

# HOW TO PREPARE STUDENTS FOR THE REAL FRONT-END OF INNOVATION CHALLENGES: A METHODOLOGICAL PERSPECTIVE

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## ABSTRACT

The new product development (NPD) phase is preceded by the process where new products are defined prior to development. This is often referred to as the Front-end of Innovation (FEI).

Unlike the NPD phase, the FEI is more dependent on a specific industry's context. In fact, defining new products holds a major strategic component by which a specific context is required that gives guidance to the definition of new products and services.

This paper is based on both a qualitative and quantitative research that focuses on firm performance in the FEI, in order to gain insights in the way FEI is impacted by strategic management, and the way product development aligns with product strategy. These key issues have been studied from the perspective of product development methodology with the intent to provide recommendations for an approach in the FEI, both in education and industry.

The research points at the need for methods in the very early stages of the FEI where search fields or opportunities have to be defined prior to idea generation. Generating search fields and detecting opportunities can be considered dedicated creative activities that follow the logic of divergent and convergent thinking.

*Keywords: Front-end of innovation, methodology, innovation management*

## 1 INTRODUCTION

The innovation capability of a firm is a key capability. As a result, there is a major interest in the way new products are developed but there is also a growing interest in the way to define new future products. Whereas the first objective is to translate basic requirements into a full product concept or product solution, the latter objective is to define new product ideas that might be suited for development, or to translate objectives and strategies into new product definitions.

## 2 THE FRONT-END OF INNOVATION

### 2.1 Definition

Innovation projects in industry generally move along three major activity domains: The pre-development activities (FEI) where future products are defined and decided on, the activities in New Product Development (NPD) where these products are actually developed and the launching or commercialization activities where these newly developed products are brought to the market [1].

New product development (NPD) activities start when a new product or service is defined and the decision is taken to start the development project. Khurana and Rosenthal [2] suggest that the pre-development activities are completed 'when a business unit either commits to the funding and launch of a new product development project, or decides not to'. Typical on pre-development activities is, as suggested in figure 1, that many ideas or proposals exist. The pre-development activity is a process of filtering and selection in order to have a limited number of projects to enter the NPD-phase, according to the available resources or strategic intentions.

In contrast with new product development, there is no common terminology on how to describe the pre-development phase of innovation. Cooper [3] introduces the term pre-development. Verganti (1997) describes these pre-development activities as the early stages of development or the pre-project

activities. Khurana & Rosenthal [2] use the term pre-phase zero. Reid & de Brentani [4] and Koen et al. [1], following Reinertsen [5] refer to them as the Fuzzy Front End. We will refer to this innovation phase as the Front-end of Innovation (FEI).

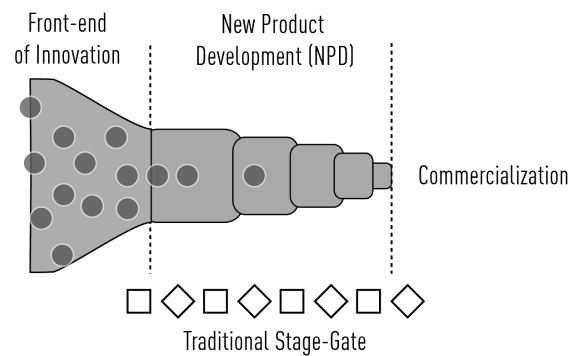


Figure 1. The innovation process, adapted from Koen, 2001

FEI-activities can be defined as all innovation activities that come before the more formal and well-structured activities of the New Product Development [1]. Kim & Wilemon [6] define the FEI activities as ‘the period between when an opportunity is first considered and when an idea is judged ready for development’. Reid & de Brentani [4] refer to the FEI as ‘the time and activity prior to an organization’s first screen of a new product idea’.

Focusing on these pre-development activities is in some cases referred to as front-loading [7] [8].

