Where New Product Development Begins: Success Factors, Contingencies and Balancing Acts in the Fuzzy Front End

Name of authors:

Johan Frishammar (Corresponding author)
Assistant Professor
Center for Management of Innovation and Technology in Process Industry (Promote)
Luleå University of Technology
SE-971 87 Luleå, Sweden
Phone: 0046-920-491407
e-mail: Johan.Frishammar@ltu.se

Henrik Florén
Assistant Professor
Center for Innovation, Entrepreneurship and Learning (CIEL)
Halmstad University
Box 823, SE-301 18 Halmstad, Sweden
Phone: 0046-35-167444
e-mail: Henrik.Floren@hh.se

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Johan Frishammar works as an assistant professor in Industrial management at Luleå University of Technology, where he also earned his Ph.D. His current research interests concerns management of the fuzzy front end, open innovation, and information and communication aspects in new product development. His articles have appeared in journals such as the *International Journal of Innovation Management*, *International Studies of Management & Organization*, *Journal of Product Innovation Management*, and *Technology Analysis & Strategic Management*.

Henrik Florén works as an assistant professor in Industrial management at Halmstad University. Prior to his current position, Henrik completed a Ph.D. from Chalmers University. His current research interests concerns management of the fuzzy front end, organizational learning, and managerial behaviour in fast-growing firms. His previous articles have appeared in journals such as *International Journal of Entrepreneurial Behaviour & Research*, *Journal of Workplace Learning*, and *Leadership and Organizational Development Journal.*

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Abstract

In light of the increasing attention to predevelopment activities in new product development, this paper reviews the literature on the "fuzzy front end" (FFE). By means of an extensive literature study, we identify, describe and analyze 17 important success factors for organizing and managing the FFE. Our findings first highlight which success factors firms need to excel in when managing and organizing the FFE. Second, the findings show that focusing these factors is not sufficient as such, as interdependencies among factors call for a broader approach. Therefore, relationships among factors and not just the factors *per se* need to be taken into account. Third, the paper identifies key contingencies requiring adjustment of the FFE process at the firm level. Furthermore, the paper draws attention to several "balancing acts" which impose on firms a trade-off among important variables, where maximizing one dimension may imply the minimizing on another. The paper ends with additional post-hoc analysis of the literature, followed by implications for the scholarly literature as well as management practice.

Keywords: Fuzzy front end, FFE, Predevelopment, Product development, NPD, Innovation

Introduction

Technically, new product projects often fail at the end of a development process, or during the subsequent commercialization stage. However, the foundations for failure often seem to be established at the very beginning, i.e. during predevelopment. This is no news. Even the standard textbooks stress the importance of proficiency in predevelopment activities, and highlight the negative consequences of avoiding vital activities (e.g. Cooper, 2001). In a sense, such failures are not surprising. Khurana and Rosenthal (1997) have shown that the predevelopment stage, hereafter referred to as the fuzzy front end (FFE), is a crossroad of complex information processing, tacit knowledge, conflicting organizational pressures, and considerable uncertainty. In addition, the FFE stage is often ill-defined and characterized by ad-hoc decision making in many firms (Montoya-Weiss and O'Driscoll, 2000), which makes missteps difficult to avoid.

Broadly speaking, the FFE is defined as the period between when an opportunity for a new product is first considered, and when the product idea is judged ready to enter formal development (Kim and Wilemon, 2002a). In view of frequent product failures it is important to identify predictive guidelines early in the new product development (NPD) process so that better choices can be made and unnecessary costs avoided (Goldenberg *et al*, 2001). Such predictive guidelines require a cumulative understanding of the research on the FFE, which is not available at this time. This study is intended to help close this knowledge gap. The purpose of the article is therefore to further our understanding of the FFE. This is achieved by means of a review and analysis of the empirical research on the FFE, with a focus on how this important phase can be organized and managed more efficiently and effectively.

A review of the literature on the FFE is justifiable for a couple of reasons. First, proficiency in the FFE seems to have a huge impact on product success (Cooper and Kleinschmidt, 1987; Khurana and Rosenthal, 1997; 1998; Murphy and Kumar, 1996). For example, problems with unclear or incorrect product definitions often cause high costs and/or failure in later stages of NPD (Bacon, Beckman, Mowery and Wilson, 1994). Second, the recent and dual striving for innovation and efficiency during NPD also implies a strong focus on FFE activities, where product concepts still can be changed and modified at relatively low cost (Elmquist and Segrestin, 2007). Third, knowledge on the subsequent development phase is massive, and several excellent review articles which cover the "full" NPD process exist (e.g. Brown & Eisenhardt, 1995; Krishnan & Ulrich, 2001). No review with a sole focus on predevelopment has been published previously. There are some conceptual articles which go through literature and advices practitioners (e.g. Chang, Chen and Wey, 2007; Cooper, Edgett and Kleinschmidt, 2002; Kim & Wilemon, 2002a; 2002b), but no comprehensive reviews of the *empirical literature on the FFE* exist. It is argued here that although empirical articles differ in rigor and quality, they still provide a more solid base for subsequent generalizations than do conceptual papers.

The mechanisms that allow proper management of the early phases in NPD were largely unexplored ten years ago (see Verganti, 1997) and still are. We hope that this review will contribute to making these mechanisms more visible, which is important for both practitioners and for further scholarly investigations.

The rest of the paper is outlined in the following way. First, we present the method and approach adopted for the review. Second, we review the success factors for management of the FFE as identified in previous research. Thereafter follows a discussion on key

contingencies in the FFE as well as an elaboration on important "balancing acts" which call for management attention. The paper ends with additional post-hoc analysis of the literature, suggestions for future research, and managerial implications.

Method and Approach

The issue of which literature to include and which to disregard is awkward as much as it is generic to every literature review project, and the problem resembles the one of type-I and type-II errors in quantitative research. That is, there is always a risk of including "the wrong literature" or, alternatively, to disregard "the right literature". To minimize these two problems, a number of actions were taken.

First, before making any formal searches for literature, we browsed all issues of the major technology innovation management (TIM) journals published during the past 10 years, i.e. from 1997 to 2007. For the list of journals, see Linton and Embrechts (2007). The reason for starting with the TIM journals was the observation that research on the FFE often appears there. The subsequent literature searches corroborate this assumption as almost eight out of ten articles included in this review were published in TIM-journals. The main reason behind this initial read-through exercise was that "fuzzy front end" is not the only term used to describe the first phase of the NPD process. Hence, this action addresses Weick's (2007) concern that perception without conception is blind. In other words, this first browsing session provided us with a clearer idea of the terminology employed. More specifically, inductive reading provided six different subject-related terms that were frequently used in the articles: *Early, Discovery, Front end, Idea, Concept,* and *Predevelopment*. Furthermore, we also found three different terms denoting "phase": *Stage*, *Process* and *Phase*. Finally, three terms were used to describe the actual work being carried out: *Development, Innovation* and *NPD*. In

subsequent formal searches for literature, these terms were used in combinations to generate the actual list of peer-review articles which constitute the base of the review.

The formal literature searches were carried out in the databases Business Source Elite, Emerald Insight, ABI/Inform, J-Store, IEEE Explore and Blackwell Synergy. These databases are complementary but to some extent also overlapping, and together they contain all relevant TIM Journals as well as the most important journals in the field of management. All in all, our search efforts generated 39 articles which were included in the actual review. A list of these can be found in the reference list, which lists separately the reviewed articles. Needless to say, the total numbers of hits in the databases were far greater than the final list of selected articles. Many articles talked about something being "fuzzy" without any connections to development work, i.e. fuzzy logic. These articles were disregarded. Other articles discussed the importance of the FFE but without presenting empirical findings and they were also disregarded. Typical examples include Cooper (1999) or Rothwell (1994) who both states that high-quality up-front analysis is essential to efficient product development. Still other articles focused on sources of ideas for innovation (e.g. McAdam and McClelland, 2002; Slater and Gann, 2003). These articles were not included, as most authors conceptualize the FFE as starting with organizations *already having an idea*, thus clearly placing the sources of these ideas outside the FFE-stage. Still another group of articles were conceptual, although the article "indirectly" was said to be based on data. A significant example in this group is the paper by Cooper, Edgett and Kleinschmidt (2002, p. 21) who states that the article "…reports our observations and experiences in working with more than 500 companies…" The article neither contains a methods chapter, nor a description of the sample. Articles by Groenveld (1997) and Moskowitz (1997) were considered inappropriate for the same reason. A final group of articles disregarded actually dealt with the FFE, but had nothing to do with

organizing or managing this phase. One significant example is Ozer's (2004) use of cluster-based methods for predictions of market potentials of new product ideas. We did include, however, empirical articles which only partly focused on the FFE. A significant example is de Brentani's (2001) research on success factors for different types of service innovations.

In addition to the peer-review articles located through the formal search procedures, some additional ones were located by means of a snowball-technique, i.e. by browsing the reference lists of the articles from the formal literature search. Books, book-chapters and conference articles were also found, but publications related to the last three categories were few and not included in the review for quality reasons. Although it is still likely that we have missed some contributions of potential importance, we hope that the combination of methods for generating the literature has strengthen the trustworthiness of the review. Even though some individual contributions might have been missed, important ideas and themes are less likely to have been excluded, assuming scientific progress is cumulative and that specific ideas or themes often appears in more than one publication.

