

MASTER

The front end evaluation process in the new product development process towards a more effective selection procedure of NPD projects

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Eindhoven, January 2017

The Front End Evaluation Process in the New Product Development Process

Towards a More Effective Selection Procedure
of NPD Projects

By

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Management Summary

Introduction

Many companies have difficulties with finding an efficient and effective approach for managing the FFE phase. And although proper management of the FFE phase, and in particular the evaluation process, is an important factor for successful product development, existing literature today does not provide a solid overview on how established organisations should design and manage this process. In order to fill this gap in the literature and provide organizations with a possible solution, this research is intended to find out how large, established organisations should design and manage the evaluation process in the FFE phase.

PostNL will be used as a case study to obtain the objectives of this research. PostNL is the parcel and mail delivery service market leader in the Netherlands, and one of the main players in the markets of Germany, Italy and Belgium. Their mission is “to serve customers through excellent service and offer the highest level of quality in the market” (PostNL Corporate Presentation, 2014). PostNL aims to improve the effectiveness and efficiency of their current NPD process, and more specifically its evaluation process in the FFE phase. The aim of the research is defined as:

Design and implement a new evaluation process – for the FFE phase of the NPD process – for PostNL in order to improve development effectivity.

And this aim will be achieved by answering the following research question:

How can PostNL redesign and implement its evaluation process in the fuzzy front-end phase of the New Product Development process, in order to increase its effectiveness?

Research methodology

To gain insight into the relevant aspects of the research question and sub-questions, the literature on the process of developing new and innovative products is reviewed and synthesized, more specifically its FFE phase and evaluation process. This study follows a science-based design approach, in which the relevant literature is connected to managerial practice. More generally, science-based design connects research to daily practice in organisations by formulating design principles following CIMO logic (Denyer, Tranfield, & Van Aken, 2008). These design principles form the basis for the design solution. The solution design follows the regulative model cycle: (1) problem definition/ identification, (2) diagnosis/ analysis, (3) design/ plan, (4) intervention (implementation in practice), and (5) evaluation (Aken, Berends, & Bij, 2012). The design (step 3, the design / plan phase in the regulative model cycle) follows a design process approach, which consists of requirement definition, solution direction definition, design parameters determination, parameter value definition, a detailed design, and iterative testing. In order to design the solution, an iterative prototyping approach was incorporated (Naumann & Jenkins, 1982).

Theoretical Background

The theory says that organisations should decide which NPD model suits them best based on their environment, their core competences and their goals. Organisations should always use a structured NPD process for a successful development, since this creates focus and clarity. An innovation strategy is also essential. Next to a focus at development, an innovation strategy makes the evaluation process more effective because it sets conditions to development, and thus everything that does not meet those conditions is not regarded anymore in further development.

For an effective evaluation process, established organisations are recommended to evaluate the NPD projects at several predefined stages. This leads, next to having a more focused development, to an

improvement in selecting the best new product ideas, regardless of their (possibly risky) characteristics. However, organisations should be aware of, and manage, the challenges that may occur during the evaluation process, among which *escalation of commitment* (EoC) issues. To cope with EoC, organisations need to increase NPD projects knowledge throughout the NPD process and make the evaluation process a multi-person activity.

Based on the literature review, 11 design-based principles have been developed and mentioned in Theoretical Background chapter.

Solution Design

The results of the problem analysis revealed two general issues, namely: (1) a high level of NPD process uncertainty, and (2) an ineffective NPD project selection process due to ineffective design and subjectivity. To tackle these issues several solution designs were introduced. Firstly, to reduce a high level of NPD process uncertainty, a structured FFE phase was introduced. This development process starts with the definition of the innovation strategy, which sets the guidelines for further new product development. Furthermore, this structured development process will reduce development uncertainty, as participants of the process are required to exchange relevant information depending on the stage they are in. Moreover, by implementing an information system, insights on development activities are increased, which in turn results in the reduction of development uncertainty.

Furthermore, the design includes an evaluation process which consists of two evaluation stages, an information system, and a new NPD management structure. The evaluation stages (e.g. preliminary assessment and thorough concept assessment) include scorecards which assess a set of criteria from the categories: relatedness, market worth, protectability, product/service advantage, technical feasibility, and risk versus return. The information system is included to improve overall NPD project knowledge throughout the NPD process and to reduce the likelihood of escalation of commitment by the decision-makers. The suggested design makes the evaluation process more rational by providing clear predefined sets of criteria to work with and a method to process the evaluation outcomes. Furthermore, the design solution incorporates and specifies multiple stakeholders throughout the evaluation process, thereby preventing potential distortion of the evaluation as a result of personal involvement. Consequently, leading to a better evaluation effectivity.

Change Plan

For a successful implementation of the solution design, PostNL should pursue the predefined change plan as described in chapter five. PostNL should be aware of the major alternations to its current NPD process, evaluation process, and collaboration structure. These alternations are expected to create resistance on individual, group, functional, and organisational level. In order to intervene against these resistances, the eight-step change approach from Kotter (1996) and the Tichy's Technical Political Cultural framework are incorporated. Furthermore, a change organisation has been determined in order to manage smooth transitions of the major business process alternations. Finally, a communication strategy has been determined for PostNL in order to effectively communicate the change process to the stakeholders.

Conclusions

Although innovation and NPD are very important for an organisations' survival, existing literature is still limited on the subject of FFE. This research contributes to the existing literature in two ways. Firstly, by discussing the FFE phase of the NPD process for established organisations, therefore providing further insights on this subject. Secondly, by giving a framework for how best to deal with the evaluation process in the NPD process.

