TRACK 6:
Technology and Innovations in the Global Economic Geography

NPD-Process Design and Project Planning in Japanese Engineering Companies – Evidence from an interview research

In this paper we report on the results of an interview research about NPD processes and planning in 15 Japanese mechanical and electrical engineering companies. We asked the companies to describe one successful and one less successful project. All in all, we collected data for 29 projects, 15 of which were successful.
We explore the structure of their NPD processes and how they conduct their planning to achieve both, efficiency and flexibility, which often carry opposing implications for organizing and managing NPD projects. While the majority of the companies in our sample build their NPD efforts on a similar process model, we find them to employ diverse procedures to achieve their aims.
In the companies we interviewed, there is a strong inclination towards planning R&D activities. NPD projects are based on well-defined procedures and written documents. However, not all aspects are planned in equal depth and later phases of NPD projects, which exhibit lower uncertainty, are planned in much more detail. The need for flexibility is highlighted by our finding that less successful projects failed to anticipate changes – especially within the environment – and therefore were often carried out according to outdated plans and information.

Key Words: New product development, Japanese firms, planning, success innovation, project management,

Introduction

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; Cooper and Kleinschmidt, 1987a; Cooper and Kleinschmidt, 1987b; Gupta and Wilemon, 1990; Khurana and Rosenthal, 1998;). 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). This study aims at achieving a better understanding of these two management principles by investigating initial planning activities as well as planning carried out throughout the course of the project.

The literature provides a number of findings that suggest Japanese R&D management practices to be a fruitful object of study for the aims of our research: NPD process in Japan have been reported to be highly adaptive and oriented towards external circumstances (Song and Montoya-Weiss, 2001). For example, it has been found that Japanese NPD project managers manage the process differently, depending on the degree of perceived technological uncertainty (Brown and Eisenhardt, 1995). In addition, Rogers (1990) notes that Japanese companies give much greater care to planning for implementation than their American counterparts for example.

The Study

Aim of the Study

Research has shown that advanced planning in NPD projects positively contributes to a number of success measures, such as time, reduction of failure rates, financial returns and innovation levels (Moorman and Miner, 1998). However, traditional planning efforts have also been criticized for exerting too much formalism and control, and thereby hindering creativity (Bart, 1993). In addition, Song and Montoya-Weiss

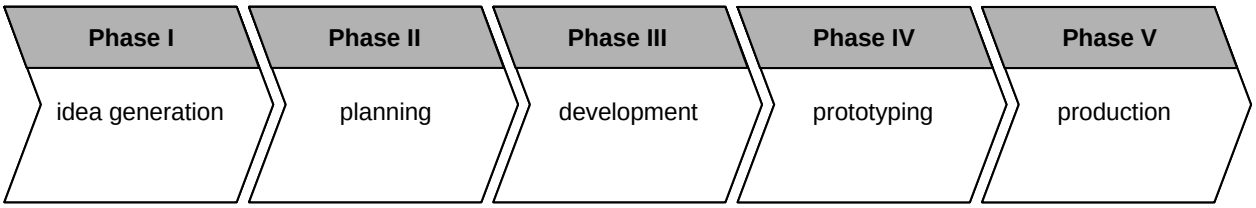

Figure 1. The new product development process.

(1998) point out the need to better align planning activities to the degree of newness of the innovation.

Aside from the acknowledged relevance of 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 such as "schedules / plans" (Pinto and Slevin, 1988) or "planning methods" (Shenhar, et al., 2002). Consequently, there is a call for research into what exactly constitutes good planning (Thieme, et al., 2003). This study tries to contribute to developing a deeper understanding of NPD planning. To achieve this, general NPD planning practices in Japanese companies including the in-depth planning of innovation projects in these companies were analyzed. The following issues have been addressed: Are Japanese companies using a formal innovation process ("Stage-Gate") including detailed regulations concerning activities, decision procedures, and functional participation? If yes, which preferred process models are found, and what specific practices are applied? Which aspects are planned and in what detail during the initial project planning as well as over the course of the innovation process? How does planning evolve over the course of the project? How do the companies account for the uncertainty inherent in NPD and balance between the need to achieve both efficiency and flexibility? How do they deal with changes that occur during project execution? How to companies manage the trade off between the quality of planning and flexibility? In order to at least partially answer these questions, we investigated the processes underlying NPD projects in 15 Japanese companies. In the following sections we will report about these as well as all major related planning activities and management styles.