After generating a tentative list of literature, about fifteen frequently cited articles were read by both authors in order to get an overview of the actual contents. This provided us with important insights on which analytical dimensions to employ for the subsequent classification and analysis of the empirical literature. Based on this, we designed a first preliminary classification matrix containing over 25 potential success factors. When subsequently reading all articles, several of the initial factors proved unusable, and were therefore deleted. Other factors were "merged", such as those on *product concept* and *product definition*. Still others factors "emerged" from inductive reading, for example *learning from experience capabilities of the pre-project team*.

The main focus of the review lies in identifying success factors for managing the FFE. Drawing on Cooper and Kleinschmidt's (1987) observation that controllable variables are relatively more important success factors than situational- or environmental variables, we focus on the factors that managers can "do something about", e.g. product definition or customer collaboration. Each success factor or dimension is defined and elaborated upon in the coming section, constituting the actual analysis of the literature. In accordance with Khurana & Rosenthal (1997), some of these factors are project-specific, while others are more all-encompassing, often referred to as foundational elements. Our review does not include dimensions on the individual level. For example, Griffiths-Hemans and Grover (2006) investigated individual level variables in the context of pre-development (e.g. thinking style of individuals and intrinsic motivation). Although these variables might be important antecedents to how firms eventually perform their FFE activities, they are not focused here.

Success Factors for Managing the FFE – Descriptions and Analysis of Previous Literature

The sections below constitute the core of the paper, and review the literature on organizing and managing the FFE. To allow for overview and transparency, most success factors are described under separate headings together with the associated empirical findings. The factors are not presented in order of importance as the present state of knowledge makes such an ordering judgemental at best. Table 1 below presents the success factors and the literature utilized in a comprehensive way.

[Take in table 1 here]

The Presence of Idea Visionaries or Product Champions

In order to overcome stability, inertia and status quo, innovative ideas benefit from leadership by committed enthusiasts (Grant, 1995). Some authors refer to such enthusiasts as product champions (Conway and McGuinnes, 1986) while other authors use the term idea visionaries (Griffiths-Hemans and Grover, 2006). The main difference between the terms seem to be that an idea visionary works at a more abstract level and relies on his/her social capital and credibility, while a product champion might be more involved with concrete activities, such as go/no go decisions.

Previous research has shown that this "role" can be played by different actors. Championing can for example be provided by the idea originator, by a person most affected by a specific problem, or from a person with new product responsibilities (Conway and McGuinnes, 1986). According to Conway and McGuinnes (1986), champions were not always easy to identify, but when they were they acted as a critical element in keeping persistent pressure on their firms to act. Indeed, many managers in the sample believed that every product concept needed to have a champion to make any progress whatsoever (Conway and McGuinnes, 1986). Similarly, champions have been found to facilitate the interpretation of product concepts through crisscrossing the interface between the project and the organization (Heller, 2000). Griffiths-Hemans and Grover (2006) also found that ideas and product concepts often need the help of others, other than the inventor, to develop, concretize and subsequently be accepted into the "formal" NPD process. According to these authors, an idea visionary was typically a person of power or authority who could promote the idea to stakeholders to seek and establish commitment.

Idea Refinement and Adequate Screening of Ideas

The FFE phase is most often conceptualized as starting with the surfacing of an idea, i.e. when a firm "first recognize, in a semi-formal way, an opportunity" (Khurana and Rosenthal, 1997). A product idea can be broadly defined as "a mental picture of a possible and feasible solution to a problem" (Griffiths-Hemans & Grover, 2006). All products originate from ideas, which result from thinking processes of different social actors, e.g. employees, customers or suppliers (Boeddrich, 2004). As ideas are early, vague drafts or solutions to problems, they need to be developed into more refined and feasible versions so that for example risks can be calculated (Boeddrich, 2004). Research by Zien and Buckler (1997) ruled out that one hundred ideas for every market success was the rule of thumb. This finding may not necessarily hold across firms and industries, but the general message is that firms need a constant flow of high quality product ideas, as well as procedures for evaluating these ideas. Accordingly, deficiencies in idea refinement and screening (e.g. poor ideas, too few ideas, or poor screening) often result in costly problems at later stages of the process (Cooper, 1988). Hence, effective generation of ideas as well as screening of ideas with the purpose of selecting which ones to pursue are truly essential activities in the FFE (Elmquist and Segrestin, 2007), but at the same time often a neglected issue (Verworn, 2006). The sections below review in more detail the literature on idea refinement and screening of ideas in the context of the FFE.

Conway and McGuinnes (1986) have suggested that firms need some sort of system to generate ideas for new product concepts. What is striking about most of the empirical literature, however, is that firms seem to benefit by adapting rather unconventional approaches to idea generation. For example, Kohn (2005) found that firms should employ an exploratory rather than a confirmatory approach to their scanning activities, when searching

for new product ideas. The main reason is that identification and interpretation of trends seem to call for a more exploratory and creative approach. Hence, the purpose of scanning should be on identifying opportunities rather than, as is common, on reducing uncertainty (Kohn, 2005). In a similar vein, Rosenthal and Capper (2006) make the plea for ethnographic research early in the FFE as a means of idea generation. As many opportunities and ideas are not obvious in advance, argue the authors, formal market research may fall short of detecting them. Therefore, they argue, ethnographic research may be an alternative method to elicit subtle and often tacit customer needs. Their findings highlight the fact that information and ideas for new products does not always reside in the conscious mind of consumers, but is rather revealed through observation of routine behaviour. The ethnographic approach usually deals with small and carefully selected samples of potential target customers with the purpose of identifying needs that are otherwise difficult to elicit (Rosenthal and Capper, 2006). Hence, ethnography as a method seems exploratory rather than confirmatory.

New ideas need not necessarily come from scanning or customer interaction, however. Murphy and Khumar (1996) concluded that the use of internal personnel for ideas resulted in higher success rates. Case research by Elmquist and Segrestin (2007) has also showed that new product ideas build on previous knowledge, which triggered exploration in new areas. In the cases they studied, new knowledge and new concepts co-evolved, which helped to advance the discovery process in the firms studied.

When ideas have been refined, firms need to weed out the potentially good from the bad. The role of screening is to initially select new product ideas for further investigation. Research by Cooper (1988) shows, however, that screening often is handled poorly, as many firms use screening only to make rough decisions, trying to get rid of obvious “loser projects”. Indeed,

screening seems to be one of the most critical steps in the NPD process. Studying Canadian manufacturing firms, Cooper and Kleinschmidt (1987) found that initial screening had the highest correlation with new product performance. Accordingly, terminating inferior product ideas early often result in large cost savings, as costs generally increase as NPD projects move toward commercialization (Lin and Chen, 2004). Research by Murphy and Kumar (1997) show that screening takes place in at least two different but related domains. The purpose of *business analysis* is to screen a new product idea in terms of its viability as a business proposition. Put simply, the business analysis ensures that a development effort is grounded in a potential for financial profitability, and this was the single most important activity in the firms studied by Murphy and Kumar. A new idea must also be screened in terms of feasibility, however. *Feasibility analysis* determines if a firm can support a development project with sufficient resources (Murphy and Kumar, 1997).

From the section above, one can easily get the impression that the faster ideas can be evaluated and, if flawed, terminated, the better off should the firm be, as it then spends energy on viable product concepts only. Intensive screening might, however, also kill ideas too early. Research by Conway and McGuinnes (1986) has shown that an overly reliance on formal processes in the FFE might interfere with the way ideas gather momentum through informal debate. This finding represents a potential paradox, as screening indeed must be performed but may provide the firm with negative consequences as well. Research has also indicated that the management of the formal and informal elements of idea screening needs to be considered. McAdam and Leonard (2004, p. 86) identified a tendency for unspoken rules to act as filters during idea screening. The interview comment from one of their respondents signal the relevance of this issue: “It met all the rules but we still didn’t like it”.

Another problem with screening is that it may perform less well in areas where the firm is not currently active. Research by Elmquist and Segrestin (2007, p. 116) has shown that "classical" screening of ideas works less well when firms go into areas where they lack experience. According to the authors, the selection logic is insufficient when firms enter areas where their knowledge base is weak, simply because the evaluation criteria are unknown. Hence, firms cannot judge whether ideas are feasible or not in a meaningful way. Bröring and colleagues reached similar findings, investigating how evaluation and selection during the FFE took place during industry convergence. These authors found that when firms lack absorptive capacity, they either focus on areas where they can benefit from past knowledge, or they try to set up partnerships early in the FFE to fill the gap of absorptive capacity regarding technology or market development (Bröring, Cloutier and Leker, 2006, p. 493).

An Adequate Degree of Formalization

Several authors have found that firms benefit when bringing some order and predictability to the FFE, as ambiguity then can be reduced (e.g. Boeddrich, 2004; de Brentani, 2001; Khurana and Rosenthal, 1998). Khurana and Rosenthal (1998) define a formal front-end process in terms of four components: It should be explicit; widely known, characterized by clear decision-making responsibilities, and finally contain specific performance measures. The underlying logic, writes Khurana and Rosenthal (1997), is that explicitness from the very beginning promotes stability in the subsequent development process.

De Brentani (2001) makes the plea for formalization, at least when it comes to incremental service offerings. In her study, high performing firms tended to have implemented a formal process which included up-front activities such as idea screening and concept evaluations. The relationship between formality and performance seems not to be linear, however. Rather,

the literature seems to suggest an inverted u-shaped relationship, implying that too little as well as too much formality might be unfavourable. Based on case study data, Khurana and Rosenthal (1998) observed two kinds of risks: Either an absence of formality, or an excessive reliance on it. Most firms in their sample did not have a formal process for FFE activities, while two firms were found to spend too much time trying to fill the requirements of a formal process. Although the optimum balance between chaos and order might be impossible to find, there eventually comes a point where formality can lead to rigidity, a fact which management must be observant about (Khurana and Rosenthal, 1998).

