Risks in new product development: devising a reference tool

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This paper describes the development and applicability of a risk reference framework (RRF) for diagnosing risks in technological breakthrough projects. In contrast to existing risk identification strategies, the RRF centers on an integral perspective on risk (i.e. business, technological and organizational) and the assessment of risks in ongoing projects. The resulting RRF consists of 12 main risk categories and 142 connected critical innovation issues and has been developed for a globally operating company in the fast-moving consumer goods industry. Our analyses show that to some extent different project members identified the same risks and that saturation occurred in the number of new risk-issues brought to light. We conclude that the success of breakthrough innovation projects improves through formal risk-assessment.

1. Introduction

Intensified international competition, diverse and rapidly changing technologies and demanding customer expectations have made the innovation process more complex and the possible outcome considerably less certain. Empirical research indicates that the success rate of major new product development (NPD) projects still is low (Crawford, 1979; Griffin, 1997; Stevens and Burley, 1997). Therefore it is no surprise that identifying and managing risks have become increasingly important issues in the product innovation literature (Wheelwright and Clark, 1992; Cooper, 1993).

The literature about project management, success and failure in NPD and risk already has yielded important findings about critical issues within the NPD process. However, for at least two reasons the literature has failed to provide a comprehensive picture of the risks involved with product development. First, a vast majority of studies used survey methods across companies, involving only one person in each division or strategic business unit. Secondly, because most studies were retrospective, events occurring late in the process have a better chance of being recognized as major determinants of the outcomes of NPD projects than events earlier on. Market and business dominate the final stages of the NPD process (Wheelwright and Clark, 1992). Therefore the role of technology-related risks can be underestimated. Moreover, as far as technology-related innovation risks are distinguished in literature, the focus is more on cost and time aspects than on feasibility of new technological solutions (Polk et al., 1996; Rosenau, 2002).

In this study, we present the results of an *in situ* study of the risk perceptions of members of NPD project teams. The purpose was to increase our understanding of NPD project risks by investigating risks in projects still in a rather early development phase. On the basis of this investigation an integral risk reference framework (RRF) for NPD projects was developed for use at certain decision points or milestones throughout the projects.

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The remainder of this article is organized as follows. In the next section we will give a concise review of the relevant literature and identify some of the limitations attached to them. Next, the research methodology of the study will be described. In the results section we will present the outcomes of eight case studies. Finally, in the conclusions and discussion section, we will elaborate on some theoretical and managerial implications of our findings. In the appendix, the risks that we found in this study are compiled as a RRF that might be of use at decision points while NPD projects are being carried out.

2. Theoretical background

The project organization is the most widely applied organizational form for NPD. Therefore, project management literature is a logical home base concerning risk issues in NPD. Traditionally research on the determinants of project management performance has primarily focused on critical implementation factors, either on the administrative process of project planning (i.e. tracking and controlling) or on the behavioural aspects of motivation, team building, and leadership (Pinto and Covin, 1987; Baker et al., 1988; Pinto and Slevin, 1989; Pinto and Mantel, 1990; Thamhain, 1996). However, recent research (Kruglianskas and Thamhain, 2000) over multiyear periods and over a large spectrum of different projects and host companies suggest a grouping into eight 'classes' of conditions that seem to have a strongly favourable influence on project performance: project leadership, work design and delegation, management support, communications, work challenge, personal drive and motivation, minimum conflict, risk and threats, and personal appraisals and awards. These studies have also shown the considerable influence of contingent factors, such as the type of project, its stage in the project life cycle and the organizational environment.