Methodology

We reviewed literature that is concerned with planning activities in NPD (e.g.,Thieme, et al., 2003; MacCormack and Verganti, 2003; Miner, et al., 2001; Song and Montoya-Weiss, 1998; Moorman and Miner, 1998) and drew on propositions from our previous research findings (Herstatt, et al., 2004a; Herstatt, et al., 2004b) to develop a standardized questionnaire.

Our questionaire was translated in Japan and the interpretation of all questions was verified in a number of discussion rounds before companies were visited. For this research project, MOST (Management of Science and Technology Department) at Tohoku University in Sendai identified a total of 30 mechanical and electrical engineering companies that already took part in a large scale research project, conducted in 2003 by the authors (Herstatt, et al., 2004b). For this study, we focused on the most innovative companies from the aforementioned sample. The selection was based on self-assessment of the companies carried out during the previous project and the contribution of new products to company sales. All in all, 16 companies finally agreed to participate. One company was excluded from the analysis as all new product development efforts turned out to be entirely controlled by the founder, owner and CEO of the company. (Although this is not an unusual finding in Japan, we decided to eliminate the interview results from this analysis because they were not comparable to the remainder of the sample.)

Sample

The Sample contains companies ranging in size from 400 employees to large corporations, one of which has more than 34,000 employees. The average number of employees is around 6500. The structure of our sample is further reflected in annual sales which vary between 1.8 billion and 2.78 trillion Yen. Here the average is approximately 500 billion Yen.

10 of the 15 companies are independent, while 5 describe themselves as dependent subsidiaries of larger corporations. Our interview partners were located in the planning and new product development departments. Further information on the companies and the projects we investigated can be found in the appendix.

The NPD Project Processes

Despite carrying out some unique procedures during their NPD processes and sometimes using a slightly different terminology, most companies we interviewed generally followed an innovation process as depicted in Figure 1. The innovation process is based upon distinct phases. The average duration of the overall NPD process varied between a minimum of 4 months and a maximum of 60 months, with an average duration of approximately 33 months over all companies and projects.

The number of phases or process steps varied between four and six. One company did not explicitly employ a prototyping stage but considered this to be a part of the prior development phase. The sixth process

stage that some of the companies specified was devoted to marketing and sales efforts by all except one firm. This company, which produces various high tech glass products, does not use the production stage to manufacture at full capacity but delays this decision until the sixth phase during which is decides about a scaling up of production based upon how production samples were evaluated by potential customers.

In all but two cases, companies followed a standard Stage-gate approach for different kinds of innovation projects. A manufacturer of power distribution devices and various control equipment reported on having different procedures for longterm and shortterm projects which are usually associated with radical and incremental innovation projects respectively. For shortterm projects (incremental innovations), the planning phase is left out and product ideas which are usually derived from evaluating customer needs or an improved understanding of technology are screened by the development team and people from the marketing department. For longterm projects (truly new products), ideas are screened prior to the planning phase. Here, R&D works together with top management including the CEO of the company and for extremely high-stake projects, even the president of the holding company is involved in the screening process. After the planning stage, there is a second gate for longterm proejcts during which the business group top management and the company CEO decide about the further coninuation of the project.

The second company, a manufacturer of electronic components and information equipment employs two different process models for incremental and radical innovations. For incremental projects with clear customer needs, the company pursues the aim of improving its products accordingly and can therefore come up with a concept very early in the process. This concept is then developed into a prototype which is shown to potential customers to receive feedback. According to the feedback, the prototype is either revised or cleared for production. For radical innovation projects, the process is similar to the one depicted in Figure 1 but concludes with marketing as a sixth stage.

While researchers have emphasized the need for different management styles, strategic actions and organizational capabilities for radical and incremental innovation projects (Trauffler, et al., 2004; Kessler and Chakrabarti, 1999), an explicit differentiation between short-term/ incremental and long-term/radical innovation and the consequent allocation of responsibilities for such innovations in the company including a different set of activities and decision procedures could only be observed in these two cases.

