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THE IMPACT OF INITIAL PLANNING ACTIVITIES ON PROJECT SUCCESS: SOME EVIDENCE FROM A STUDY OF JAPANESE COMPANIES

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THE IMPACT OF INITIAL PLANNING ACTIVITIES ON PROJECT SUCCESS: SOME EVIDENCE FROM A STUDY OF JAPANESE COMPANIES

The domain of New Product Development (NPD) is subject to considerable uncertainties. However, companies are required to manage the innovation process as efficiently as possible. The resulting conflicting demands often leave companies struggling to achieve both, efficiency as well as flexibility due to their often opposing implications for organizing and managing NPD projects. In this context, planning plays a central role. This study tries to develop a deeper understanding of the influences of project planning, the degree of technological newness and both their effects on project success. Our analysis is based on project planning of in combination with New Product Development projects in 497 electrical and mechanical engineering companies.

INTRODUCTION

"Products are the primary means by which companies achieve their objectives" (Inwood and Hammond, 1993). As a result, New Product Development (NPD) is understood as one of the most important tasks in business. Research by Cooper shows that companies in many different industries draw almost one third of their revenues from new products, which have been introduced in the market during the last five years. In especially dynamic industries, even 100 percent of revenues may stem from new products (Cooper, 2001).

Despite the importance of New Product Development, failure rates remain high (see, e.g. Robertson, 1971; Booz, Allen and Hamilton, 1982; Griffin, 1997). For example, the study by Booz-Allen & Hamilton showed that only one of four projects that enter the development state becomes a commercial success (Booz, Allen and Hamilton, 1982). Therefore, researchers as well as practitioners are still trying to find ways to enhance the success of New Product Development. The "fuzzy front end" or "pre-development phase" is indicated as being one of the greatest opportunities to do so. Why should that be?

Firstly, several large scale studies highlight the importance of the fuzzy front end (e.g. Booz, Allen and Hamilton, 1982; Cooper and Kleinschmidt, 1994; Dwyer and Mellor, 1991). Cooper and Kleinschmidt found that "the greatest differences between winners and losers were found in the quality of pre-development activities" (Cooper and Kleinschmidt, 1994). Secondly, the fuzzy front end strongly determines which products will be developed in a firm (Kim and Wilemon, 2002; Zhang and Doll, 2001). Thirdly, quality, costs, and time scales are defined to a large extent here (Bürgel and Zeller, 1997). The front end has the greatest potential for improvement with the least possible effort (Cleland, 1999; Moore and Pessemier, 1993; Souder and Moenaert, 1992). In addition, unclear goals and specifications like product specifications may lead to substantial delays (Kim and Wilemon, 2002; Khurana and Rosenthal, 1998; Verganti, 1997). A large scale German study (Bullinger, 1990) reports that one third of the total development effort is caused by unnecessary changes. And last but not least, the fuzzy front end is one of the least well-known areas in innovation management (Nobelius and Trygg, 2002).

Front end activities include idea generation, idea assessment, the reduction of market and technological uncertainty, and project planning. Cooper, too, divides the fuzzy front end into four phases from idea generation, initial screening, and preliminary evaluation to concept evaluation and stresses the importance of both market-related and technical activities (Cooper, 1988). Khurana and Rosenthal define the front end "to include product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews" (Khurana and Rosenthal, 1998). In contrast to them, we focus on project-related activities and exclude strategic aspects from our study. In our point of view, during the product development process information is gathered to reduce uncertainty, whereby uncertainty is defined as the difference between the amount of information required to perform a particular task, and the amount of information already possessed by the organization (Galbraith, 1973). We assume that the more uncertainty about the market and technology is reduced during the front end, the lower deviations from front end specifications during the following project execution phase and the higher the product development success. This uncertainty reduction point of view is shared by several authors (e.g., Moenaert et al., 1995; Moriaty and Kosnik, 1989; Mullins and Sutherland, 1998).