In a similar vein, Boeddrich (2004) discusses something called “the fantasy route to innovation” versus “the technocratic route to innovation”. Based on case data, Boeddrich identifies two ideal routes. According to the first principle, ideas will emerge only in a free and chaotic environment without systematic processes. According to the other, innovation can be created through excess formality and data mining. Both ways are doomed imperfect; idea generation without focus is just as meaningless as believing that machines and excess formality creates innovation (Boeddrich, 2004, p. 275). This idea is further supported by Gassmann and colleagues. According to their study, too much discipline, project management and rigorous orientation towards customers endangers creativity and makes the early innovation process bureaucratic. On the other hand, too much slack and freedom might also be hurtful and result in technical gimmicks rather than novel product concepts (Gassmann, Sandmeier and Wecht, 2006). In sum, formalization of FFE activities seems necessary, although a sufficient degree rather than too much or too little seems appropriate.

Early Customer Involvement

Customer involvement, including needs analysis and being market oriented, has received a fair share of attention in the NPD literature. For example, an understanding of user needs was the most important discriminator between success and failure projects in the SAPPHO studies (Rothwell, 1974). Also, a market orientation has favourable effects on the number of new products introduced (Lukas and Ferrell, 2000) as well as on NPD performance (Pelham and Wilson, 1996). Close customer involvement is somewhat controversial, however. Literature on social networks shows that although close customers may have great motivation to cooperate, they often cannot provide access to rich and diverse information (Granovetter, 1982; Krackhardt, 1992).

In the context of the FFE the positive effects seem to offset the negative ones, however. For example, customer needs need to be well understood before actual development starts (Verworn, 2006). Cooper and Kleinschmidt (1987) and Cooper (1988) both found that early assessment of customers contributed strongly to product success, as did Zien and Buckler (1997). Research by Murphy and Kumar (1997) found that direct contact with customers was the most important activity for generating new product ideas. In their study, customer input also helped in clarifying project objectives. Hence, products designed to meet specific needs were more likely to be developed (Murphy and Kumar, 1997). Research has also shown that NPD teams working without necessary customer information succeed (Bacon *et al*., 1994). Similarly, Langerak *et al*. (2004) found that a market orientation was positively related to proficiency in idea generation and idea screening. In practice, their findings reveal that a market oriented culture promotes values and norms which provide consistency to the FFE. Consequently, efficiency and effectiveness in the FFE phase can be enhanced by pursuing a market-oriented culture (Langerak *et al*., 2004). The importance of early customer

involvement is also strengthened by research that has evaluated specific methods for early tapping of customer knowledge into the FFE (Gassmann *et al*., 2006).

In the context of services, both Alam (2006) and de Brentani (2001) found that the FFE can be made less fuzzy by interacting with customers. Through case studies, Alam (2006) found that customer interaction during the FFE reduced development cycle time, and facilitated the screening and evaluation of service concepts. Similar findings are provided by de Brentani, who found that successful new service concepts target clearly identified customer needs, help customers to solve important problems, and are consistent with customer values. These findings were found for all kinds of services – both highly innovative and more continuous ones (de Brentani, 2001).

As pointed out at the beginning of the section, customer involvement may also imply problems. In the context of the FFE, Alam (2006) found it feasible to ask customers to suggest benefits and outcomes rather than to focus on ultimate solutions. The argument behind this is that customers cannot tell a firm exactly which product to develop, as customers often are poor reporters of their own needs (Alam, 2006).

Internal Cooperation among Functions and Departments

Although the importance of cross-functional integration is well known (see e.g. Griffin and Hauser, 1996), empirical research suggest it be of paramount importance in the FFE phase as well. Case research by Verganti (1997) concluded that early cross-functional integration has positive benefits, and suggested all major functions of a firm to be involved early. Verworn (2006) found that in most FFE projects, idea generation and selection took place in meetings where the various functions of a company were represented. It has also been found that the

establishment of cross-functional teams in the FFE could promote innovation and overcome resistance to change (McAdam and Leonard, 2004). Furthermore, cross-functional integration has been found necessary to "keeping an idea alive and active" (Conway and McGuinnes, 1986, p. 287). Basically, this means that an idea had to be exposed to the review and criticism of knowledgeable individuals from all affected functions and departments.

Cross-functional integration has also been found important for knowledge creation (Heller, 2000). All firms but one in Verganti's (1997) study assigned a multifunctional team to perform concept generation and product planning. Cross-functional exchange of information proved to enlarge the knowledge base available in the FFE stage, and therefore reduced uncertainty regarding future constraints and opportunities. Second, it also assured alignment between product concepts and company strategy. Third, it facilitated for downstream phases, e.g. process engineering, to start earlier with some preliminary activities, and finally, downstream actors commitment to upstream decisions were fostered.

The strongest interdependencies in the FFE phase have been identified as being between R&D and marketing, as these functions often share responsibility for concept- and product definition (Kohn, 2006). Integration between these two ensures task relevance for engineers and task feasibility on the marketing side (Gassmann *et al*., 2006). Although R&D and marketing integration might be the most important type during the FFE, both Verganti's (1997) findings as well as those of Bacon *et al*. (1994) suggests more functions to be involved, e.g. engineering, manufacturing, and process design. Projects lacking such multifunctional involvement without exception proved to be failures. The findings of Bacon and colleagues also highlight another important success condition: The existence of multifunctional teams proved to be a necessary, but not sufficient, condition for success. Trust

and effective communication among members of the multifunctional team was found critical. (Bacon *et al*., 1994).

The establishment of a cross-functional team need not only be a positive thing, however. Murmann (1994) found that complexity, workload and project scope could be reduced, and the FFE phase accelerated, if a firm assigned a small and homogeneous team to the tasks. This finding needs not necessarily be contradictive or counter intuitive vis-à-vis the mainstream literature – it might just be that the exact composition of a successful team varies with context, and that both homogeneity and heterogeneity are needed to some extent.

Finally, research by Moenaert *et al*. (1995) has found that cross-functional integration impacts positively on uncertainty reduction in the FFE. Moenaert and colleagues found that cross-functional information flows helped reduce task variability and increase task analyzability, which is important for commercial success. Otherwise stated, commercially successful product innovations were characterized by maximum uncertainty reduction during the planning stage of the project lifecycle. The authors suggest that cross-functional integration is especially important in the FFE, as modifications or drastic changes are least expensive when performed there.

Information Processing other than Cross-functional Integration and Early Customer Involvement

Information processing, i.e. acquiring, sharing and using information, is important in several domains other than pure customer involvement or cross-functional integration. The research of Bacon *et al.* (1994) has shown that prospective and current product offerings of competitors need attention. In their sample, successful teams generally made such analysis, while information on competing products was ignored or unavailable in less successful teams.

Furthermore, the research of Bacon *et al*. (1994) shows that pure analysis of information is insufficient; results need to be communicated to all team members. Furthermore, these authors also found regulatory and standards assessment to be of importance – most teams dealt with legally mandated issues in their product definitions. De facto or market driven standards proved more problematic, however. Since such standards often are set by customers and competitors, a product development team's knowledge about standards is often directly related to its customer- and competitor information (Bacon *et al.*, 1994).

Information about competitors and standards are often firm or industry specific. Although such issues are important in the FFE, Börjesson *et al.* (2006) advices practitioners too have a broader outlook. One-sided attention, they claim, often leads to product ideas or concepts which resemble what the firm already is offering. Hence, the scanning process also needs to include more experimentation than the scanning processes often suggested in the strategy literature. Under the best of circumstances, the scanning process for product idea generation should be both active and informal while still providing deep environmental knowledge (Börjesson *et al*., 2006).

Senior Management Involvement

Although activities during the FFE are typically carried out individually or in small teams (Kim and Wilemon, 2002a), several authors note that such teams need support from senior management to succeed. Several reasons lay behind the importance of senior management involvement. First, such support is crucial to overcome resistance to change and thus go beyond initial resourcing and public support (McAdam and Leonard, 2004). Second, new product ideas have a much greater probability of being developed if executive champions become personally involved in proposed projects during the FFE (Murphy and Kumar, 1997).

Third, top management support in the FFE lead to increased levels of innovation (Koen *et al*., 2001). Finally, senior management involvement is important for the alignment of individual activities. Such intervention is needed as important activities often cut across functional boundaries, and senior management can provide strategic thinking in the FFE (Khurana and Rosenthal, 1998).

Preliminary Technology Assessment

Before product development gets underway, past research has pointed to the importance of early considering the technology on which a product will be based upon. Proficiency in preliminary technology assessment has been found to be strongly linked to success in NPD (Cooper and Kleinschmidt, 1987). In simple terms, uncertainty reduction through technology assessment is a crucial activity before investing a significant amount of resources into a project (Murmann, 1994). Hence, the key question here concerns the technical viability of the product. According to Cooper (1988), technology assessment means answering the questions of whether the product can be developed, what technical solutions that will be required, and at what cost? Finally, firms need also ask if the product can be manufactured.