Typical Activities and Personnel involved

The first stage of the innovation process described above, idea generation, first of all consists of information gathering activities such as market research, trend forecast, need and demand analyses and brainstorming sessions. Then, ideas are assessed and some rough first planning steps are carried out. All but one of the participating firms employ multifunctional teams consisting of R&D and marketing personnel at this stage. One company, a manufacturer of special metals and various equipment used in power transmission, telecommunications, and construction, has an especially interesting approach to this stage: The company maintains various R&D units worldwide which are allowed to decide which projects they want to pursue and with what priority. This autonomy is further supported by assigning each unit a R&D budget of its own a large percentage of which can be used very flexibly by the respective team. These efforts are coordinated by a central R&D planning team. Ideas may be shared between the different R&D units and the central R&D planning team has the authority to direct research to other teams if problems occur.

During the planning phase, stage 2 in Figure 1, the idea is scrutinized as technical feasibility is analyzed, business plans are developed, product objectives are formed and project planning is carried out. In one company, customers were already included in this early stage of the process to discuss the new product idea. This stage typically ends with the development of some first product concepts. With the exception of the company mentioned above, this stage is also carried out by multifunctional teams which in many cases are increased in terms of the number of people and corporate functions involved. The manufacturing department is frequently included and in some cases top management is involved in the planning efforts.

In stage 3, the development phase, the product concept and criteria it has to meet are refined. Profit, product and cost plans are further developed. As the project unfolds, product design and reliability are reviewed and checked. One of the companies already distributes samples of the product to selected potential customers at this stage. We did not observe any changes in the involved personnel in comparison to the preceding stage.

During prototyping, the 4th stage, one or more potential prototypes of the final product are developed and are subject to final quality tests and checks for manufacturability. At this stage, customers are frequently integrated into the process to receive feedback about the product's quality and customer acceptance. In one case, product samples are sold to potential customers who test them for a period of one year before the company finally decides about mass-manufacturing the product or not. With the exception of one company which includes top management in the prototyping and mass production stages, no other firm reported about any further changes to the functions assigned to the project in this or later phases of the project.

In stage 5, mass production, only two of the companies still carry out some final checks with regard to manufacturability and screen existing intellectual property rights (IPR). Frequently, this stage is divided into two sub-stages: Many companies begin with small-scale mass production to gain further information about customer acceptance and market performance of the product before scaling up and committing considerable financial resources into large-scale mass production lines.

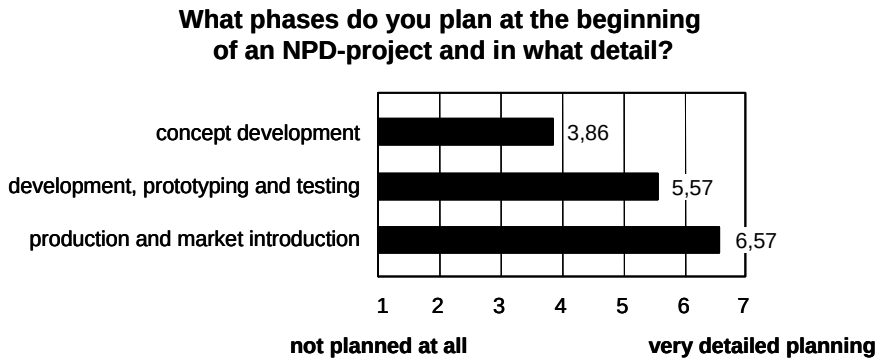

Figure 2. Level of detail of process planning.

Decision Gates

The companies we interviewed structure their NPD processes with a minimum of two and a maximum of five gates between process steps. The distribution of gates is even: 9 companies have a gate between idea generation and planning, 10 have a gate between planning and development, 9 have a gate between development and prototyping and finally 10 have a gate between prototyping and production.

With regard to the criteria employed at those decision gates, we identified two recurring practices: Several companies changed the evaluation criteria from technically oriented aspects during the early decision gates to economic and financial criteria as the project matured. Another set of companies did not change their evaluation criteria but rather changed the performance levels and information requirements the projects had to meet with more stringent performance levels and exhaustive business case analyses in the end.

One of our interview partners depicted an especially comprehensive approach to project evaluation at the gates. The company applies a so-called radar chart that is know to every employee in the company. The radar chart visualizes the level of performance of the project along certain dimensions. In this case, the company judges the originality of the project, its alignment with the corporate strategy and the current product portfolio, its feasibility, the IPR situation with regard to the technologies incorporated in the new product as well as financial data. Each of these dimensions is measured with several variables turning this approach into a very detailed and demanding scheme of analysis.