A second important stream of literature is provided by the research on NPD. In the last few decades, numerous studies have been published on determinants of new product success and failure. Early research used mainly exploratory case study designs. The research moved to groups of cases and to large surveys about successful innovations. A major advance was made in Europe in the 1970s with the pioneering Sappho Studies (Rothwell, 1972; Rothwell et al., 1974). Here a pair-wise comparison methodology was used to differentiate between successful and unsuccessful policies and practices by contrasting the results of successful and unsuccessful innovations. The Sappho studies were followed by similar studies in other countries. Particularly important in this respect are the Stanford Innovation Project (Maidique and Zirger, 1984) in the USA, NewProd I and II in Canada (Cooper 1979; Cooper and Kleinschmidt, 1987) and the success and failure studies in Japan (Song and Parry, 1996, 1997). This stream of research on determinants of new product successes and failures identified various clusters of important managerial issues: product performance-related factors, market factors, marketing factors (understanding the market and customer needs), synergy factors (good fit between product and marketing requirements and the resources of the firm) and organization and project management factors. Within the literature on success and failure in NPD, two follow-up streams of research can be distinguished (Brown and Eisenhardt, 1995). On the one hand, a stream of research focuses on communication, highlighting the political and information-seeking dynamics underlying the communication processes of successful innovation teams, and on the other hand research portrays product development as a balancing act between product visions developed at the executive level and disciplined problem solving at the project level. This last stream also stressed the important role of suppliers in the product innovation process. The comprehensiveness of these studies with respect to the risks involved in NPD is affected by the fact that in all cases data were gathered afterwards via cross-sectional survey designs and scores were gained by asking single project leaders for their assessments. As a result, projects that were terminated early on in the NPD process, i.e. before the product was introduced, are underrepresented.

The third source of literature relates to the identification and management of risks. The important role of risk has gained increased scientific recognition as the consequences of risk handling became visible through the many studies on NPD success and failure (see e.g. Rothwell et al., 1974; Souder and Jenssen, 1999). Research revealed that individual characteristics and organizational mechanisms affect risk perceptions and propensities to accept or avoid risks. Mechanisms described in this research concern e.g. group think, escalation of commitment, risk seeking versus risk avoidance behaviour (Cooper and More, 1979; Cooper, 1981; Tversky and Kahneman, 1986;

March and Shapira, 1987; Pidgeon, 1988; Vlek and Cvetkovich, 1989; Sitkin and Pablo, 1992; Williams, 1995, 1996, Ruefli et al., 1999; Schmidt and Calantone, 2002). Different approaches have been developed to measure and manage risks. Some of the most widely applied methods include the following:

Potential Problem Analysis (PPA) (Kepner and Tregoe, 1965; Ho, 1993): According to Kepner and Tregoe, problems are usually a result of 'changes'. In PPA, the search for the cause of a potential problem narrows down to the search for the change that could produce the undesired effects. This change may consist of several elements and conditions taken together as a complex, or it may consist of a simple, single element. Finding the change is done through brainstorming followed by analysing the facts used in specifying the problem. Analysis of these facts is thus seen as the crux of problem solving.

Fault Tree Analysis (FTA) (Pilot, 2002): FTA was first introduced by Bell Laboratories and is one of the most widely used methods in system reliability, maintainability and safety analysis. It is a deductive procedure that determines the various combinations of hardware and software failures and human errors that could cause undesired events (referred to as top events) at the system level. The main purpose of the fault tree analysis is to help identify potential causes of system failures before the failures actually occur. The method can also be used to evaluate the probability of the top event using analytical or statistical methods. These calculations involve system quantitative reliability and maintainability information, such as failure probability, failure rate and repair rate. After completing a fault tree analysis, one can focus efforts on improving the safety and reliability of systems.

Failure mode and effects analysis (FMEA) (Cotnareanu, 1999): FMEA deals with a systemized group of activities intended to recognize and evaluate the potential failure of a product or process and identify actions that could eliminate or reduce the likelihood of the potential failure occurring and document the entire process. FMEA helps manufacturers to prevent defects, enhance safety and increase customer satisfaction. Most FMEAs are conducted in the product design or process development stages, but it can also be conducted on existing products and processes.

Many companies included these methods in their standing operating procedures. Notwithstanding the reliability and comprehensiveness of these methods, they have their limitations.

- *Focusing on parts of the risks*: FTA and FMEA primarily focus on potential failures in the technology of the new product, ignoring organizational and market-related risks. The success of product innovation, however, is determined by *both* external influences *and* internal circumstances in which all these factors interact. To be effective, a risk assessment method therefore needs to help identify potential risks in more domains than the technology domain.
- *Data gathering*: PPA mostly uses brainstorming techniques. The outcomes of such sessions may be biased by groupthink and escalation of commitment effects introduced through the *composition of the group and the group process* (Janis, 1982; Bazerman, 1990; Schmidt and Calantone, 2002). As a result, members of a brainstorm group may hesitate to label factors as risky or not risky. Brainstorming is vulnerable as it may fail to trigger people to think of the less obvious risks. Thus in diagnosing risks in NPD, a data gathering procedure is needed that minimizes the inter-social influence of individuals when they give meaning to the risks involved.