In this environment of uncertainty, companies often struggle to achieve both, efficiency as well as flexibility due to their often opposing implications for organizing and managing NPD projects. In this context, planning plays a central role (Verganti, 1999). However, the benefit of extensive initial planning is perceived quite differently: While Moorman and Miner (1998) for example report a positive influence of initial planning on various success measures, others have questioned the effectiveness of elaborated initial planning and contend that the ability to rapidly react to changes later in the process and to improvise may lead to success in NPD (see e.g. Eisenhardt and Tabrizi, 1995; Moorman and Miner, 1998; Miner, et al., 2001).

Aside from the aforementioned dispute regarding planning in NPD, most existing studies do not look in any greater detail into the various aspects related to planning and present them collectively under one heading. Consequently, there is a call for research into what exactly constitutes good planning (Thieme, et al., 2003). This study aims at achieving a better understanding of planning in NPD by investigating a sample of some 497 R&D projects in Japanese elctrical and mechanical engineering companies.

PROJECT PLANNING AND ITS IMPACT ON PROJECT SUCCESS

Measuring Project Success

Success in NPD is a complex construct as it is a composite of various subjective and objective measures (Balachandra and Friar, 1997). The difficulties of measuring success have driven project managers to use simple criteria such as achieving target budget, scheduled goal and acceptable performance, even though these measures are partial and often misleading of the real project success (Dvir and Lechler, 2004).

However, success criteria should be comprehensive enough to reflect various interests and views, which make a multi-dimensional and a multi-criteria approach (Dvir, et al., 2003b). Pinto and Prescott even suggest that researchers in project management need to first and most importantly give a comprehensive and clear definition of project success before starting to undertake studies of the project implementation process (Pinto and Prescott, 1990).

It is common to distinguish between internal measures of success, such as meeting budget, schedule, and performance goals, and external measures of success such as the value of the project and client satisfaction (Dvir and Lechler, 2004). Aside from such process- and financially-oriented measures of success, knowledge acquired through the project is a another and relatively frequently cited measure of success (Moorman and Miner, 1998; Herstatt, et al., 2004). Auditing failed and difficult projects is especially instructive and provides the involved personnel with experience which may be used in later projects (Verganti, 1999). This dimension is especially relevant for Japanese companies, as "knowledge creation" is a key to why they have become so successful and can stimulate continuous innovation within companies to achieve competitive advantage (Nonaka and Takeuchi, 1995). However, despite the importance of inter-project learning, many companies do not audit or review their projects. One reason for this is that auditing projects is regarded as extra time and efforts, causing (opportunity) costs. Oftentimes, narrow financial perspectives held by senior managers prohibit using projects to develop new capabilities (Bowen et al., 1994).

Planning and Project Success

In new product development (NPD) companies often struggle to achieve both, efficiency as well as flexibility due to their often opposing implications for organizing and managing NPD projects. In this context, planning plays a central role. In NPD, one can distinguish between two different perspectives on planning (Verganti, 1999).

One stream of research strongly emphasizes the importance of the early phases of a NPD project as decisions taken at this stage are unlikely to be changed later on and if they are, then often only at considerable cost (Verganti, 1999). The importance of these initial planning activities is documented in a number of studies (Cooper and Kleinschmidt, 1986, 1987a, 1987b; Gupta and Wilemon, 1990; Khurana and Rosenthal, 1998) and it has been shown that advanced planning in NPD projects positively contributes to a number of success factors, such as time, reduction of failure rates, financial returns and innovation levels (Moorman and Miner, 1998).

Hence, we hypothesize that:

Hypothesis 1a: Planning positively contributes to external project success.