Problems

Not surprisingly, especially considering the example we described above, a frequent problem that the companies encountered during their NPD processes was the elimination of new ideas as they were not able to meet the specified targets or the team was not able to apply the criteria or gain meaningful information for them for very new products.

Aside from this issue, two other categories of problems were mentioned repeatedly: the collaboration of R&D and marketing personnel was considered suboptimal in many cases. Oftentimes, the teams felt that marketing was integrated too late and that therefore crucial information was missing. But also the communication between the people of the different departments was often prone to problems and they tended to have different expectations towards the product or couldn't agree on the number of functions it should incorporate. Finally, timing was often considered to be of vital importance and some companies stated that their installed processes sometimes were too cumbersome and didn't allow them to develop new products as fast as they would like.

General Planning Activities in NPD

Research has shown that product development cycle times are faster (Griffin, 1997), failure rates are lower (Cooper and Kleinschmidt, 1986), financial returns are greater (Ittner and Larcker, 1997; Song and Parry, 1997), and innovation levels are higher (Olson, et al., 1995) when companies carefully plan and use advanced planning techniques. Besides, Dvir et al. (1999) found that the preparation of formal design and planning documents has a strong positive effect on meeting the project‘s time and budget objectives and further significantly contributes to end-customers' benefits.

All companies in our sample reported on having well-defined procedures, usually in the form of written documents, which are being followed during NPD projects. Accordingly, the companies do not plan the process for NPD projects from scratch individually. However, they widely agreed to planning NPD projects differently according to the degree of newness. During the interviews we frequently found that our interview partners resorted to planning different phases of the NPD process in different detail. A practice which they attributed to the uncertainty inherent in NPD that is especially pronounced during the early stages of the front-end of innovation ("Fuzzy Front End"). The need for flexibility at this point prevails over gains in efficiency associated with more detailed planning. During the later stages, however, when a major part of the uncertainty is already reduced, the need for flexibility is less pronounced and companies strive for more efficiency. This finding is summarized in Figure 2.

In all the companies we interviewed, planning was carried out by a multifunctional group. It consists of the project leader – who in the projects we investigated always had a technical background – and team members from the marketing department. Out of the 15 companies, 9 at least sometimes include external parties in the planning of their R&D projects. These parties often are technical advisors, consultants, market researchers or designers who are brought in to complement the market and/or technical knowledge available in the company. Oftentimes, these external parties were former employees of the company. Two of our interview partners reported on including university researchers in order to be up to date about the latest findings in engineering and management. One company, with one very large and important customer, reported that staff of this customer is frequently included in the planning of new products, especially when the company develops exclusively for this client.

Project-related Planning

To assess project related planning issues, we asked the companies to select a successful and a less successful NPD project that they recently completed. Project success was measured in terms of profit level, sales volume, market share, competitive advantage and customer satisfaction (Figure 3).

The respondents were asked to assess whether the projects fell short of their objectives, met them or even exceeded them on a seven-point Likert scale. In doing so, we followed the notion of evaluating success by comparing the actual outcome of the companies' activities with the organizations' planned objectives (Zhang and Doll, 2001: 102). This allows for a comparison of companies operating in different industries (Verganti, 1997).

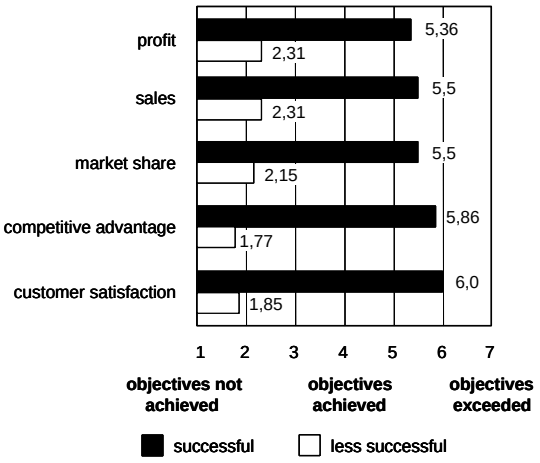

Figure 3. Project success.

One of the key problems of traditional approaches of planning and controlling R&D projects is that they exert too much formal control which curtails creativity (Bart, 1993). In addition, early planning efforts suffer from great uncertainty during the early phases. Consequently, crucial information such as customer needs, competitive product offerings, technological risks and opportunities and the regulatory environment is hard to anticipate at this stage (Verganti, 1997). While being culturally inclined towards planning (confer e.g. Nakata and Sivakumar, 1996), Japanese managers have been shown to be highly adaptive towards external cirumstances (Song and Montoya-Weiss, 2001) and to give great care to the process of planning for implementation (Rogers, 1990).