In sum, we can draw two conclusions. First, we can conclude that the three streams of literature we reviewed deliver an important initial understanding of risk issues in relation to NPD projects. Secondly, the overall posterior perspective in NPD studies and the methodological onesidedness of the most widely used risk identification and management methods raise the question whether risks related to the different phases of NPD projects have been looked at adequately.

3. Method

In this study risk perceptions of persons working within ongoing NPD projects were identified. On the basis of the results a RRF was developed. The study included eight in-depth cases within one of the world's leading companies in the fast moving consumer goods. After careful consideration between the scientists and the company's R&D management, eight of the company's development projects were selected. All were considered to include novelties in terms of technology and/or marketing, and could thus be seen as breakthrough projects (Wheelwright and Clark, 1992).

Our study applied a qualitative, constructivist risk concept implying that risks are viewed as

individual perceptions of issues that potentially can jeopardize the success of NPD projects, identified via individual interviews. As a result of the case study approach, we were able to enhance the internal validity of the risk perceptions, i.e. that the risks identified on the project level really meant something to the project members involved. For the development of the RRF *theoretical generalization* was considered to be of more importance than *statistical generalization* (Yin, 1994). The reason for this relates to the goal we set ourselves: to deepen the scientific knowledge about risks in NPD.

The risk concept used has three dimensions: occurrence, impact and control (Halman and Keizer, 1994, 1997). A particular NPD activity is seen as risky if (1) the likelihood of a bad result is considerable, (2) the impact on the success of the NPD project is great and (3) the ability of the team to influence it within the time and resource limits of the project is small. The approach aims at gaining an integral overview of *technological, business, and organizational* risks.

Our study included two steps. First, on the basis of a literature review the researchers drafted an initial list of potential risks. Secondly, the 117 project members involved were interviewed. Apart from three persons who were interviewed twice because they were engaged in two projects, each interviewed member of the eight project teams was involved in only one project. Two interviewers interviewed each respondent individually for approximately 90 min. The respondents were asked to prepare themselves for the interview by reviewing the project plan and its intended scope, objectives and deadlines. All interviews followed a standard protocol. First, the interviewee clarified his or her position in the company and the task he or she had within the project. Next, the interviewee was asked to explain, from his or her personal perspective, what the project was about and to indicate the main critical issues in the project in relation to his or her own responsibility and competence. After this, issues for the project and project team as a whole were addressed. Respondents were invited to look beyond functional borders. In the last part of the interview, respondents were asked to look at the literature-based initial list of NPD risks to check whether specific issues should be added or deleted. These interviews resulted in a total list of 325 perceived project risks.

To merge the initial literature-based list with the outcomes of the interviews, a content analysis was applied using the procedure recommended by Kassarjian (1977). First, every critical issue included in the literature-based initial list of risks was given a unique code. Next, two scientists independently verified whether they were adequately addressed already by one of the issues included in the literature-based list for each of the 325 perceived project risks. If so, the scientist gave each project risk issue involved the same code as the matching one in the literature list. After this process, the scientists compared their outcomes and discussed the differences. In cases where consensus could not be reached, a third scientist served as a referee and determined the final coding. The referee had to intervene in 5% of the identified 325 perceived project risk issues. Finally, the literature-based list was revised into an RRF containing 12 main risk categories and 142 related critical innovation issues.

The issues in the RRF have been given a neutral formulation. Prospect theory (Tversky and Kahneman, 1986) suggests that framing makes a difference to risk perception. People tend to underestimate the risk of situations that are presented in a negative way, and overestimate the risk of situations that are presented in a positive way. To avoid underestimation of the risks associated with NPD projects, we prefer a neutral presentation of potential risk items. For example, when respondents indicated during the interviews that there were reasons to believe that the quality of required raw materials would not always be in accordance with the technical specifications, the phrasing in the RRF would be: 'Raw materials meeting technical requirements'.

4. Results

The key features of each project are presented in Table 1. Within this table, the number of project members interviewed is listed besides the number of different risk issues identified and the stage each project was in when the interviews took place. During the content analysis, it appeared that members of different project teams sometimes perceived the same risks. As a result the total number of 325 identified risks could be reduced to 142.