However, this 'orthodox thinking' (Dvir and Lechler, 2004) about the benefits of project planning has been called into question by several researchers. Bart reports of managers' claims that new product R&D projects seldom turn out the way that they were planned originally. He argues that the traditional approach of planning and controlling R&D projects tends to fail mainly because creativity - which plays an important role in NPD - is hampered by too much of formal control. Therefore, trade-offs are necessary and control should be reduced to a minimum necessary level (Bart, 1993). McGinnis and Ackelsberg (1983) follow a similar train of thought by arguing that ambiguity in goals and processes is necessary to foster search and experimentation in order to arrive at better solutions. According to them, too much control will limit the number of options that are considered especially in innovation procejects and there is a danger that planning becomes an end in itself, rather than a means of establishing and attaining goals. In addition, Song and Montoya-Weiss (1998) point out the need to better align planning activities to the degree of newness of the innovation.

Therefore, a second stream of research more recently questions the effectiveness of elaborated initial planning and contends that the ability to rapidly react to changes later in the process and to improvise may lead to success in NPD (Eisenhardt and Tabrizi, 1995; Ward, et al., 1995; Brown and Eisenhardt, 1997; Moorman and Miner, 1998; Miner, et al., 2001).

We suggest that:

Hypothesis 1b: Planning positively contributes to internal success.

Degree of Newness and Project Success

The new product development process is a process of uncertainty reduction. A common line of argument is that the more market and technological uncertainty are reduced during the fuzzy front end, the less deviations occur during project execution and the higher the probability of success (Mishra, Kim, Lee, 1996; Moenaert et al., 1995; Song and Parry, 1996). According to this rationale, the degree of newness should negatively influence project success, as radical innovations are associated with higher degrees of uncertainty than incremental innovations. In fact, research into this issue shows mixed results. Even though, more innovative product can create more opportunities for the product success by competitive advantage, they mostly come with higher uncertainty and risk (Song and Montoya-Weiss, 1998). Balachandra and Friar (1997) showed that an innovative product has a bigger chance of success in the market. However, at the same time, innovative products more easily fail. Bonner also found that product innovativeness does not have a significant influence on the project performance measured by the degree to which the project met its schedule, budget, product performance objective and the overall level of satisfaction with the team's performance (Bonner et al., 2002). Verworn et al. (2006) show that especially the reduction of technological uncertainty contributes to efficiency and effectiveness of NPD projects. Therefore, a conclusive relationship between innovativeness and commercial success is still not fixed (Balachandra and Friar, 1997). These observations lead us to hypothesize that:

> *Hypothesis 2a: The degree of technological newness positively influences external project success.*
>
> *Hypothesis 2b: The degree of technological newness negatively influences internal success.*

Hypothesis 2c: The degree of technological newness positively contributes to learning.

The Effect of Changes on Project Success

As Andersen (1996) points out, a project is a unique endeavor and he argues that initial planning consequently is not feasible as uniqueness implies that it is impossible to know all the necessary activities at such an early stage. Therefore, an initial plan is very likely to be adapted to the current situation as new information becomes available during the project execution. Dvir and Lechler (2004) show that these changes to the original plan have negative effects which can more than offset the positive effect that results from high quality planning. The occurrence of many changes during the project design and implementation stages hinders meeting the project schedule and budget goals. (Dvir, et al., 2003a).

Learning on the other hand seems to result primarily from problematic and failed projects (Verganti, 1999). These often provide the involved personnel with experience which may be used in later projects (Verganti, 1999).

We therefore hypothesize that:

Hypothesis 3a: Changes negatively influence internal project success.

Hypothesis 3b: Changes positively contribute to project learning.

METHODS

Data Collection

The factors obtained from literature and exploratory interviews were verified during a pilot study and a pre-test in Japan. As items had to be translated into Japanese, in particular the interpretation of the questions had to be verified. The purpose of the pilot study and the pre-test was (a) to assess construct validity and further purify the scales whenever necessary and

(b) to evaluate and improve the quality of the questionnaire prior to full implementation of the survey. The results suggested that several scales reported in former studies could be used with minor modifications. A few additional items resulting from the interviews were added to the constructs.