In the Front-end of innovation, seeds are sown that, ultimately, might result in successful new product launches on a short or the long term. Under the pressure of a fast changing world, short product life cycle times and harsh competition, these new product launches might be essential to the firm’s success in the long term. Therefore, a balance is required between short-term success and the long-term vision. The complete innovation processes could be, depending on the nature of the product or service itself, very complex and very expensive. And these processes depend to a large extent on the input for the process: ideas for new products, user needs that have been detected, technological opportunities that have been scouted, choices that have been made between different options, and so on.

## 2.2 The importance of the Front-end of Innovation

Prior research has pointed at the importance of the early stages of the innovation process [2] [4] [9], focusing on different important aspects of the FEI such as decision-making, adaptation of the process to the context and the culture of the firm.

The outcome of this process is of great importance on the innovation phases that come after the FEI. Backman et al. [10] state that the best opportunities for improvement of the innovation process lie in the front-end activities. Cooper & Edgett [11] find that due diligence in the early days of a project, or front-end loading, pays off in terms of time saving and higher success rate. Verworn [12] suggests that a better understanding of the FEI, leads to a higher success rate in the overall new product development process. She provides evidence of the leveraging effect of FEI on new product development success.

Furthermore, compared to NPD, the FEI process generates relatively low costs on itself. FEI processes are lean and require generally limited funding and resources, compared to NPD. The impact of decisions in the FEI, however, is very high. Product success and firm success are to a large extent depending on decisions made in the FEI. The impact decisions can have on the final product result decreases along with the project evolution: whereas FEI decisions can impact the product as a whole, NPD decision have to take into account earlier decisions and can only have an impact on partial aspects of products. On the other hand, the cost of corrective actions increases over time as the project is in development [13].

FEI can be seen as a lightweight process on itself but with a huge impact on the NPD and launching processes that follow these early stages. It contributes to firm’s success on the long term. As such, FEI plays a major role in the educational context. Students not only have to be trained in the NPD context but should also be prepared for the FEI.

## 2.3 Product definition in the Front-end of Innovation

The Front-end of Innovation (FEI) consists of a set of activities that leads to two important deliverables: the product and project definition documents. The product definition describes all product related elements, starting from the product functions, the market it is meant for, the technology it uses, the product architecture and the requirements about the new product to be developed.

The project definition describes or makes statements about project related elements: the resources needed, the project organization, the risks involved, ...

The product definition activities have been defined in different models [1][2][7][2][14]. Although there are some differences in these models, many similarities can be detected as well.

We define three major activity parts that can be seen as the base of FEI-activities: exploring activities, idea generating activities, and product definition activities. Each of the clusters consists of a wide range of activities, described by the different authors mentioned.

## 2.4 A product definition framework

The framework we use for the research on the FEI-activities is based on the models mentioned earlier. It is build in three major steps, according to the level of detail a product definition deliverable reaches throughout the FEI as illustrated in figure 2.