The 142 risks were clustered in 12 main risk categories. These risk categories along with the number of corresponding risk issues are presented in Table 2. The resulting RRF reflects the multidimensional nature of product innovation success

Table 1. Key features of projects with number of participants, number of identified risk issues, and stage of the projects.

Project 1		
Key features: Change in raw materials. Requires new brand image and different raw materials suppliers	No. staff interviews: 12	No. risks identified: 29
Aim of project: Product similar to existing product but on basis of completely new raw materials	*Project stage:* feasibility phase	
Project 2		
Key features: Adding completely new ingredient. Requires change in consumer habits. Also affects production.	No. staff interviews: 21	No. risks identified: 75
Aim of project: Gain competitive advantage by changing product appearance and product performance.	*Project stage:* feasibility phase	
Project 3		
Key features: Change in ingredients must meet legal restrictions and requires adaptations to package and consumer message	No. staff interviews: 19	No. risks identified: 42
Aim of the project: Exploit success of similar product achieved in niche market on a much larger scale	*Project stage:* feasibility phase	
Project 4		
Key features: New raw material delivering new product performance. New consumer message. Competitor reactions expected. Health and safety issues must be checked	No. staff interviews: 13	No. risks identified: 40
Aim of the project: Introduction of new product with high performance and high price.	*Project stage:* definition phase	
Project 5		
Key features: Platform for further variants. Contingency required for key component supply. Quality during storage and transport. Patenting required to withstand competition	No. staff interviews: 15	No. risks identified: 51
Aim of the project: Be first in the market with product that has new format, new component, and new package, easy to use.	*Project stage:* feasibility phase	
Project 6		
Key features: New connection between chemical components. Affects user habits.	No. staff interviews: 13	No. risks identified: 36
Aim of project: Product should have competitive advantage to maintain market share.	*Project stage:* feasibility phase	
Project 7		
Key features: New consumer value if product performance claim can be met. Solution must be patented and supply of raw materials warranted. Marketing approach not settled.	No. staff interviews: 12	No. risks identified: 20
Aim of the project: Stay ahead of competition with new technical solution.	*Project stage:* production phase	
Project 8		
Key features: Replacing strong brand because of changes in user requirements. Must be in time with convincing consumer benefits.	No. staff interviews: 12	No. risks identified: 32
Aim of project: Maintain leading market position.	*Project stage:* feasibility phase	

Table 2. Risk reference framework: 12 risk categories with the number of connected critical innovation issues.

Risk categories	Number of identified risks per category	%
1. Commercial viability risks (CommViab)	17	12
2. Competitor risks (Compet)	9	6
3. Consumer acceptance and Marketing risks (ConsAcc)	16	11
4. Public acceptance risks (Extern)	8	6
5. Intellectual property risks (IntProp)	7	5
6. Manufacturing technology risks (ManTec)	12	8
7. Organization and Project management risks (OrgProj)	22	15
8. Product family and Brand positioning risks (Prodfam)	13	9
9. Product technology risks (ProdTec)	11	8
10. Screening and Appraisal risks (ScrAppr)	6	4
11. Supply chain and Sourcing risks (SuppCh)	11	8
12. Trade customer risks (TradCust)	10	7
Total number of critical innovation issues:	142	100

and failure in which technological, organizational and business factors interact.

The framework shows that our interviews elicited more risks than are recognized within the literature on product innovation success and failure and project management. Overall the literature on NPD and project management (e.g. Cooper, 1979, 1981, 1993; Cooper and Kleinschmidt, 1987, 1993; Rothwell, 1972; Rothwell et al., 1974, Montoya-Weiss and Calantone, 1994; Pinto and Slevin, 1989) highlights risks regarding consumer acceptance, competition, commercial viability, competition, intellectual property, and organizational and project management. Risks regarding production technology and manufacturing were included in Cooper's New Prod- studies, but only in a very general way and possibly due to the posterior perspective of his studies they showed no great impact on project outcomes. Our study shows that in ongoing projects people also perceive risks regarding product family and brand positioning, product and manufacturing technology, supply chain and sourcing, trade customer, public acceptance, screening and appraisal. And in more detail than in earlier studies risks were perceived regarding product technology and manufacturing technology. The RRF is presented in the Appendix A.