This study is based on the revised standardized questionnaire which was sent to 2000 research and development directors of mechanical and electrical engineering companies identified in Japan in 2004/5. The database from a Japanese industry association was used to identify companies and R&D directors and covers the majority of Japanese companies in both industries (census assumed). Out of the total of 2000 questionnaires, we achieved a response rate of 28%. Of these 555 questionnaires, 497 data sets could be used for analysis. Comparisons of average values did not identify significant differences between those questionnaires that were returned early and those that were returned later, so in accordance with Armstrong and Overton (1977), we did not assume a significant non-response bias. We used 7-point Likert-type scales ranging from 1 = strongly disagree to 7 = strongly agree and 1 = objectives not achieved to 7 = objectives exceeded.

Company and Project Characteristics

The size of the firms participating in our study ranged from having 5 to 70.000 employees and annual sales ranging from 5 billion Yen to 30.000.000 billion Yen. The majority of the sample consists of medium to large companies employing with 100 to 10,000 employees and annual sales between 1 billion and 1 trillion Yen For the purpose of this study, interviewees were asked to describe the development of the last product introduced to the market. This definition includes the modification of existing products. However, most of the new products studied here were medium or highly innovative. According to the scheme of Booz, Allen and Hamilton (1982), 28% of the products were new to the world, 36% new product lines and

14% product modifications. Only 22% of the products had a rather low degree of newness (either repositioning in the market or cost reduction products). Thus, the NPD projects were relatively balanced concerning the degree of newness of new product concepts.

ANALYSIS AND RESULTS

All constructs with the exception of learning were measured via multiple items (see Appendix Table 2). To check internal consistency of the factors, first Cronbach Alpha and Item-to-Total Correlation were computed for each item. This step led to a minor modification of two variables. After this, all factors exhibited Cronbach Alphas of .785 and above, thus exceeding the value of .70 as demanded by Nunally (1978). Item-to-Total Correlation ranged from .501 to .790 being in line with the suggestions of Adler (1996). Then, a factor analysis was performed using the principle component method. Factors were selected with Eigen value over 1.0. To help the explanation of the resulting factors, the varimax rotation method was applied. In addition, factor loadings and variance explained were computed (see Appendix Table 3). The resulting factors were used to calculate three multiple regression models to test our hypotheses:

Model		**Model 1**	**Model 2**	**Model 3**
R^2		.072	.197	.163
planning	coefficient	$.250^{***}$	$.408^{***}$	$.160^{***}$
	standardized coefficient	$.250^{***}$	$.407^{***}$	$.139^{***}$
newness	coefficient	$-.077^{*}$	$-.099^{**}$	$.182^{***}$
	standardized coefficient	$-.077^{*}$	$-.100^{**}$	$.157^{***}$
changes	coefficient	$.079^{*}$	$-.097^{**}$	$.361^{***}$
	standardized coefficient	$.078^{*}$	$-.095^{**}$	$.305^{***}$

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$; n= 497

Table 1: Results of the regression analysis

As can be seen from Table 3, all correlation coefficients are highly significant. R2 varies between .072 and .197, the latter being quite satisfactory considering the narrow focus of factors investigated. Model 1, the analysis pertaining to external success, supports H1a, however, we do not find support for H2a, as the coefficient is negative and significant at the 0.1 level.

Model 2 lends support to our hypothesis H1b as the coefficient is both, positive and highly significant. The Model further lends support to H2b and H3a: both coefficients are negative and significant at the 0.05 level. In both models, the intensity of planning is the most influential factor.

The evaluation of the factors influencing learning, our third model, lends support to our hypotheses H2c and H3b. While the intensity of planning also positively influences project learning, the changes that occur throughout the course of a project are the most influential factor in this model.