Research by Bacon *et al*. (1994) has found that success is much more likely if the necessary technology is both available and reliable. Accordingly, products that required significant advances in underlying technologies during development frequently failed. In this study, projects based on technologies that were in hand at project inception were found significantly more successful. The simultaneous development of technology and products proved very difficult, especially in those cases where technology development took place in later stages. Hence, successful innovation does not solely result from market-pull; necessary technology must be well-characterized and "in hand" (Bacon *et al*, 1994, p. 44). Research by Verworn

(2006) suggests that firms are aware of the fact that technology uncertainty must be reduced during the FFE. In her study, technology uncertainty prior to development was relatively low and in most projects requirements were explicitly defined and technical feasibility checked (Verworn, 2006).

Alignment Between NPD and Strategy

Alignment between NPD and the *overall business strategy* of the firm has been found critical to project success. The rationale seems to be that projects must capitalize in some way on the core competences of their firms, and projects who don't meet this criterion were less successful (Bacon *et al*., 1994). On another level, Khurana and Rosenthal (1997) reaches a similar conclusion regarding alignment between NPD and *product strategy*. Product strategy, which includes a product-platform strategy and a product line strategy to support go/no go decisions, need alignment with NPD in order to be effective. To make things worse, very few firms in the sample of Khurana and Rosenthal (1997) had clear product strategies to guide NPD decision making in the FFE. Deficiencies included that NPD decision making was based on project-specific criteria rather than on issues of strategic fit, and that the R&D department funded projects based on superior technology rather than on what was actually required by the firm's products. Similarly, Khurana and Rosenthal (1998) found that successful firms were able to link business strategy, product strategy, and product-specific decisions.

An Early and Well Defined Product Definition

In the context of the FFE, previous literature has emphasized the importance of an early and well defined product concept, as well as related issues such as expected customer benefits and conceptions of target markets. Product concepts are "representations of the goals for the development process" (Seidel, 2007, p. 523) and can be viewed as a form or technology plus a

statement of customer benefits (Montoya-Weiss & O'Driscoll, 2000). Product concepts can be technology or customer- and market driven, where concepts in the first category often are more straight-forward and tangible, while those in the latter category might be less obvious (Backman *et al*., 2007, p. 26). A clear product concept prior to development makes it easier to judge whether an opportunity is worth further exploration, and facilitates the understanding of what and how to prioritize during the subsequent development phase (Khurana and Rosenthal, 1997; Kohn, 2006).

A product concept may be operationalized in the form of pictures, drawings, three-dimensional models, or mock-ups (Dickinson and Wilby, 1997) but is usually restricted to a description of a new product idea, plus its primary features and customer benefits (Parish and Moore, 1996). Some authors include, however, also market segments, competitive situation, and alignment with existing business and technology plans in the product concept (e.g. Khurana and Rosenthal, 1997) but this is usually referred to as product definition or protocol by most scholars. Product definition and protocol appear to have been used synonymously in the literature, and in addition to the actual product concept, the product definition/protocol also includes information about target markets, customer needs, and product specifications (Montoya-Weiss and Calantone, 1994; Song and Parry, 1996) as well as product positioning and product requirements (Cooper and Kleinschmidt, 1987). Proficiency in concept development and concept definition has previously been found to positively impact on project success (Cooper and Kleinschmidt, 1987; Song and Parry, 1996) and is especially important as it deeply impacts the final Go/Kill decision prior to product development (Cooper, 1988).

Research by Bacon *et al*. (1994) has showed that the creation of a robust product definition requires information and feedback from all main functions of a firm. This fact partly explains

why firms have reported severe difficulties in clarifying product concepts and product definitions at the FFE (see e.g. Khurana and Rosenthal, 1997). A clear product definition is not the same as a static one, however. The product definition often needs to change during development, due to changes in for example customer needs or technology. Although change in the definition may disrupt product development, it is important to note that such changes are often necessary (Bacon *et al*., 1994). The research of Bacon and colleagues points to a couple of important conclusions regarding product definition change. First, hasty and poorly managed change causes delays, higher costs, and often product failure. Hence, if change in the product definition is needed, it needs to be carefully planned for. Indeed, many of the successful firms in their study "froze" large parts of the product definition, or made no changes at all to it, but in cases where successful change took place, changes were very selective, thus changing the fewest possible elements of the definition. When change occurred, successful teams often used a priority criteria list that provided a hierarchical ranking of product features, which guided trade-off decisions (Bacon *et al*., 1994).

Contemporary research by Seidel has shown that changes in product concepts often result in ambiguity concerning which concept is being developed – the original or the deferred. Such ambiguity frequently led to decision delays and possibly also to lower market results (Seidel, 2007). Consequently, such ambiguity should be removed as urgently as possible.

A product concept need not only be well defined, however. In the end, it also need acceptance from customers. As customers seem to favour innovations consisting of something new surrounded by already familiar product attributes, Goldenberg *et al*. (2001) advocates developing new concepts based on templates. In their sample, products based on templates were generally more successful than those that were not. Template-based concepts, argue the

authors, are likely to be perceived as new, yet familiar. Therefore, they can create a sense of a new superior product while still minimize the risk of rejection associated with their novelty, as they are structurally similar to other products. The reason for this is that humans, in general, reject radical innovations and ignore minor ones as neither type fit their cognitive schemes. Hence, modest innovations based on templates tend to be more successful than trivial or radical ones (Goldenberg *et al*, 2001). Similar findings are reported in the context of organizational adaptation of new product concepts, where firms have been found to be more comfortable with ideas that are based on pre-existing products rather than on new technology (Griffiths-Hemans and Grover, 2006). Indeed, all studies seem to point to the importance of the product definition. Murphy and Kumar (1997) found, however, that product definition is more about gaining credibility, although the creation of a prototype proved significant as well.

Remaining Success Factors

In order to save space and allow for transparency as well as readability, success factors that have received relatively little attention from scholars focusing the FFE are clustered together here. Needless to say, the fact that these factors have not received more attention is not necessarily a sign of them being unimportant. Rather, some of them appear crucial for successful management of the FFE.

A first likely success factor can be referred to as *Beneficial external cooperation with others except customers.* Murmann (1994) notes, for example, that one key task during the FFE is to reduce technological uncertainty, and that this can be achieved by selecting and partnering with competent suppliers. Khurana and Rosenthal (1997) note, however, that some firms have an even broader value chain perspective during the FFE. According to the authors, such a perspective is crucial as customers buy an augmented product rather than just a tangible

artefact (e.g. also the delivery process and sales interaction). This fact need, of course, be planned for during the FFE. These ideas are consistent with the emerging literature on open innovation (e.g. Chesbrough, 2007), although the literature on the FFE is intra-organizational rather than inter-organizational in its current focus and form.

A second success factor of importance is the *Learning from experience capabilities of the pre-project team*. Research by Verganti has shown that feed-forward planning is important during the FFE, and that pre-project team members need to identify critical areas and forecast their influence on project performance. According to Verganti, critical areas are uncertain yet relevant elements of a product, which are costly and time consuming to make corrections in later on in a project. Being in the FFE, such feed-forward planning can only be performed by drawing on experience from previous projects, i.e. through learning from experience. A lack of this capability makes working in teams' fruitless (Verganti, 1997, p. 387).

Important to consider are also *Project priorities*. According to Khurana and Rosenthal (1997), project priorities include making trade-offs among the three competing virtues of scope (product functionality), scheduling (timing), and resources (cost). In the cases studied, these researchers observed confusion about project priorities, and concluded that fuzzy project priorities were the single most important cause for time delays and product over-engineering. This finding is also supported by Murphy and Kumar (1997), who single out the clarification of project requirements as a key predevelopment objective. Research by Bacon *et al*. (1994) has further demonstrated that the use of a priority criteria list, i.e. a rank ordering of key product features, is crucial for successful product definition. Hence, this seems a very important factor to consider for management of the FFE.

Furthermore, the literature also point to the importance of having *Project management and the presence of a project manager*. The project manager is often involved with lobbying for support and resources, and coordinates technical- as well as design issues. At high performing firms, the project leader was involved with these tasks very early in the FFE (Khurana and Rosenthal, 1997). Previous research has also shown that no front-end is equivalent to another in terms of activities, sequences, degree of overlap, and relative time duration. This calls for flexibility, and effective project management (Nobelius and Trygg, 2002).

Another issue of importance is the establishment and maintenance of *a creative organizational culture.* According to Murphy and Kumar (1997), such a culture allows a firm to utilize the creativity and talents of employees, as well as maintaining a steady stream of ideas in the FFE. The issue of a creative culture has also been heavily emphasized in many of the conceptual papers on the FFE, but it hardly constitutes a single factor as such.

Finally, two remaining factors deserve attention. Khurana and Rosenthal (1997) found product success in the FFE to be strongly associated with the existence of *a cross-functional executive review committee*. Furthermore, they also noticed the importance of *Product portfolio planning*, something which was missing completely in more than a third of their cases, and performed incomplete and sporadic in several of the others.

Integration Among Many Different Activities and Factors

Although successful management of the FFE requires firms to excel in individual factors and activities, this is a necessary rather than sufficient condition. Firms need also be able to integrate or align different activities and factors, as reciprocal interdependencies among different success factors exist. This observation is usually attributed to the seminal article by

Khurana and Rosenthal (1998) where they suggested a “holistic approach” to the FFE, but several other scholars have made similar observations, using labels such as interdependencies, synergy, or fit.