Analysis showed that some risks were perceived in all project teams. Concerns regarding (1) the organization and management of the innovation project, (2) competitive advantage of products, (3) the extent to which products appeal to generally accepted social values (e.g. health, safety, nature and environment), (4) the ability to communicate the new product to target consumers and (5) the ability to effectively anticipate possible negative external reactions, recurred in all interviews and can be seen as issues that are characteristic of the company and maybe of the sector the company is in. Of course the low frequency at which specific risks occur can never be an argument for abstaining from taking managerial action. Too many projects have failed because less frequently occurring risks were not taken seriously. The purpose behind any effective RRF is to identify risks in time, so that management still have the ability to influence the course of events.

Next we investigated which risk items within the twelve main risk categories were most frequently perceived by members of the eight NPD project teams. We ranked all risk issues according to the frequency each of them was mentioned. The results are shown in Table 3. Apparently, in the feasibility phase, risk issues relating to product technology, manufacturing technology, and supply chain and sourcing are considered as relevant as risk issues already well known in literature relating to consumer acceptance, commercial viability, and organisation and project management. Such an overview is practical for identifying more structural weaknesses in a company's NPD.

As a final angle we investigated to what extent our research design delivered a comprehensive inventory of the risks that are relevant for the company under investigation. Figure 1 presents the results of this analysis. The eight projects are placed in the figure in the sequence in which they were carried out. The first project is placed on the left and the last project on the right. The figure shows that the first four projects contributed considerably to the number of risk issues in the framework and that the last few projects hardly added new issues. The 'law of diminishing returns' appears to apply, i.e. that for this particular sample of cases saturation is achieved. Assuming that the eight projects investigated in this study

Table 3. Most frequently perceived risk issues within categories.

Ranking	Category	Perceived risks	Frequency
1	Consumer acceptance and marketing risks	Communicating the new product to target consumers	26
2	Organization and project management risks	Organization and management of the project	23
3	Product technology risks	Stability of the product, while in storage in production plant, in shop/warehouse, during transportation or at home	22
4	Manufacturing technology risks	Quality and safety requirements of production system (facilities and personnel)	18
5	Supply chain and sourcing risks	Constant and predictable quality of supply by suppliers	16
6	Public acceptance risks	Possible negative external reactions by key opinion formers or interest groups	15
7	Manufacturing technology risks	Adequate production means (equipment and tools) available when needed	15
8	Product technology risks	New product fulfils intended functions	13
9	Commercial viability risks	New product meets consumer standards and demands	13
10	Consumer acceptance and marketing risks	New product's appeal to generally accepted values (health, safety, nature, environmental issues)	12

provide a representative sample of this company's technological breakthrough projects, the conclusions seems to be justified that the collection of risks in our framework is a comprehensive list of this company's NPD risks.

5. Discussion and theoretical implications

The purpose of this research was to increase our understanding of NPD project risks by investigating the risk perceptions of members of ongoing NPD projects and to develop an integral RRF for such projects, reflecting the issues that deserve to be managed in the course of these projects to enhance their success chances. Key motivation for this study was that we assume that some risks have not been identified in earlier research because most researchers have primarily looked at projects that already had resulted in products that were launched successfully or unsuccessfully, and not at projects that were still in an early development phase when it is not yet clear whether a marketable result will be achieved. Our study elicited quite a number of risks that have not yet been highlighted in the literature. Next to already well-known and well-documented risks regarding consumer acceptance, competition, and organisation and project management, we found some new and some more detailed risk clusters relating to: product family and brand positioning, commercial viability, product technology, manufacturing technology, supply chain and sourcing, trade customer acceptance, public acceptance, and screening and appraisal. One implication might be that a distinction should be made between risk factors of NPD projects busy realizing the intended new product and risk factors of NPD projects entering the launch and marketing phases. These two sets of risk factors seem to overlap only partially.

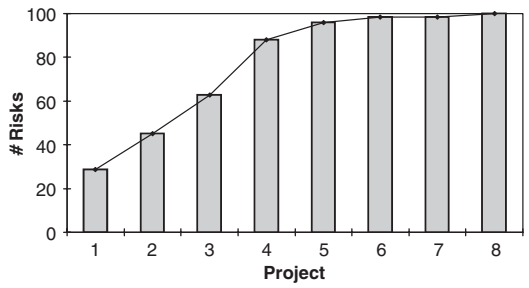

Figure 1. Law of diminishing returns in risk-identification.