We asked our interview partners to assess both, the initial planning of the project as well as the planning activities that continued throughout the course of the project following the notion, that planning is not a one-time activity but rather a continuous effort (Lechler, 1997): The current performance should frequently be compared to specified targets which may have to be re-specified from time to time.

With respect to initial planning, we asked the companies about the level of detail of their plans, whether milestones were planned, about the autonomy of the team and the participation of team members in the planning process and finally if responsibilities were assigned and whether contingency plans were devised in case the environment changed in ways not anticipated by the original plan. Surprisingly, with the exception of the level of detail of the initial plan and the planning of milestones, we could not find any differences between the more and the less successful projects. Teams were rather free to decide how to reach milestones, all project team members participated in the project planning process, and responsibilities of team members were assigned at the beginning of the project. But successful projects were planned in more detail than less successful ones and milestones were more often set. This is in line with findings of Ittner and Larcker (1997) as well as Dvir et al. (1999). The results are summarized in Figure 4.

Another noticeable difference between successful and less successful projects can be found when looking at the state of the environment or "environmental turbulence" (Moorman and Miner, 1998: 5) in which the project was carried out. Again, there is little difference between the two categories of projects (successful vs. non-successful) with regard to changes within the team or within the company. However, when looking at the changes in the environment, we find that the successful projects were carried out in a much more stable environment than the less successful ones. In a turbulent environment, the benefit of formal planning is reduced, as many changes occur which oftentimes cannot be properly anticipated beforehand. Consequently, plans are frequently outdated as the assumptions underlying them do not hold up anymore. This is emphasized by the fact that each project is a unique endeavour, making it impossible to know all the tasks that have to be carried out beforehand (Andersen, 1996). For such environments, an emergent style of planning is recommended and improvisation may become necessary to avoid sticking to outdated plans (Eisenhardt and Tabrizi, 1995).

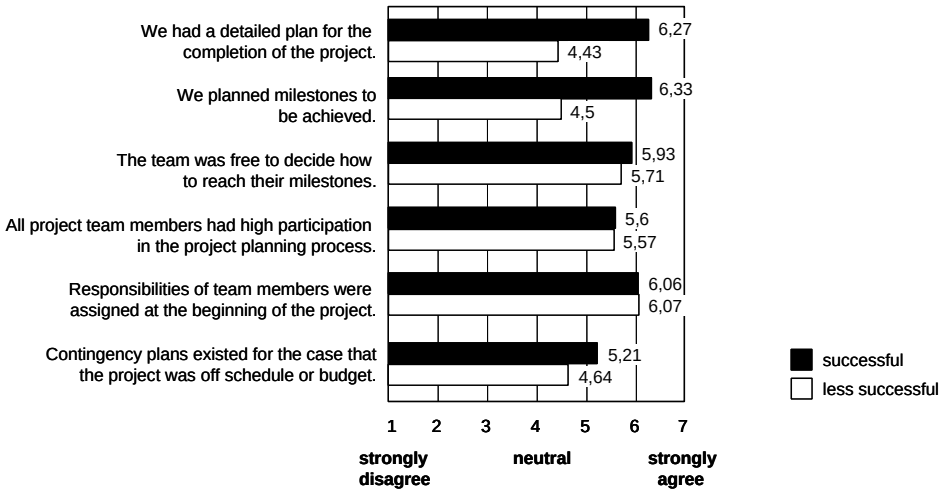

Figure 4. Initial planning efforts.

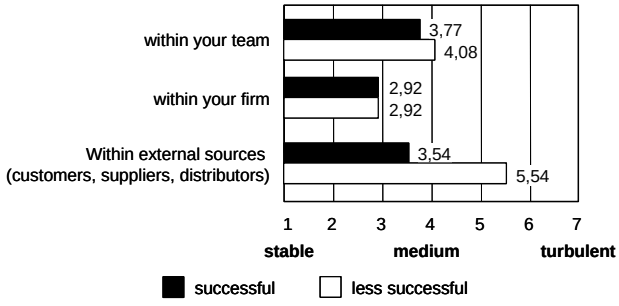

Figure 5. Environmental turbulence during project planning.