DISCUSSION

Our analyses lend support to six of the hypotheses articulated above. In both, models 1 and 2, the intensity of planning – an actionable variable – is the most influential factor. Comparing models 1 and 2 a possible explanation for the lack of support for H2a is that the negative influence of technological newness on internal success – i.e. on reaching milestones, being on budget and within personnel requirements – may result in higher cost thereby reducing potential profits. Budget constraints and running out of resources may also force a company to consider simpler designs than originally intended with possible negative consequences for competitive advantage, customer satisfaction and sales. With regard to changes, our findings are inconsistent. In line with Dvir and Lechler (2004), we find that they negatively influence project goals such as staying on time and within budget. However, contrary to them our research shows a positive effect of changes on market-oriented success measures. While these differences may also stem from measurement and methodological differences, another possible explanation is the nature of the projects investigated. While Dvir and Lechler analyze a broad variety of projects ranging – aside from product development – from construction to software and reorganization projects, our sample exclusively consists of new product development projects which may be less prone to negative influences by changes due to the highly dynamic and uncertain environment they are carried out in.

Model 3 supports the notion of learning by doing or learning from experience. While both, the intensity of planning as well as the degree of technological newness contribute to project learning, changes and unforeseen events are by far the most important driver of project learning.

This paper is a part of an ongoing research project and as such is subject to certain limitations. The operationalization of the learning construct needs further refinement. The analysis could further be extended to include other relevant factors of influence as explained below. Finally, to shed more light on potential interdependencies and interactions of the phenomena investigated here, more sophisticated statistical analyses are required.

Future research could further refine the concept of planning in NPD to consider other factors aside from its intensity. In addition the inclusion of market newness into similar investigations appears worthwhile to better understand how both of the related uncertainties influence success. Finally, further detailing the contribution of planning to project success with respect to varying degrees of newness or within different environments will additionally contribute to a better understanding of effective planning in new product development.

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APPENDIX

Construct	Measurement Items
Intensity of Planning	The project was broken into work packages. (P1) Timings were assigned to the work packages. (P2) Resources (personnel, financial) were assigned to the work packages. (P3) There was a detailed cost plan for the project. (P4) Responsibilities of team members were assigned at the beginning of the project. (P5)
Degree of Technological Newness	Our company did not have much experience with the technical components of the new product. (N1) The required production lines were not yet existent in our company. (N2) Our company did not have much experience with the required production processes. (N3) The required competencies and skills to realize the product concept differed strongly from available competencies/skills for most of the employees. (N4)
Changes	During project execution, a lot of new elements emerged that had not been foreseen during the pre-development stage. (C1) The project team was confronted with surprises and unforeseen findings during project execution. (C2) During project execution we diverged from planned procedures. (C3)
External Success	To what degree did the new product fulfill your company's objectives with regard to the following aspects? • profit? (E1) • sales? (E2) • market share? (E3) • competitive advantage? (E4) • customer satisfaction with the new product? (E5)
Internal Success	Planned milestones were reached. (I1) Planned financial resources were sufficient. (I2) Planned personnel resources were sufficient. (I3) I was satisfied with the development process. (I4) Overall, considering all aspects, the project was a success. (I5)
Learning	I learned a lot during the project.

Table 2: Measurement Items

Construct	Item	CA	Item-to-Total Correlation	Factor Analysis	
				Factor loadings	Variance explained
Itensity of Planning	P1	.786	.553	.626	54.2%
	P2		.534	.657	
	P3		.643	.765	
	P4		.501	.564	
	P5		.590	.649	
Degree of Newness	N1	.800	.576	.565	62.6%
	N2		.635	.802	
	N3		.737	.926	
	N4		.515	.494	
Changes during Project Execution	C1	.785	.657	.782	70.2%
	C2		.707	.892	
	C3		.516	.568	
External Success	E1	.869	.688	.765	66.1%
	E2		.790	.868	
	E3		.765	.831	
	E4		.674	.708	
	E5		.579	.603	
Internal Success	I1	.801	.542	.612	55.8%
	I2		.570	.633	
	I3		.621	.690	
	I4		.634	.742	
	I5		.555	.632	

Table 3: Cronbach Alpha, Item-to-Total Correlation, Factor loadings, and variance explained