Cooper (1988), for example, found that synergy among skills and resources in the areas of technology, marketing and manufacturing were an important success factor in the FFE. As synergy is largely beyond the control of the project team, it is an important screening criterion for a review committee when judging product ideas. Hence, projects that are synergistic can be approved, while those that are not can be modified (Cooper, 1988). Similar conclusions are reached by Verganti, who notes that a product concept must fit with product technologies, and a design solution with process design (Verganti, 1997). Furthermore, the results of Murphy and Kumar (1997) point to the importance of fit among a product idea, firm strategy, and operating capabilities, as a firm must possess both technical and managerial skills to design and develop a new product.

Expanding the integration theme, Khurana and Rosenthal (1998) take a “process view” of the FFE, as firms often seem to treat interrelated activities independently. In essence, Khurana and Rosenthal’s point is that understanding the interrelationships among activities is as important as the activities themselves. In their sample, more successful firms had three characteristics: First, they linked business strategy, product strategy, and product-specific decisions. Second, senior management was deeply involved in providing integration, and finally, successful firms understood the benefits of achieving a holistic front-end, a fact they embraced either through institutionalizing a formal process, or by using cultural control as a means of integration (Khurana and Rosenthal, 1998).

Key Contingencies in the Management of the FFE

As discussed by Nobelius and Trygg (2002) and others, the FFE process differ among firms with regards to actual activities performed, relative importance of these activities, and time duration. By consulting the extant literature, four variables in particular seem to be of importance for how the FFE stage materializes: (1) *Product newness*, (2) *Type of product*, (3) *Type of customer*, and (4) *Access to relevant knowledge*.

Product newness. About half of the surveyed literature was concerned with incremental product development (49% of all articles), while an additional 33% did not report any information on the newness dimension. Judging from the methods descriptions in the last category, however, a clear majority of these articles were concerned with incremental product development as well. Only five articles focus solely on discontinuous NPD in the FFE (Elmquist and Segrestin, 2007; Heller, 2000; McAdam and Leonar, 2004; Seidel, 2007; Verworn, 2006) while an additional two focus on the FFE for both incremental and discontinuous products (de Brentani, 2001; Herstatt and Verworn, 2004). These studies show that discontinuous products pose considerable challenges to teams in the FFE (Seidel, 2007), call for more complex and iterative problem solving processes (Herstatt et al., 2004), that concept generation and refinement works by a different logic (Elmquist and Segrestin), that interpretative knowledge is needed to a larger extent (Heller, 2000) as is creativity (McAdam and Leonard, 2004). In a similar vein, de Brentani (2001) found that an open and supportive internal environment within the firm characterized discontinuous FFE projects that were successful.

Additional literature has also suggested that projects involving discontinuous product development tend to be defined less explicitly in the FFE (Khurana and Rosenthal, 1998) and

that information search are unstructured, and individual rather then organizational initiative, is needed (Reid and de Brentani, 2004). Defining product concepts may also take longer time (Veryzer, 1998), linking technological capabilities to market needs may be more complex (O'Connor and Veryzer, 2001) and market analysis in the FFE may be less helpful (Song and Montoya-Weiss, 1998). Therefore, more empirically grounded knowledge on what the FFE phase looks like under conditions of discontinuity is needed, as firms clearly need to have their FFE process account for the newness dimension.

Type of product. In the articles which constitute the base of our review, 67% were concerned with physical products only. The main category was physical/assembled products, which accounted for 64% of the total number of articles. Only one article (Elmquist and Segrestin, 2007) focus solely on non-assembled products, in this case medical drugs. Two articles had a sole focus on services (Alam, 2006; de Brentani, 2001), while four articles reported combinations of different types of assembled products and/or services (Khurana and Rosenthal, 1997; 1998; McAdam and Leonard, 2004; Montoya-Weiss and O'Driscoll, 2000). An additional seven articles (18%) did not report which type of product that was investigated, although most of these articles seemed to be concerned with the FFE for physical/assembled products.

Surprisingly, not a single article discusses the differences between physical/assembled and physical/non-assembled products and the subsequent implications for the FFE, and none but the two articles focusing solely on services discuss explicitly the differences between the FFE for services and physical products. As inseparability, intangibility, perishability and heterogeneity characterize services, the FFE stage is likely to come out different compared with the case of physical products. Differences between the situations of assembled/non-

assembled physical products should be expected. Non-assembled products are usually characterized by being produced in bulk, the simultaneous need for product and process innovation, high capital investment, a production process difficult to change, and long product lifecycles (Parish and Moore, 1996). These issues can be expected to have major influences on how FFE activities in product development are performed, but this is not at all reflected upon by the extant literature. Hence, the FFE under different types of products is far from sufficiently understood.

Type of customer. Findings by Khurana and Rosenthal (1998) point to the fact that proximity between customer and the development organization is of importance. Proximity, here understood as the intensity of ongoing dialog rather than physical distance, was found to increase from consumer to industrial to original equipment manufacturer (OEM) markets. In short, Khurana and Rosenthal (1998) found that as proximity increased, there was less formality and closure in the front end. Despite the fact that this finding is not reflected upon by other authors, it seems to have major implications for how the FFE phase materialize.

Access to relevant knowledge. Research by Bröring et al. (2006) has shown that when firms lack absorptive capacity, they either focus in areas where they can benefit from past knowledge, or they try to establish partnerships to eliminate deficiencies in market or technology knowledge. This study was carried out in the context of industry convergence, but firms may find themselves in this situation for other reasons as well, for example when they attempt to diversify. Elmquist and Segrestin (2007) makes a similar observation, concluding that existing FFE models are insufficient when the aim is to develop products that are based on knowledge that a firm does not possess. Therefore, access to relevant knowledge or,

alternatively, the absence of it should also have major implications for how the FFE stage is performed.

Balancing Acts in the Management of FFE

In the sections above we have presented a number of success factors and key-contingencies relevant to the management of the FFE. In these sections a number of factors and activities that seem to be in a state of opposition have been touched upon but left without sufficient elaboration. We use the metaphor of a "balancing act" when referring to them, as they all impose on firms some kind of trade-off situation which calls for management attention.

Gentle or harsh screening of ideas? As noted above, one success factor during the FFE is the effective screening of ideas. Put frankly, it is essential to get rid of obvious looser ideas as fast as possible in order to save the cost associated with their further development. The problem is, however, that while harsh screening is needed to get rid of obvious looser projects, it might also kill good ideas too early. We know from research by Conway and McGuinnes (1986) that ideas gain momentum within firms through informal discussion. So, although it is central to sort out bad ideas from good ones early on, such a screening process might also make firms fail to notice really good ideas. Hence, there is a danger that firms terminate emergent ideas before the have grown into robust ones, ready for being judged thoroughly. It therefore appears important for firms to balance too gentle and too harsh screening. Finding an appropriate level is, however, not an easy task, and research is still too fragmented to give firms specific advice on how to do this in practice.

Formalization – when is enough enough? As suggested by Khurana and Rosenthal (1998), the relationship between formality and performance during the FFE seems to be non-linear. The

basic proposition is that formalization is good because it facilitates transparency, order and predictability. On the other hand, – in the strivings to enforce effectiveness – formalization also risk inhibiting innovation. Accordingly, the relationship between formality and performance seems to follow an inverted u-shape curve, where both too little and to much formality has a negative effect on performance (Boeddrich, 2004; Gassmann *et al.*, 2006; Khurana and Rosenthal, 1998).

From this follows that firms need to balance the level of formalization they impose on the FFE, as both under- or overly formalized activities seems bad for performance in the FFE. At this point, however, reliable advice on how to decide on this balance is difficult to give, due to gaps in our understanding of the FFE and additional research is needed on varieties of effective formality in the FFE. Perhaps it is possible to identify situations in which firms should impose a high degree of formalization, and other situations in which low formalization is the right and proper approach? We also need to understand better how an appropriate degree of formalization can aid firms to expose and evaluate critical issues, without adding unnecessary complexity, barriers, costs, and delays to the FFE.

Uncertainty reduction – or equivocality reduction? Uncertainty – within organization studies – is often 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). A key problem with the FFE seems to be the high degree of market and technological uncertainty that characterizes this phase. It is often claimed that if companies do not manage to reduce these uncertainties, they might face severe consequences (see e.g. Herstatt and Verworn, 2004; Moenaert *et al.*, 1995; Murmann, 1994, p. 246).

A key objective in the FFE is, therefore, to reduce market and technological uncertainty. Two stances can be taken in view of this proposition, however. First, if a firm understands its environment as being concrete, that events are hard, measurable, and determinant, then it will set out to reduce uncertainty by means of linear thinking and logic based on clear data. Under such conditions, more information will reduce uncertainty to an acceptable degree, and the development project can move forward. If, on the other hand, a firm finds its environment impossible to analyze – and many firms indeed seem to make this assumption during the FFE – another approach will protrude as more relevant. Firms then need to reduce equivocality rather than uncertainty. Put simply, an equivocal situation is a situation where multiple meanings exist. This means that firms need to construct, coerce, or enact a reasonable interpretation that makes previous action sensible and suggests how to move forward (cf. Daft and Weick, 1984). Accordingly, firms should engage in sensemaking, rather than searching for additional information, as more information tends to increase rather than decrease equivocality.

From this follows that firms have to balance their need to reduce uncertainty with the need to reduce equivocality, as trying to reduce one often implies increasing the other. Our interpretation is that the FFE literature, at this point, subsumes to uncertainty reduction at the expense of equivocality reduction. This is unfortunate, as FFE progression often seems to call for reduction of equivocally rather then uncertainty reduction. Hence, additional research which targets the simultaneous need for reducing uncertainty and equivocality is called for.