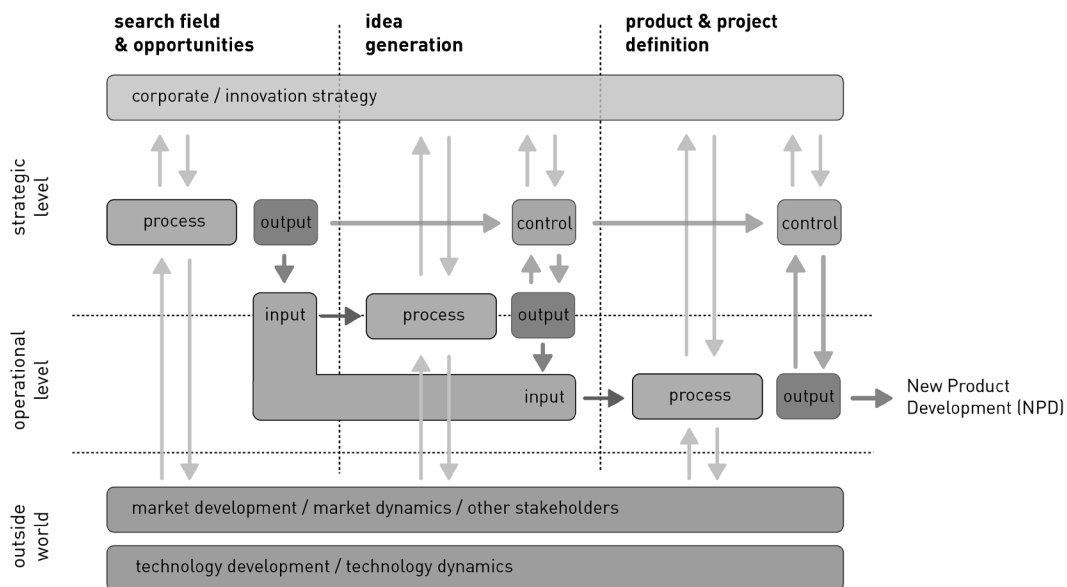


Figure 2. FEI process model

On the left side, in the search field and opportunity phase, the field of innovation is determined. All possible innovation fields are limited to a specific choice. That could be an answer to a specific problem; it could be the detection of a specific target customer, or the choice for a specific technology. In the middle, idea generation is the phase where product functions are determined and linked to a certain target market and technology.

On the right, the product definition is completed by adding requirements, product architectures, specifications, sub-functions, features, and so on. Every sub-phase contributes to the final product definition by adding more detail and specific elements to it on every sub-phase.

Although this model suggests linearity, we know that FEI activities in reality hardly follow this linear structure. Iteration and a circular approach are closer to reality. The simplification we make, however, is in function of the logic of adding detail to the product definition throughout the FEI. The phases are determined by the nature of its specific outcome, apart from the fact how this outcome is reached.

## 2.5 The transition from strategy to operations

An important part of the product definition activities is strategy driven. It is clear that the initiation of a new innovation process is a strategic decision, certainly when the innovation project requires new

resources and new investments. During the FEI, the strategy formation process comes to interface with more operational activities. Many employees make part of the innovation process without having any influence on the strategic decision that guide these innovation processes.

In our framework, this interface is situated between the opportunity and search field activities and the idea generating activities. The interface can also be seen between the operational activities of idea generation and product definition, and the control mechanisms that are strategy driven (figure 2).

### **3 RESEARCHING THE FEI**

#### **3.1 Knowledge gaps**

Literature research points at two major knowledge gaps. First, more clarity is needed about the way the product definition process evolves throughout the FEI in an industrial context and how the milestones at different sub-phases could support and improve the full procedure of defining new products, considering the different settings of every individual innovation process in industry. These elements are important in order to organize a management approach for the FEI.

Secondly, it is unclear whether or not this interface between strategy and operations really exists and if so, if the interface is considered problematic for proficiency in the FEI. The knowledge gap addressed is the way idea generation and product definition are embedded in strategic guidance and control.

#### **3.2 Research approach**

The research was conducted in two steps and with two different methods. The first part was a qualitative research part. Through a multiple case study in 13 firms, the existing FEI processes in the different cases were compared to the theoretical framework of FEI. The framework is based on literature research and is therefore empirically grounded. However, the specific set-up of the rationale for this framework requires that cases should be challenged against this framework in order to understand the actual problems that impede efficiency and effectiveness in the FEI.

The second part of the research has a quantitative nature. In a larger sample (N=61), through an Internet survey, the preliminary conclusions of the first phase have been elaborated in order to obtain validations on a larger sample. The nature of this research part is still explorative and explanatory, as it revealed limited power for prediction.

### **4 RESEARCH FINDINGS AND IMPLICATIONS**

#### **4.1 Research findings**

The research provides several new insights that are relevant to the innovation context of the firm but might be very interesting in an educational context as well.

##### **4.1.1 The FEI framework**

Although the FEI framework (figure 2) is supported quite well through the cases, the results point at the fact that synthesizing (generating) activities on the level of search fields and opportunities and on the level of product idea generation are performed less in a structured way than assessment activities. In several cases, opportunity scouting and product idea generation are not perceived as explicit activities. Ideas and opportunities appear in a very informal way and enter a workflow that focuses on assessment rather than creation.

In several cases, no distinction is made between idea generating activities and search field generating activities or opportunity scouting activities. Although this should not necessarily be perceived as a problem, the cases reveal that it leads to a confusing setting where new proposals are compared one to another, having a completely different abstraction level.