As the project unfolds, the need for planning persists and actual progress needs to be monitored and compared to the goals specified during initial planning. We argue here that a frequent comparison of these two states forms the basis for good planning, as deviations from the initial plan can be detected early and be corrected timely in order to minimize the negative impact of outdated plans. In doing so, firms may discover, that they need to modify their initial plans. While such changes may become necessary to insure a good market fit for the product, or to substitute a technology which could not be handled as desired, they often have a negative effect on project efficiency as they lead to prolonged cycle-times and increase cost (Ahmadi, et al., 2001). This again highlights the importance of constant monitoring and enacting necessary changes to plans as early as possible. In this context, focussing on milestones during the planning effort leaves the team with greater freedom to decide how to reach the milestones and will c.p. cause fewer changes than planning specific activities. The same argument holds for an emergent style of planning. However, if companies find that the project progresses without major deviations from the original plan, activity planning may reap aditional efficiencies by optimizing the process.

As Figure 6 shows, there is no noticable difference between the successful and the less successul projects concerning planning styles. In both cases, there were some changes to the original plan which resulted from a frequent comparison of actual progress against the project schedule. The companies relied on formal planning rather than an emergent style of planning, however, focussing on milestones provided the teams with freedom and flexibility to proceed as they deemed necessary.

All in all, our findings suggest that the most noticable difference between successful and less successful projects is based on the initial planning efforts undertaken by the company and the turbulence of the environment. These findings are supported by prior research which has shown that many of the changes made during NPD projects and therefore a considerable amount of cost could have been avoided had the initial planning been carried out more thoroughly (Bullinger, 1990). Our interview partners confirmed this, often stating that market related data which the plans were based upon was poorly researched or had changed in the meantime. This also underscores the influence of environmental turbulence on NPD which requires companies to react rapidly to the ever changing environment and highlights the importance of high-quality initial planning and the correct anticipation of future developments (Calantone, et al., 2003; Verganti, 1999; MacCormack and Verganti, 2003).

Changes

As has been described above, companies may often feel the need to amend their plans. However, careful analysis is necessary to determine whether such changes are indeed required or not. For example, it is not always necessary or even advisable to integrate the newest technologies into a product which just became available during development (Gupta and Wilemon, 1990). Such avoidable changes may add up to one third of total development cost (Bullinger, 1990). Consequently, successful companies only perform necessary changes that may already have been anticipated in advance and have undergone a thorough examination with regard to their necessity (Keplinger, 1991; Geschka, 1993; Fricke and Lohse, 1997;

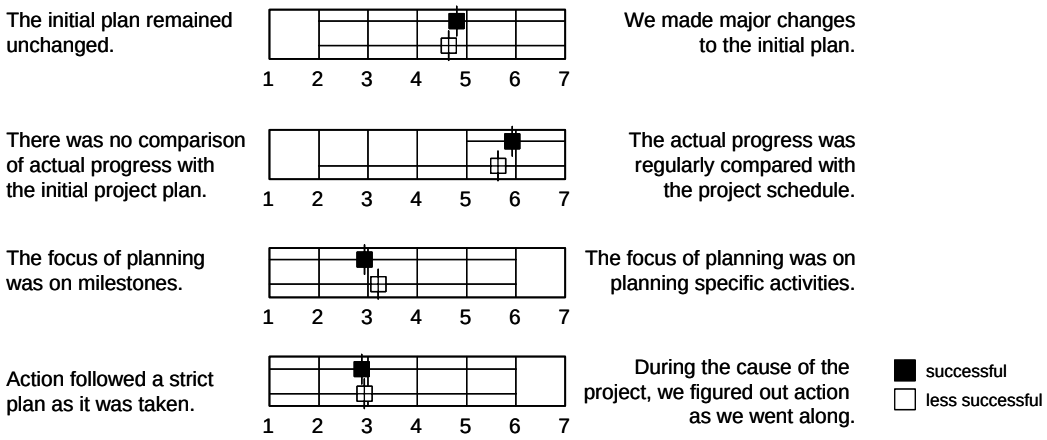

Figure 6. Planning throughout the course of the project

Brennecke, et al., 2001). Dvir and Lechler (2004) found that both, changes made to the process as well as to the desired outcome of a project, have a negative effect on success. According to Wiskow (1999), 37% of the disturbances leading to changes can fully be influenced by the project team, while another 25% can be partially influenced. This again underscores the importance of careful planning activities.