Product definition – fixed or flexible? A key objective in the FFE is the creation of a clear, robust and unambiguous product definition. This goal is based on the assumption that such a definition facilitates the subsequent development phase. However, product features often need

to be changed during development, as market needs change or problems with underlying technologies are experienced. From this follows that a fourth balancing act during the FFE concerns the trade-off between a fixed product definition and the need for chance in the very same product definition during the subsequent product development process.

Hence, it appears that firms at the same time need to be able to put closure to their product definition work in order to plan for and pursue development, while simultaneously keeping the definition sufficiently open to market and/or technological changes. This is indeed a challenge as the concept is developed vis-à-vis a future about which the firm can only be limitedly knowledgeable about. Future research should explore if there are any transferable techniques to assist product development teams in distinguishing at the outset which aspects of the product definition that can be frozen from those that must be left uncertain until a later time.

Innovation versus Efficiency. Another problem has to do with the act of balancing the competing virtues of innovation and resource efficiency. Firms need to secure an appropriate level of innovativeness in their organizations, but demands of resource efficiency simultaneously run the risk of hassling innovation. Even if the challenge of how to organize for exploration while at the same time secure exploitative capabilities in organizations have been discussed extensively (see e.g. March, 1991; Gupta, Smith and Shalley, 2006), this issue appears to extend also to the management of FFE. Innovation and creativity in the front-end is enabled by organisational slack and an emphasis on people management, while resource efficiency is enabled by discipline and an emphasis on process management (Gassmann *et al*., 2006). Hence, the challenge for effective front end management is to balance the logics of creating innovation with the logics of fostering efficiency.

The challenge to be resolved here is about how to manage competing value orientations (cf. Quinn and Rohrbaugh, 1983; Hooijberg, 1996). If a firm stresses a value orientation that nurtures innovation, this will be – at least seemingly – the antithesis to an orientation that will serve the task of resource efficiency. Guidance on how to resolve this balancing acts is, however, hard to find in the literature on the FFE. Future research is needed on for example how this balancing act interacts with front end performance in different industrial contexts.

Additional Post-hoc Analysis of the Literature and Suggestions for Further Research

In addition to the success factors, key contingencies and balancing acts discussed above, our survey of the FFE literature also identified additional issues in need of further elaboration. We refer to this analysis as *post-hoc*, as these factors and patterns were not specified *a priori* to our survey of the literature but rather emerged through reading and inductive analysis. Subsequently, after elaboration, these factors also turn into suggestion for further research.

Reflections on FFE conceptualization. As the FFE phase seems to differ not only among firms but also among projects within the same firm, chopping up reality into too detailed bite-sized pieces might be neither desired nor useful. However, slightly more than half of the articles which constitute the base for our review fail to provide any definition of the FFE whatsoever, and among the remaining articles, many different definitions prevail. One of the more popular ones are provided by Cooper (1988), who conceptualize the FFE to include initial screening, preliminary market and technical assessment, detailed market study, and business/financial analysis. Another popular definition was provided by Khurana and Rosenthal (1998) who include product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews. Common among many scholars is that they include refinement, assessment and selection of

ideas for new product concepts in the FFE (e.g. Alam, 2006; Boeddrich, 2004; Bröring and Leker, 2007; Griffiths-Hemans and Grover, 2006; Herstatt and Verworn, 2004). Scholars also seem to agree on when the FFE phase ends, i.e. with the organization deciding either to approve or disprove a NPD project (Herstatt and Verworn, 2004; Khurana and Rosenthal, 1998; Verworn, 2006). As the FFE ends with a go/no decision, the "output" of the FFE phase should be a *product definition* rather than a *product concept,* as a go/no decision hardly can be made by judging the concept without considering available resources, market estimates, and business plans (see e.g. Herstatt and Verworn, 2004; Verworn, 2006).

It is more difficult, however, to say where the FFE begins. Khurana and Rosenthal (1998, p. 59) did "…not explicitly study the earlier, essentially creative act of idea generation" but some other authors do include idea generation as a part of the FFE. Khurana and Rosenthal (1997) conceive of the FFE to start when a firm"…first recognize, in a semi-formal way, an opportunity". This quote has important implications, because it indicates that if a firm has recognized an opportunity, the idea must be shared in a collective structure as opposite to only exist in the mind of a single person. Also, the quote implies that sources of ideas such as customers, suppliers, etcetera be placed *outside* the FFE phase, a position also taken in this article. Further empirical research on FFE conceptualization is needed, however, as terms and concepts partly seem to mismatch the actual activities and course of events carried out by firms developing new products. Based on the previous discussion on contingency variables, it seems sensible, in such an undertaking, to think in terms of several different types of definitions rather than one all-encompassing.

Current state of an FFE theory and the lack of performance measures. A theory is usually pictured as consisting of different components, such as constructs and variables (the "what"

component), which are connected through propositions and hypotheses respectively (the "how" component). A theory must also include temporal and contextual factors answering to the questions of "who?", "when?" and "where?" Finally, a theory must also provide an answer to the important question of "why", that is the underlying dynamics that justify the selection of variables and constructs, and explain the relationships among these (see e.g. Bacharach, 1989).

Judging the FFE literature against the definition above, we must conclude that only fragments of a theory about the FFE exist, and several reasons lay behind this assertion. First, the reviewed literature has a clear focus on *what* and *how*, at the expense of *why*. Hence, the literature is primarily concerned with identifying success factors (e.g. de Brentani, 2001; Gassmann *et al.*, 2006; Kohn, 2005) and to some extent how these factors relate to each other (e.g. Khurana and Rosenthal, 1998; Verganti, 1997) but not so much on *why* a given factor is related to another. Hence, the literature suffers from the absence of coherent explanations in form of narratives. Second, the literature is dominated by exploratory case studies[1] (56% of the surveyed articles), often with aim of description rather then theory building or theory testing. Third, the literature on the FFE lacks one or a few dependent variables, and are concerned with issues as diverse as product definitions (Bacon *et al.*, 1994), absorptive capacity (Bröring and Leker, 2007), concept testing (Dickinson and Wilby, 1997), uncertainty reduction (Herstatt and Verworn, 1994), development time (Murmann, 1994) and learning (Verganti, 1997). This fact makes it difficult to compare findings, as replications are virtually non-existent. The up-side is, at least from the perspective of academia, that no single area seems overstudied. Daft (1985, p. 200) has suggested that research topics behave like product lifecycles. When a topic is new, most projects contribute with new knowledge but as a field

[1] As research on the FFE is a relatively recent phenomenon, we expected to find a centre of gravity in qualitative research, which was also the case. Qualitative studies were twice as common as quantitative ones (56% vs. 28%), while an additional 15 % of the articles based their findings on research making use of a combination of qualitative and quantitative approaches.

mature, it becomes much more difficult to conduct a study that produces novel insights. Our interim observations are thus that the literature on the FFE is currently far from reaching maturity, and systematic cumulative knowledge creation seems to be the exception rather than the rule.

Another observation, related to the absence of a dependent variable, is the lack of performance measures. Performance measures or even thoughts thereof, are indeed uncommon. Khurana and Rosenthal (1997, p. 114) suggest that firms should evaluate the FFE on degree of formality and degree of integration of activities. Other researchers have suggested that firms may apply criteria from several different areas, such as marketing, technology, business, and human factors (Montoya-Weiss and O'Driscoll, 2000, p. 146). About 95% of our surveyed articles do not address the issue of performance measurement at all, however, and one may indeed ask what high performance in the FFE is? As the FFE is conceptualized to end with a go/no go decision, where a product definition is judged, one possible way is to judge performance is to focus on the product definition. The key issue of exactly what and how to measure performance in the FFE is a fruitful suggestion for further research, as is the construction of normative theoretical models which explain and predict FFE performance in a comprehensive yet parsimonious way.

Variables not covered in the literature. An additional issue worthy of elaboration is success factors not covered in the literature, which nevertheless may be of great importance. Verganti (1997), for example, point to the reciprocal interdependencies between product development and production, and the co-evolvement of product and process innovation has not been studied in the context of the FFE. Two other issues are valuing and rewarding FFE activities, and learning from failure in the context of the FFE. Valuing and rewarding FFE activities

seems important for sustaining a constant flow of ideas and product concepts. As most ideas and product concepts fail, learning from these cases seems central to future success. Baumard and Starbuck (2005) have shown that such learning is difficult, and Cannon and Edmondson (2005) have elaborated upon how firms can use failure as a source of innovation. These factors have not been investigated in the context of the FFE, however, and given the current state of FFE theory, other relevant factors might have been missed by the extant literature as well.

A holistic perspective – what is it, really? Several authors (e.g. Cooper, 1988; Verganti, 1997; Khurana and Rosenthal, 1998) note that proficiency in individual factors is not sufficient for successful management of the FFE. Rather, interdependencies among factors call for a more holistic approach. Such a holistic perspective requires synergy in skills and resources in technology, marketing and manufacturing (Cooper, 1988), fit between product concept and product technology (Verganti, 1997), and integration among product strategy, product definition, project definition, and organizational roles (Khurana and Rosenthal, 1998). Most of these are categories rather than variables, however, and detailed guidelines for how to impose a holistic perspective on the FFE seem to be lacking. To some extent this notion is already covered above by the call for better theory, but this important point really needs emphasis. Accordingly, future research should focus on which concrete factors and variables that needs integration, how they are related, which variables that is dependent and independent, and which ones that acts as mediators or moderators. Although the case studies by Khurana and Rosenthal (1998) have added tremendously to our understanding of what a holistic perspective is, additional research can refine and explicate their original ideas on a more concrete level.