Our study was carried out within a fast moving Consumer Goods Company. This limitation raises the question to what extent the results we found are company specific and/or sector specific. Although further research within other firms and in other sectors is required to answer this question satisfactorily, our assumption is that early phase NPD activities outside the fast moving consumer goods sector will also include most of the risk clusters discovered in our study. New products are almost by definition developed on the basis of one or more new technologies and/or raw materials that must be bought from a new or already known supplier, and must be delivered with or without distribution partners to customers and/or retailers that will buy the product only if it

convincingly meets their wants and expectations against acceptable prices.

Our study also revealed that certain risk issues were perceived more often than other risk issues for over the eight different NPD cases. Because almost all respondents in our research were only involved in one of the projects, this result cannot be attributed to respondents' personal and/or functional tendencies to over-emphasize certain risks and under-emphasize other risks. An interesting background question is whether risks that are perceived more often in different projects suggest structural weaknesses in the company in question. In-depth studies are required to determine to what extent cultural and social mechanisms (Hedström and Swedberg, 1998) play a role in the development of path-dependent organisational routines (Weick, 1979; Nelson and Winter, 1982, March et al., 2000).

Our study raises some ideas for future research. First, the results are mainly based on investigations within projects that were in the feasibility phase of their development cycle. The question could be addressed whether an explicit focus on risks perceived in the other development phases would highlight other risks and mitigate the prominence of risks that are identified within the current design. Secondly, the concept of risk we have worked with (Halman and Keizer, 1994) assumes that companies want to make risk identifications during the development cycle of their NPD projects to find cues for corrective interventions. A question worth being investigated is which risk strategies are possible and effective in which phase of the development cycle. Thirdly, one of the reasons for undertaking this time-consuming research was that we realized that the design of most existing studies has hardly included projects that are terminated before the intended end of their life cycle. An interesting follow-up question would be to check which variables or circumstances act as terminators in different development phases. The outcomes could help R&D management to target the developments in their projects that need to be taken seriously in this respect.

6. Managerial implications

Naturally the RRF proposed here cannot claim to include every risk issue that may appear during a specific NPD project. After all, in this study we focused on enhancing internal instead of external validity. Pidgeon (1988) already rightly concluded that risk analyses, no matter how sophisticated, are inherently incomplete: 'One can never know completely what one does not know'. The challenge is to have and use an approach that stimulates people involved to identify risks, while there is time to take action to manage them. For this, some kind of formal risk assessment needs to take place. Making a judgment on perceived risks, involves the integration of a large amount of information. The chance of missing significant events is almost certainly to be higher when using informal risk assessment. Sjöberg (1980) relied on psychological research (Slovic and Lichtenstein, 1971; Tversky and Kahneman, 1986) to demonstrate that people are not very good at integrating information intuitively. Therefore, we conclude that it is preferable to add a structured and systematic component to the process of risk identification. The proposed RRF might serve that purpose.

Regarding the application of the RRF we need to distinguish between its application within its home base company and its use for other companies. The company investigated can use the framework as one of its tools to make people aware both of the risks that are associated with their NPD projects at the start and during the development of new products. Further use of the framework for the research company might include efforts to improve their NPD practices. Our study shows that specific risks are perceived in several projects. These risks might be inspected thoroughly to find means for structural improvement.

The framework may also benefit other companies. R&D management can take the framework and customize it for use in their own NPD projects. For this, they need to take the RRF and delete from it what is not relevant and to add what is missing. In this way, the framework can be given a first customisation round. For subsequent use in starts-ups or during different development phases, the RRF can be refined and further customized if required.

