. However this result is different from those of Cooper and Kleinschmidt [6], Zirger and Maidique [7], and Song and Parry [8]. That may be because their samples were all at the project level, whereas ours are at the program level.

3) When the company's main product is in the decline stage in PLC, the category score is the highest and is positive. On the contrary, the score of the growth stage is low and negative. But the category of 'late maturity' stage has

Table 3　Results of Quantification Theory I

variable	category	category score	parcial corre. coefficient
will or eagerness for NPD	very passive	−5.239	0.280
	slightly passive	−10.894	
	average	−9.026	
	slightly active	1.853	
	very active	5.615	
attitude toward NPD	follower	−17.111	0.197
	rather follower	−0.419	
	medium	−5.635	
	rather challenger	3.384	
	challenger	2.165	
degree of product innovation	very low	−13.163	0.382
	slightly low	−9.736	
	average	7.156	
	slightly high	0.316	
	very high	4.653	
degree of competition	slightly loose	−8.678	0.128
	average	−4.986	
	slightly keen	1.145	
	very keen	0.788	
market position	very weak	−0.99	0.108
	slightly strong	2.967	
	rather strong	−0.795	
	very strong	−2.5	
ability of technological development	slightly inferior	2.773	0.117
	slightly superior	0.959	
	rather superior	−2.383	
	very superior	4.582	
stage on PLC	growth	−9.062	0.337
	early maturity	7.049	
	late maturity	−2.902	
	decline	15.439	
multiple R		0.579	

※ effective samples ：120,　missing samples ：48

a negative score. This means that the above hypothesis is not always supported, but can be verified on the whole in terms of the absolute values of categories.

4) As for market position, categories except for 'slightly strong' have negative signs. As scores of 'very strong' and 'rather strong' are negative, it cannot be said that the above hypothesis is supported.

5) As the category 'very superior' has the highest positive score in the technological development ability, the result seems to support the hypothesis. However, it cannot be said that it is completely supported, as 'rather superior' has a negative score and 'slightly superior' has a positive score.

6) As for the will or eagerness toward NPD and the attitude, the hypotheses were supported. The 'follower' has a negative score, while 'challenger' has a positive score.

As factors determining the performance of NPD, almost all the results correspond to the hypotheses except for the variable of PLC. As for the ability or resources, the hypotheses are not supported completely. In particular, more attention should be paid to the relationship between the ability to perform NPD and the performance. The technological know-how itself does not always lead to high performance, but it may be effective in conjunction with marketing ability, including an understanding of market needs. As for the third group of variables, the will or attitude to NPD, the hypotheses are supported completely. The variables of market environment and the company will or attitude are more important than the ability or resources of the company in explaining the performance in terms of the height of partial correction coefficients.

4. Conclusion and some limits

It is indispensable for firms to carry out NPD effectively and efficiently and to succeed in it. The factors determining the performance of NPD as well as the conditions relating to company attitude toward the activities of NPD were discussed in this paper. As factors relating to the performance, three groups of variables were assumed. It was found that variable of market environment and company attitude are the more important. We also examined the relationship between company attitude toward NPD and product environments. Most other studies on activities and performance of NPD have been at the project level, using data collected from each project. In contrast, our current study focuses on the overall activities and performance of NPD by using data from companies or business units that have managed several projects. Therefore, our study may be considered to be at the quasi-program level. Studies at either the project level or the program level have both good and bad points.

In most studies, pairwise comparison methods were used. According to our experience, however, it is very difficult to collect as much data on unsuccessful products as on successful ones. Generally, most Japanese companies do not readily disclose data on failures. For these reasons, we used data collected from companies or business units and did not use a pairwise comparison method.

References and notes

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