What drives success – underlying confusion about what to do or lack of execution? In our review of the literature, we have noticed that previous scholars list many different practical problems associated with the FFE. A sample include unclear or incorrect product definition (Bacon *et al.*, 1994), too narrow scanning for new ideas (Börjesson *et al.*, 2006; Kohn, 2005), lack of technology foresight (Groenveld, 1997), project priorities (Khurana and Rosenthal, 1998) and ad-hoc decision making (Montoya-Weiss and O'Driscoll, 2000). Based on case study research, Khurana and Rosenthal (1998) suggest that problems in the FFE often relate to lack of disciplined execution, rather than confusion about what ought to be done. As we don't know the relative importance of different factors for explaining FFE performance, however, current state of knowledge makes it difficult to say whether this is correct or not. Future research should indeed focus this issue as well.

Managerial Implications

Given the current state of knowledge, detailed managerial advice on how to achieve efficiency and effectiveness in the FFE is difficult to provide. The only thing that appears completely obvious is that the FFE process in organizations is neither simple nor particularly well understood. Still, our review of the literature gives some tentative managerial implications. First, we have identified 17 success factors for organizing and managing the FFE; all grounded in the findings of previous scholars. To save some space, all these factors are not repeated again but it can be noted that the research on some of them (e.g. product definition and early customer involvement) are more extensive and well established than on some of the others (e.g. learning from past projects), which could be taken as an indication of importance. Current knowledge makes it, however, more or less impossible to validly rank these factors vis-à-vis one another on a general level, but we still think that management can benefit from our review of the factors. Thus, we suggest they can judge each factor from the

specific vantage point and context of their respective firms as a first means to assess their respective impact and importance.

Second, the fact that excelling in individual factors is a necessary rather than sufficient criterion also provides management with an important implication. Although we do not know exactly what a so-called “holistic perspective” is, it is quite clear that managers cannot work with factors in isolation, but must ask themselves how the interdependencies among factors operate at their respective firms, and which factors should be integrated. Until better normative models exist, this should be done primarily by experience in combination with trial-and-error.

Third, our identification of key contingencies, namely product newness, type of product, type of customer, and access to relevant knowledge, also provides managers with implications. Although more research on these contingencies is needed, they still give managers hints on the need to adjust their FFE process at the firm level. Finally, we also believe that our “balancing acts” provides important implications. More research is needed here as well, but all these trade-off situations (e.g. uncertainty vs. equivocality reduction; innovation vs. efficiency) provide managers with ideas for further improvement of their FFE process. They also aid in decision making situations concerning the variables included in these balancing acts, where a lack of proper knowledge of these often lead to negative unintended consequences which now can be anticipated in advance.

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These will be provided at a later point in time, as they might disclose the identity of the authors.

References Included in the Literature Review

Alam, I. (2006). Removing the fuzziness from the fuzzy front-end of service innovations through customer interactions. *Industrial Marketing Management, 35*(4), 468-480.

Backman, M., Börjesson, S. & Setterberg, S. (2007). Working with Concepts in the Fuzzy Front End: Exploring the Context for Innovation for Different Types of Concepts at Volvo Cars. *R & D Management, 37*(1), 17-28.

Bacon, G. Beckman, S. Mowery, D. &Wilson, E. (1994). Managing Product Definition in High-technology Industries: A Pilot Study. *California Management Review, 36*(3), 32-56.

Boeddrich, H-J. (2004). Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process. *Creativity and Innovation Management, 13*(4), 274-285.

De Brentani, U. (2001). Innovative Versus Incremental New Business Services: Different Keys for Achieving Success. *The Journal of Product Innovation Management, 18*(3), 169-187.

Bröring, S., Cloutier, L.M. & Leker, J. (2006). The Front End of Innovation in an Era of Industry Convergence: Evidence From Nutraceuticals and Functional Foods. *R & D Management, 36*(5), 487-498.

Bröring, S. & Leker, J. (2007). Industry Convergence and Its Implications for the Front End of Innovation: A Problem of Absorptive Capacity. *Creativity and Innovation Management, 16*(2), 165-175.

Börjesson, S., Dahlsten, F. & Williander, M. (2006). Innovative Scanning Experiences From an Idea Generation Project at Volvo Cars. *Technovation, 26*(7), 775-783.

Conway, H.A. and McGuinness, N.W. (1986). Idea Generation in Technology-Based Firms. *Journal of Product Innovation Management 3*(4), 276-291.

Cooper, R.G. (1988). Predevelopment Activities Determine New Product Success. *Industrial Marketing Management 17*(3), 237-247.

Cooper, R.G. and Kleinschmidt, E.J. (1987). New Products: What Separates Winners from Losers? *Journal of Product Innovation Management 4*(3), 169-184.

Dickinson, J.R. and Wilby, C.P. (1997). Concept Testing With and Without Product Trial. *Journal of Product Innovation Management 14*(2), 117-125.

Elmquist, M. and Segrestin, B. (2007). Towards a New Logic for Front End Management: From Drug Discovery to Drug Design in Pharmaceutical R&D. *Creativity and Innovation Management, 16*(2), 106-120.

Gassmann, O., Sandmeier, P. and Wecht, C.H. (2006). Extreme Customer Innovation in the Front-end: Learning From a New Software Paradigm. *International Journal of Technology Management 33*(1), 46-66.

Goldenberg, J., Lehmann, D.R. and Mazursky, D. (2001). The Idea Itself and the Circumstances of its Emergence as Predictors of New Product Success. *Management Science 47*(1), 69-84.

Griffiths-Hemans, J. and Grover, R. (2006). Setting the Stage for Creative New Products: Investigating the Idea Fruition Process. *Journal of the Academy of Marketing Science 34*(1) 27-39.

Heller, T. (2000). If Only We'd Known Sooner: Developing Knowledge of Organizational Changes Earlier in the Product Development Process. *IEEE Transactions on Engineering Management 47*(3), 335-359.

Herstatt, C. and Verworn, B. (2004). Reducing Project Related Uncertainty in the 'Fuzzy Front End' of Innovation: A Comparison of German and Japanese Product Innovation Projects. *International Journal of Product Development 1*(1), 43-65.

Khurana, A. and Rosenthal, S.R. (1997). Integrating the Fuzzy Front End of New Product Development. *Sloan Management Review 38*(2), 103-120.

Khurana, A. and Rosenthal, S.R. (1998). Towards Holistic "Front Ends" in New Product Development. *Journal of Product Innovation Management 15*(1), 57-74.

Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., Elkins, C.,

Herald, K., Incorvia, M., Johnson, A., Karol, R., Seibert, R., Slavejkov, A. and Wagner, K. (2001). Providing Clarity and a Common Language to the "Fuzzy Front End". *Research Technology Management 44*(2), 46-55.

Kohn, K. (2005). Idea Generation in New Product Development Through Business Environmental Scanning: The Case of XCar. *Marketing Intelligence & Planning 23*(6/7), 688-704.

Kohn, K. (2006). Managing the Balance of Perspectives in the Early Phase of NPD: A Case Study From the Automotive Industry. *European Journal of Innovation Management 9*(1), 44-60.

Langerak, F., Hultink, E.J. and Robben, H.S.J. (2004). The Role of Predevelopment Activities in the Relationship Between Market Orientation and Performance. *R & D Management 34*(3), 295-309.

Lin, C-T. and Chen, C-T. (2004). New Product Go/No-Go Evaluation at the Front End: A Fuzzy Linguistic Approach. *IEEE Transactions on Engineering Management 51*(2), 197-207.

McAdam, R. and Leonard, D. (2004). Reengineering Based Inquiry Into Innovation in the Front End of New Product and Service Development Processes. *International Journal of Product Development 1*(1), 66-91.

Moenaert, R.K., De Meyer, A., Souder, W.E. and Deschoolmeester, D. (1995). R&D/Marketing Communication During the Fuzzy Front-end. *IEEE Transactions on Engineering Management 42*(3), 243.

Montoya-Weiss, M.M. and O'Driscoll, T.M. (2000). From Experience: Applying Performance Support Technology in the Fuzzy Front End. *The Journal of Product Innovation Management 17*(2), 143-161.

Murmann, P.A. (1994). Expected Development Time Reductions in the German Mechanical Engineering Industry. Journal of Product Innovation Management 11(3), 236.

Murphy, S.A. and Kumar, V. (1996). The Role of Predevelopment Activities and Firm Attributes in New Product Success. *Technovation 16*(8), 431.

Murphy, S.A. and Kumar, V. (1997). The Front End of New Product Development: A Canadian survey. *R & D Management 27*(1), 5-15.

Nobelius, D. and Trygg, L. (2002). Stop Chasing the Front End Process - Management of the Early Phases in Product Development Projects. *International Journal of Project Management 20*(5), 331-340.

Rosenthal, S.R. and Capper, M. (2006). Ethnographies in the Front End: Designing for Enhanced Customer Experiences. *Journal of Product Innovation Management 23*(3), 215-237.

Seidel, V.P. (2007). Concept Shifting and the Radical Product Development Process. *Journal of Product Innovation Management 24*(6), 522.

Song, X.M. and Parry, M.E. (1996). What Separates Japanese New Product Winners From Losers. *Journal of Product Innovation Management 13*(5), 422.

Verganti, R. (1997). Leveraging on Systemic Learning to Manage the Early Phases of Product Innovation Projects. *R & D Management 27*(4), 377-392.