Due to the fact that the incorporation of external consultants in the process is mainly organized for synthesizing (generating) activities, we could assume that the synthesizing (generating) activities are perceived the more difficult ones and therefore are harder to organize in a formal way.

The theoretical framework is supported by the fact that the quantitative research reveals that two third of the firms provide strategic guidance prior to idea generation activities. However, the qualitative research also reveals that strategic guidance is in some cases very superficial. Vague guidelines are defined that have no real added value towards the process of product definition.

#### **4.1.2 The strategic - operational interface**

The research revealed difficulties in organizing strategic guidance. Although a strategic delineation of the innovation search fields would be most helpful, executing this kind of homework prior to idea generation is hardly done. That is less a problem in small organizations where a close and continuous interaction with the CEO bridges this lack of guidance.

#### **4.1.3 Technology driven innovation**

Specific innovation settings lead to different FEI processes. The cases clearly revealed that technology driven firms operate in a more structured and formal way through the FEI. However, as a consequence, typical FEI activities, such as the linkage of technology to specific user needs, or the integration of market insights in the requirements, are more likely to be invisible or secondary compared to technological decisions.

#### **4.1.4 Exploration and exploitation**

Innovation within the borders of the existing competences and existing product-market combinations has a very different nature than innovation that looks for new opportunities beyond the existing product-market combinations. The first is often referred to as exploitation; the latter is often referred to as exploration. The qualitative research reveals that in few cases parallel channels are organized for both exploration and exploitation. In situations where both activities are performed simultaneously, the risk for fuzziness and confusion rises. The different abstraction levels make it difficult to prioritize and make the right decisions.

### **4.2 Implications towards product development education**

Product development education is not only about translating requirements into new designs. It is more and more important to be able to define the requirements that eventually lead to new products. Doing so, product development becomes more strategic-driven. Several elements seem essential for educating students to operate in the FEI-context.

#### **4.2.1 Deep-rooted knowledge on product abstraction levels**

Product abstraction levels are the key for proficiency in the FEI. Much fuzziness is created through confusion on abstraction levels and required output on different abstraction levels. A lack of this knowledge makes it difficult to understand the distinct sub-phases in the FEI and the important difference between exploration and exploitation activities. Playing with abstraction levels, on the other hand, makes it easier to generate new search fields and product ideas in a divergent way.

#### **4.2.2 Generating activities compared to assessment activities**

We argue that the synthesizing activities of opportunity scouting, search field generation and product idea generation definitely need more attention. Performance in a creative setting has to do with the capability to explore in a divergent way on the different abstraction levels. In order to be able to make the right decisions in this early development phases, a broad approach is necessary for comparison between potential scenarios, opportunities and product ideas.

The fact that these generating activities on the different abstraction levels are not widespread, could point to a true need for competences regarding generating activities in the very early stages of the FEI. Handling product abstraction levels is one thing. Finding the right approach for search field generation, opportunity scouting and product idea generation, however, needs as much attention. There is a need for very dedicated qualitative tools that support the different sub-phases in the FEI. Tools that focus on a specific sub-phase and that can deal with the specific conditions for the FEI, such as the integration with technology, or a push-pull context where customers interfere with the ongoing process.

#### **4.2.3 Contextual flexibility**

The results of this research imply that students should have skills to operate in an exploration or an exploitation context. The potential and varying conditions for innovation should be simulated in an educational context and students should be trained to deal with a wide range of situations in a cross-functional setting. This would actually mean that future product developers have to experience the difficulties that might be intrinsic to collaborating with individuals with a very different background, knowledge and reference framework (such as a management perspective compared to a product

development perspective). Since it is not necessary to simulate these conditions within a firm, it would be meaningful to have students with different backgrounds work together on joint projects. This would also apply to management, marketing or technological oriented education programmes.

The FEI is a specific setting that needs specific training in an educational context. The main challenges are the adaptation to the innovation context, and the ability to imply divergent thinking in the very early strategic phases of innovation.

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