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Appendix: Risk Reference Framework including risk issues taken from literature and issues resulting from case studies

01. *Product Family and Brand positioning risks*		
1.001	Literature	Contribution to category's business strategy
1.002	Literature	Contribution to project portfolio
1.003	Cases	Contribution to brand name position
1.004	Cases	Global roll out potential and schedule
1.005	Cases	Fit within existing brand
1.006	Cases	Cannibalisation of existing portfolio
1.007	Cases	Fit with brand image
1.008	Literature	Family development potential
1.009	Cases	Platform deployment
1.010	Cases	Company reputation
1.011	Cases	Brand recovery potential
1.012	Cases	Brand development potential
1.013	Cases	Consumer acceptance of platform
02. *Product technology risks*		
2.001	Literature	Intended functions known and specified
2.002	Literature	New product fulfils intended functions
2.003	Cases	In-use conditions known and specified
2.004	Cases	Interactions of product in-use with sustaining materials, tools etc.
2.005	Cases	Components' properties, function and behaviour
2.006	Cases	Correct balance between product components
2.007	Cases	Product format meets functional requirements
2.008	Literature	Safety and technical requirements for assembled product
2.009	Literature	Alternatives to realise intended product functions
2.010	Cases	Parity in performance compared with other products
2.011	Cases	Stability of product while in storage (factory, shop/warehouse, transportation, at home)
03. *Manufacturing technology risks*		
3.001	Cases	Raw materials meeting technical requirements
3.002	Cases	Process steps to realise the new product

Appendix (Contd.)

3.003	Literature	Conditions (temperature, energy, safety requirements) to guarantee the processing of a good product quality
3.004	Literature	Production means (equipment and tools) necessary to guarantee good product quality
3.005	Literature	Scale up potential according to production yield standards
3.006	Literature	Production system requirements (quality and safety standards, training of human resources, facilities etc.)
3.007	Cases	Product packaging implications
3.008	Cases	Alternative approaches to process the required product
3.009	Cases	Efficiency of production
3.010	Literature	Adequate production capacity available
3.011	Literature	Adequate Production Start Up
3.012	Cases	Reusability of rejects in production
04. *Intellectual property position*		
4.001	Literature	Protection of original know-how
4.002	Literature	Dependency on third party development
4.003	Literature	Availability of required external licenses or know-how
4.004	Literature	Relation to legal and patent rights of competitors
4.005	Literature	Knowledge of relevant patent issues
4.006	Cases	Patent crossing potential
4.007	Literature	Trade mark registration potential
05. *Supply chain and sourcing risks*		
5.001	Cases	Constant and predictable product quality
5.002	Cases	Capacity to meet peak demands
5.003	Literature	Appropriate after sales services
5.004	Cases	Contingency options for each of the selected suppliers
5.005	Cases	Reliability of each supplier in delivering according to requirements
5.006	Cases	Financial position of each supplier ensuring a long-term supply performance
5.007	Cases	Past experiences with each of the suppliers
5.008	Cases	Suppliers' readiness to accept modifications if required
5.009	Cases	Possibility to cancel supply contracts
5.010	Cases	Ability to produce required quantities against acceptable prices
5.011	Cases	Appropriate contract arrangements with suppliers
06. *Consumer acceptance and Marketing risks*		
6.001	Literature	Product specifications meeting consumer standards and demands
6.002	Cases	Fit of new product with consumer habits and/or user conditions
6.003	Literature	Consumer benefits of new product: unique features or attributes
6.004	Literature	Consumers' conviction that they get value for money, compared with competitive products
6.005	Literature	Product's appeal to generally accepted values (e.g. health, safety, nature, environment)
6.006	Literature	Product's easy-in-use advantages, compared with competitive products
6.007	Literature	Product offering additional enjoyment, compared with competitive products
6.008	Literature	Product reducing consumer's costs, compared with competitive products
6.009	Cases	Non-intended product use by consumers
6.010	Cases	Stability of target consumer's attitudes during the development period
6.011	Literature	Communicating the product with target consumers
6.012	Literature	Knowledge of primary consumer requirements
6.013	Literature	Target consumers accepting key product ingredients
6.014	Literature	Niche marketing capabilities
6.015	Cases	Realistic product claim
6.016	Literature	Efficacy of advertising
6.017	Literature	Product claims stimulating target consumers to buy
6.018	Literature	Repeat sales potential of new product
07. *Trade customer acceptance risks*		
7.001	Cases	Product specifications meeting trade customer standards and demands
7.002	Cases	Trade customers welcoming the new product from the perspective of potential sales
7.003	Cases	Trade customers welcoming the new product from the perspective of profit margin
7.004	Cases	Trade customers welcoming the new product given required surface and volume on shelf and storage facilities
7.005	Cases	Trade customer's attitude remaining unchanged during the development period
7.006	Cases	Communicating the product with trade customers

Appendix (Contd.)