Verworn, B. (2006). How German Measurement and Control Firms Integrate Market and Technological Knowledge into the Front End of New Product Development. *International Journal of Technology Management 34*(3-4), 379-389.

Zien, K.A. and Buckler, S.A. (1997). Dreams to Market: Crafting a Culture of Innovation. *Journal of Product Innovation Management* 14(4), 274-287.

Additional References Outside the Literature Review

Bacharach, S.B. (1989). Organizational Theories: Some Criteria for Evaluation. *Academy of Management Review* 14(4), 496-515.

Baumard, P. and Starbuck, W.H. (2005). Learning From Failures: Why it May Not Happen.

Long Range Planning 38(3), 281-298.
Brown, S.L. and Eisenhardt, K. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review*, 20(2), 343-378.
Cannon, M.D. and Edmondson, A.C. (2005). Failing to Learn and Learning to Fail (Intelligently): How Great Organizations Put Failure to Work to Innovate and Improve. *Long Range Planning* 38(3), 299-319.
Chang, S.L., Chen, C.Y and Wey, S.C. (2007). Conceptualizing, assessing, and managing front-end fuzziness in innovation/NPD projects, *R&D Management*, 37(5), 469–478.
Chesbrough, H.W. (2007). The Market for Innovation: Implications for Corporate Strategy, California Management Review, 49(3), 45-66.
Cooper, R.G. (1999). The invisible success factors in product innovation. *Journal of Product Innovation Management*, 16, 115-133.
Cooper, R.G. (2001). *Winning at new products.* New York, NY: Basic Books.
Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. (2002). Optimizing the Stage-Gate Process: What Best-Practice Companies Do, Part I. *Research-Technology Management*, 45(5), 21–27.
Daft, R.L. (1985). Why I Recommend That Your Manuscript be Rejected and What You can Do about It, in: Cummings, L.L. and Frost, P.J. (Eds.), *Publishing in the Organizational Sciences*, pp. 193-209. Illinois: Richard D. Irwing, Inc.
Daft, R. and Weick, K. (1984). Toward a model of organizations as interpretive systems. *Academy of Management Review*. 9(2), 284–295.
Galbraith, J. (1973). *Designing Complex Organizations*. Reading. MA: Addison-Wesley.
Granovetter, M.S. (1982). The Strength of Weak Ties: A Network Theory Revisited, in: Marsden, P. and Lin, N. (Eds.), *Social Structure and Network Analysis*. Beverly Hills, CA: Sage.
Grant, R. (1995). *Contemporary strategy analysis.* Cambridge, MA: Blackwell.
Griffin, A. and Hauser, J. (1996). Integrating R&D and Marketing: A review and analysis of the literature. *Journal of Product Innovation Management*, 13(3), 191-215.
Groenveld, P. (1997). Roadmapping Integrates Business and Technology. *Research Technology Management* 40(5): 48-55.
Gupta A.K., Smith, K.G. & Shalley, C.E. (2006). The Interplay Between Exploration And Exploitation, Academy of Management Journal, 49(4): 693 – 706.
Hooijberg, R. (1996). A multidirectional approach toward leadership: An extension of the concept of behavioral complexity. *Human Relations*, 49(7): 917-947.
Kim, J. and Wilemon, D. (2002a). Focusing the Fuzzy Front-end in New Product Development. *R&D Management* 32(4), 269-279.
Kim, J. and Wilemon, D. (2002b). Strategic Issues in Managing Innovation's Fuzzy Front-end. *European Journal of Innovation Management* 5(1), 27-39.
Krackhardt, D. (1992). The Strength of Strong Ties: The Importance of Philos in Organizations, in: Nohria, N. and Eccles (Eds.), *Networks and Organizations: Structure, Form and Action.* Boston, MA: HBS Press.
Krishnan, V. and Ulrich, K.T. (2001). Product development decisions: A review of the literature. *Management Science* 47(1), 1-21.
Linton, J.D. and Embrechts, M. (2007). MOT TIM journal rankings 2006. *Technovation*, 27, 91-94.
Lukas, B. and Ferrell, O.C. (2000). The Effect of Market Orientation on Product Innovation. *Journal of the Academy of Marketing Science* 28(2), 239– 247.
March, J.G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2: 71-87.
McAdam, R. and McClelland, J. (2002). Sources of new product ideas and creativity practices in the UK textile industry. *Technovation*, 22, 113-121.
Montoya-Weiss, M.M. and Calantone, R. (1994). Determinants of new product performance: A review and meta-analysis. *Journal of Product lnnovation Management*, 11(5), 397-417
Moskowitz, H. (1997). Concept Development and Optimization for Foodservice (2): Accelerating Concept Development at the Fuzzy Front End by Combining Ideation and Consumer Evaluation, *Journal of Foodservice Systems*, 9, 175-192.

O'Connor, G.C. and Veryzer, R.W. (2001). The Nature of Market Visioning for Technology-Based Radical Innovation. *Journal of Product Innovation Management* 18: 231-246.

Ozer, M. (2004). Managing the selection process for new product ideas. *Research Technology Management*, *47*(4), 10-11.

Parish, T.D. and Moore, L.E. (1996). Nonassembled Product Development, in: Rosenau, M.D. (Ed.), *The PDMA Handbook of New Product Development*, pp. 287-296. Hoboken, NJ: John Wiley and Sons.

Pelham, A.M. and Wilson, D. (1996). A longitudinal study of the impact of market structure and market orientation culture on dimensions of small-firm performance, *Journal of the Academy of Marketing Science*, 24(1), 27-43.

Quinn, R.E. & Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. *Management Science*, 29: 363-377.

Reid, S.E. and de Brentani, U. (2004). The Fuzzy Front End of New Product Development for Discontinuous Innovations: A Theoretical Model. *Journal of Product Innovation Management* 21(3): 170-184.

Rothwell, R. (1974). SAPPHO updated: Project SAPPHO Phase II. *Research Policy* 3(3), 258-291.

Rothwell, R. (1994). Toward the fifth-generation innovation process. *International Marketing Review*, 11(1), 7-31.

Slater, A. and Gann, D. (2003). Sources of ideas for innovation in engineering design. *Research Policy*, 32, 1309-1324.

Veryzer, R.W. (1998). Discontinuous Innovation and the New Product Development Process. *Journal of Product Innovation Management* 15: 304-321.

Weick, K.E. (2007). The generative properties of richness. *Academy of Management Journal*, 50(1), 14-19.

Song, X.M. and Montoya-Weiss, M. (1998). Critical Development Activities for Really New Versus Incremental Products. *Journal of Product Innovation Management* 15: 124-135.

Tables:

Success factors for managing the fuzzy front end	Obtained from the literature
1. The presence of idea visionaries or product champions	Conway and McGuinnes (1986); Griffiths-Hemans and Grover (2006); Heller (2000)
2. Idea refinement and adequate screening of ideas	Boeddrich (2004); Bröring et al. (2006); Conway and McGuinnes (1986); Cooper (1988); Cooper and Kleinschmidt (1987); Elmquist and Segrestin (2007); Griffiths-Hemans and Grover (2006); Khurana and Rosenthal (1997); Kohn (2005); Lin and Chen (2004); McAdam and Leonar (2004); Murphy and Kumar (1996; 1997); Rosenthal and Capper (2006); Zien and Buckler (1997); Verworn
3. An adequate degree of formalization	Boeddrich (2004); de Brentani (2001); Gassmann et al. (2006); Khurana and Rosenthal (1997; 1998)
4. Early customer involvement	Alam (2006); Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Gassmann et al. (2006); Langerak et al. (2004); Murphy and Kumar (1997); Verworn (2006); Zien and Buckler
5. Internal cooperation among functions and departments	Bacon et al. (1994); Conway and McGuinnes (1986); Gassmann et al. (2006); Heller (2000); McAdam and Leonar (2004); Moenaert et al. (1995); Murmann (1994); Kohn (2006); Verganti (1997); Verworn (2006)
6. Information processing other than cross-functional integration and early customer involvement	Bacon et al. (1994); Börjesson et al. (2006)
7. Senior management involvement	Koen et al. (2001); Khurana and Rosenthal (1998); McAdam and Leonar (2004); Murphy and Kumar (1997);
8. Preliminary technology assessment	Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Murmann (1994); Verworn (2006)
9. Alignment between NPD and strategy	Bacon et al. (1994); Khurana and Rosenthal (1997; 1998)
10. An early and well defined product definition	Backman et al. (2007); Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Dickinson and Wilby (1997); Khurana and Rosenthal (1997); Kohn (2006); Montoya-Weiss and Calantone (1994); Montoya-Weiss and O'Driscoll (2000); Parish and Moore (1996); Seidel (2007); Song and Parry (1996)
11. External cooperation with others except customers	Khurana and Rosenthal (1997); Murmann (1994)
12. Learning from experience capabilities of the pre-project team	Verganti (1997)
13. Project priorities	Khurana and Rosenthal (1997); Murphy and Kumar (1997)
14. Project management and the presence of a project manager	Khurana and Rosenthal (1997); Nobelius and Trygg (2002)
15. A creative organizational culture	Murphy and Kumar (1997)
16. A cross-functional executive review committee	Khurana and Rosenthal (1997)
17. Product portfolio planning	Khurana and Rosenthal (1997)

Table 1: Success factors for managing the FFE. Note: Some authors present findings on more than one success factors, and accordingly some articles "belong" to several success factors.