We asked the respondents to assess changes to the technical concept, to project objectives, and to the core team as well as whether a lot of new elements emerged during the execution of the project, and if the team had to diverge from planned procedures. Finally we wanted to know, if other people or staff from other functions were integrated into the project during its course. An increasing integration of corporate functions such as marketing, operations or procurement over the course of the project, known as "dynamic integration", has been shown to contribute to success (Salomo, et al., 2003). Olson et al. (2001) observe that the need for interdisciplinary co-operation increases over the course of the project and it is argued that a high degree of integration early in the project incurs cost, without generating comparable benefits, as teams may end up in fruitless and premature discussions because of incomplete information (Salomo, et al., 2003).

As depicted in Figure 7, there is no noticeable difference between the successful and the less successful projects. However for all questions, the deviations between the respective mean values exhibit the expected directions.

In sum, our findings suggest that changes during project execution do not seem to exert as strong an influence on project success as the initial planning activities. This is contrary to the findings of Dvir and Lechler (2004) and may stem from the fact that the aforementioned authors drew their sample from a variety of projects ranging – aside from product development – from construction to software projects and reorganization. Our sample exclusively includes NPD projects which may not be subject to such negative influences from project changes as other types of projects. Of course, the exploratory nature of our research and the small sample size limit the generalizability of our results.

Project Management

With regard to project management, we interviewed the participants about the management style that was exerted as well as about the team staff and the resources that were used for the project.

Management Styles

Management style may be described along the dimension of formality and participation (confer e.g. Thieme, et al., 2003), where formality is "the degree to which rules, policies and procedures govern the role behavior and activities of organizations (van de Ven and Ferry, 1980: 303). These differing management styles reflect varied managerial assumptions and goals (Lewis, et al., 2002).

In new product development, "formality occurs via utilization of structured processes for managing the project" (Tatikonda and Rosenthal, 2000) and is associated with the assumption that NPD is predictable and rational enough to be planned and managed top-down (Lewis, et al., 2002).

A participative management style is usually associated with less formal control mechanisms such as ad hoc management reviews or few structured progress reviews (Tatikonda and Rosenthal, 2000) and fosters learning (Lewis, et al., 2002) and communication (Gupta, et al., 1986) among team members.

However, research by Lewis et al. (2002) has shown that such seemingly contradictory behaviors and requirements and the resulting paradox (Lewis, 2000) are frequently united in practice, as elements of both approaches are mixed.

While there appears to be no significant difference between the successful and less successful projects with regard to the management styles involved, open and extensive communication seems to be more prevalent in the successful projects as the willingness to let all parties contribute to the project is higher. Our findings do not show differences in the evolvement of management style between successful and less successful projects. In both cases, management style remained the same and did neither become more formal nor more participative.

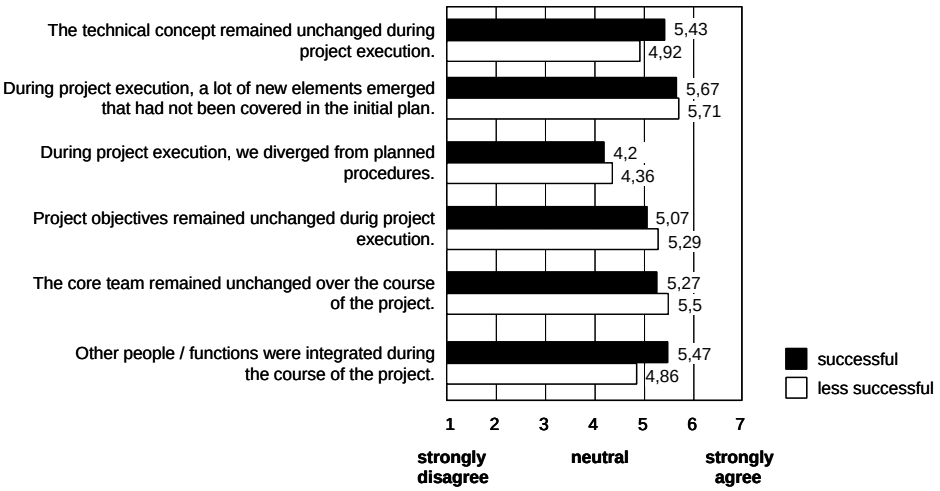

Figure 7. Changes during project execution

Staff and Resources

While it may be both, an antecedent to or a consequence of project perfomance, team motivation was considerably lower in the less succesful projects than in their successful counterparts. Project performance influenced the level of motivation inasmuch as motivation in successful projects remained constant or increased slightly, while it radically decreased in unsuccessful projects.