7.007	Cases	Use of right distribution channels
7.008	Cases	Appropriate product care by trade
7.009	Cases	Trade supporting persons endorsing the new product
7.010	Cases	Meeting stock demands
08. *Competitor risks*		
8.001	Literature	Implications of being technology leader or follower for this project
8.002	Literature	Product providing clear competitive advantages
8.003	Literature	Impact of the introduction of the new product on market share positions
8.004	Literature	Impact of the introduction of the new product on market prices
8.005	Literature	Competitive product being launched before launch of new product
8.006	Literature	Response actions towards public and media expected from competitors
8.007	Literature	New product enabling the creation of potential barriers for competitors
8.008	Literature	Acting effectively to competitor's actions
8.009	Literature	Foreseeing future competitor's challenges
09. *Commercial viability risks*		
9.001	Literature	The market target clearly defined and agreed
9.002	Literature	Market target based on convincing research data
9.003	Literature	Capital cost projection for the product's life cycle feasible and based on convincing data
9.004	Literature	Delays in product launch affecting the commercial viability of the product
9.005	Literature	Sales perspectives being realistic
9.006	Literature	Profit margin based on convincing research data
9.007	Literature	Profit margin meeting the company's standards
9.008	Literature	The return on investment (R.O.I.) projection meeting the company's standards
9.009	Cases	Clear and reliable volume estimates
9.010	Cases	Product viability because of repeat sales
9.011	Cases	Attractive purchasing agreements with suppliers
9.012	Cases	Knowledge of pricing sensitivity
9.013	Cases	Adequate investments to secure safety in production
9.014	Cases	Long term market potential
9.015	Cases	Financing of capital investment being secured
9.016	Cases	Fall back potential to use prior product concept
9.017	Cases	Product viability in spite of market restrictions
10. *Organisational and Project Management risks*		
10.001	Literature	Internal political climate being in favour of this project
10.002	Literature	Top management's priority and support for the project
10.003	Literature	Sponsor's interest for the project
10.004	Literature	Project mission and project goals being clearly specified and feasible
10.005	Literature	Project team being sufficiently authorized and qualified for the project
10.006	Literature	Project team utilising the knowledge and experience of (internal) experts effectively
10.007	Literature	Roles, tasks and responsibilities of all team members defined and appropriate
10.008	Literature	Organisation and management of the project
10.009	Literature	Decision making process
10.010	Literature	Communication between members in the project team
10.011	Literature	Reliable and feasible estimation of required money, time and (human) resources
10.012	Literature	Required money, time and (human) resources being available when needed
10.013	Literature	Project team being timely informed about project progress
10.014	Literature	External parties' ability and willingness to deliver in time, within budget and conform technical specifications
10.015	Literature	Contingency options for the parts in the project that have been contracted out to external parties
10.016	Literature	Collaboration within the project team
10.017	Literature	Collaboration with external parties
10.018	Literature	Collaboration between project team and the parent organization
10.019	Literature	Motivated and committed project team
10.020	Literature	Project team paying attention to the right issues
10.021	Literature	Project planning and contingency planning
10.022	Literature	Learning from past experiences

Appendix (Contd.)

11. *External risks*		
11.001	Cases	Clearness about who is responsible for PR of this project
11.002	Cases	Clearness abut who are key opinion formers
11.003	Cases	Anticipating effectively to possible negative external reactions
11.004	Cases	Anticipating effectively to legal and political restrictions for markets where the product will be launched
11.005	Cases	Environmental issues
11.006	Cases	Safety issues
11.007	Cases	In case of new technology: checking prior (external) experience
11.008	Cases	Support of key opinion formers
12. *Screening and appraisal*		
12.001	Cases	Testing and measuring of new product performance targets
12.002	Cases	Testing and measuring trade customer appreciation
12.003	Cases	Testing and measuring consumer appreciation
12.004	Cases	Testing and measuring adverse properties as a consequence of the technological change
12.005	Cases	Credibility of the (internal) measures to external agencies
12.006	Cases	Tests providing reliable evidence