As has been desribed above, our interview partners were of the opinion that many of the less successful projects particularly suffered from the environmental turbulence in which they were carried out. The most frequent explanations that we were given were that customer needs and market trends had not been correctly anticipated or that competitors had entered the market either earlier than the company, or with a superior product. Consequently, in these cases, the interviewees rated the marketing and management skills of the project team considerably lower than for their successul counterparts.

For both groups of projects, the teams had substantial access to management and resources, both within and outside the company. We found no pronounced differences here.

Conclusions

Companies achieve a balance by formulating rules for standard approaches but also employing an participative management style to insure extensive communication flows among the parties envolved in the project.

With the exception of two companies, the processes employed for radical and incremental innovation projects are equal. Decision gates are equally distributed across. We found companies to follow two approaches with respect to the criteria applied for decision making. One strategy was to change the content of the criteria. In this case, the focus shifted from technically oriented aspects during the early decision gates to economic and financial criteria applied during later gates. The second approach was to apply the same criteria throughout the process but to increase the level of performance the project has to meet. Following these procedures a number of problems were frequently cited by our interview partners. Their major concerns were the killing of new ideas at decision gates and difficult communication as well as differing expectations between the departments envolved.

With regard to the planning efforts undertaken by the companies initial planning and environmental turbulence seem to be the most influential factors for project success. While it is true that for about half of the successful projects environmental turbulence was lower than for their less successful counterparts, the other half of the projects was carried out under approximately equal conditions of environmental turbulence. As aggregate scores for initial planning activities in these cases are also virtually identical, we conclude that in these cases the responsible parties have been better at anticipating the future developments and changes. This is underlined by the slightly higher prevalence of contingency plans for the successful projects. Our findings support the notion of planned flexibility as developed by Verganti (1997; 1999): It is not sufficient for companies to rely solely on initial planning and trying to anticipate as many of the possible changes during the course of the project but it is equally important to maintain flexibility in order to be able to introduce changes late in the project without suffering considerable cost disadvantages.

Future Research

Future research should try to work on the interaction between initial planning, planning changes and process management style. Further research is needed to determine the impact of product novelty on planning activities and the present findings regarding the interplay of anticipation and flexibility should be subjected to large scale research endeavors. Another worthwhile avenue of research to pursue would be to

study NPD project planning activities across different cultural backgrounds to find out how the balance is struck

Appendix

Company	Employees	Sales in MYPY	Projects (S: successful, U: unsuccessful)	Position of interviewee
1	3138	179677	S: Infrared LED U: LED for Communication Devices	Assistant Manager Division Planning Section
2	2100	89000	S: Uninterruptible power supply unit U: Inverter	General Manager Planning Marketing Department
3	692	53651	S: Piezoelectronic inverter U: Communication transformer	Director General Manager
4	400	15843	S: Coupler U: Optical fiber for telecommunications	Senior Managing Director Telecommunications Group
5	900	70000	S: PCB recycling process and technology U: Water purification technology	General Manager R&D Planning Department
6	2700	1800	S: Audio Visual Navigation System for cars U: Car Audio System	Director Vice General Manager Marketing and Sales
7	3000	170000	S: Micro-optics Device U: Micro-optics Device	General Manager Planning & Development Department
8	24239	2781400	S: Multiplexer U: not specified for reasons of confidentiality	Technology Expert Planning Division
9	34690	2695055	S: PDP-Display U: Unique Computer Architecture with unique Operating System	General Manager R&D Strategy and Planning Office
10	15000	800000	S: mid-size car U: compact size car	General Manager Advanced Engineering Department
11	6800	390000	S: / U: both not specified for reasons of confidentiality	Manager Planning Department
12	5388	312334	S: / U: both not specified for reasons of confidentiality	General Manager Advanced Engineering Development Group
13	882	76500	S: Color Laser Printer U: not specified for reasons of confidentiality	Deputy Divisional General Manager
14	771	15935	S: Low power radio station U: not specified for reasons of confidentiality	Adviser Engineering Department
15	5483	350459	S: MEMS Sensor U: not specified for reasons of confidentiality	General Manager

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