An important limitation of this research is that the design and its scorecards have only been tested by a selection of PostNL's senior management and the researcher, and not yet been used for any actual project evaluations. As for the designed evaluation process, the assessment scorecards require further development and testing. The assessment criteria need to be calibrated by running actual projects through the design and assessing to what degree predicted outcomes beforehand match the actual outcomes. Moreover, a distinction may be made between must-meet and should-meet criteria, and between objective and subjective measures. Doing this has the intention of focusing the design even further in the right direction of carrying out a successful NPD process.

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List of Abbreviations

- CIMO** Context Intervention Mechanism Outcome
- EC** Executive Committee
- EoC** Escalation of Commitment
- FFE** Fuzzy Front End
- IS** Information System
- MT** G&I Management Team Growth and Innovation
- NPD** New Product Development
- VC** Venture Capitalist

1. Introduction

To increase or sustain innovative performance, companies must stimulate a creative organizational and entrepreneurial culture, in which they manage, communicate, but also stimulate employees to bring forth new, creative and innovative ideas (Kenney et al., 2010; Fry, 1987). These ideas must be elaborated on, in order to bring a new product or service to the market. This process from idea-to-launch is called a New Product Development (NPD) process. The NPD process can be divided into two main phases, namely the fuzzy front end (FFE) and the execution-oriented back-end phase (Wowak, Craighead, Ketchen, & Hult, 2016).

According to Kim and Wilemon (2002, p. 270), the front end begins *“when an opportunity is first considered worthy of further ideation, exploration, and assessment, and ends when a firm decides to invest in the idea, commits significant resources to its development, and launches the project”*. During the FFE phase, the development team identifies and selects interesting innovation ideas, and assimilates the most favourable ideas into product or service concepts for further development (Koen, Bertels, & Kleinschmidt, 2014). Usually, the main deliverable of the FFE phase is a plan for the product that will lead to the execution-oriented back-end of the NPD process (Kim & Wilemon, 2002). Therefore, decisions made during the FFE phase determine the course of the newly developed product and hence it is argued that these decisions play a critical role in whether the NPD will be successful or not (Wagner, 2012). Zhang and Doll (2001) argue that *“most projects do not fail at the end, they fail at the beginning”*. Furthermore, Hauser et al. (2006) emphasize that: *“there is no doubt that the fuzzy front end of the NPD process has a big effect on a product’s ultimate success”*. A critical process in the FFE phase is the selection of the product or service concepts that will eventually be worked out and executed in the execution-oriented back-end phase. This process, that aims to select only the best concepts, is called the evaluation process.

Many companies have difficulties with finding an efficient and effective approach for managing the FFE phase. And although proper management of the FFE phase, and in particular the evaluation process, is an important factor for successful product development, existing literature today does not provide a solid overview on how established organisations should design and manage this process. In order to fill this gap in the literature and provide organizations with a possible solution, this research is intended to find out how large, established organisations should design and manage the evaluation process in the FFE phase.

PostNL will serve as a case study, for which this research report aims to implement a redesign of its evaluation process in the FFE phase. PostNL is the parcel and mail delivery service market leader in the Netherlands, and one of the main players in the markets of Germany, Italy and Belgium. Their mission is *“to serve customers through excellent service and offer the highest level of quality in the market”* (PostNL 2020: Committed to sustainable delivery, 2015). Furthermore, PostNL’s senior management argues that in order to maintain a sustainable business model and cash flow after 2020, it is a necessity that the organisation extends its current product portfolio. To do so, PostNL is looking for value creating growth opportunities, which are driven by market and technological trends. However, recent research at PostNL showed that PostNL wishes to improve the manageability, objectivity and time-to-market of their NPD projects, as project costs and gains expectations repeatedly have not been met (Hoogkamer, 2015). According to this recent research this is the result of:

- A lack of an uniform evaluation process of NPD projects,
- A lack of an effective implementation of the evaluation process, and
- A lack of insight on all NPD activities.

To overcome these challenges, a redesign of the evaluation process – in the FFE phase of the NPD process – is assumed to be necessary. To make such an evaluation process redesign possible, a thorough understanding of its overarching FFE phase is needed as well. These two objectives will allow PostNL to improve the effectiveness of their NPD process.

The focus of this research will be limited to the development of a redesign of PostNL's evaluation process and outlining its overarching FFE phase of the NPD process. The scope of the study is narrowed on the MailNL division of PostNL. The redesign and outline will be based on a comprehensive analysis and diagnosis of available literature and company data. The aim of the case study is defined as:

Design and implement a new evaluation process – for the FFE phase of the NPD process – for PostNL in order to improve development effectivity.

And this aim will be achieved by answering the following research question:

How can PostNL redesign and implement its evaluation process in the fuzzy front-end phase of the New Product Development process, in order to increase its effectiveness?

To answer the research question, several sub-questions are formulated:

- What insights does the literature provide us on the FFE phase of the NPD process and its evaluation process?
- How should PostNL (re-)design its evaluation process in the FFE phase?
- How should PostNL implement its evaluation process (re-)design?

This research report will provide PostNL with a solution that is useful to (re-)structure the evaluation process, and thus the FFE phase of their NPD process. The structure of this research report is as follows: In Chapter 2, the methods used in this research report are explicated. In Chapter 3, the relevant theoretical literature background is set out, and its relevance to the case study is discussed. Chapter 4 then explains the set up and overview of a tailored evaluation process design for PostNL. In order to successfully implement the proposed design, a change plan is provided in Chapter 5. Finally, conclusions, theoretical and managerial implications, and research limitations are elaborated on in Chapter 6. An overview of this research report is illustrated below in Figure 1-1.

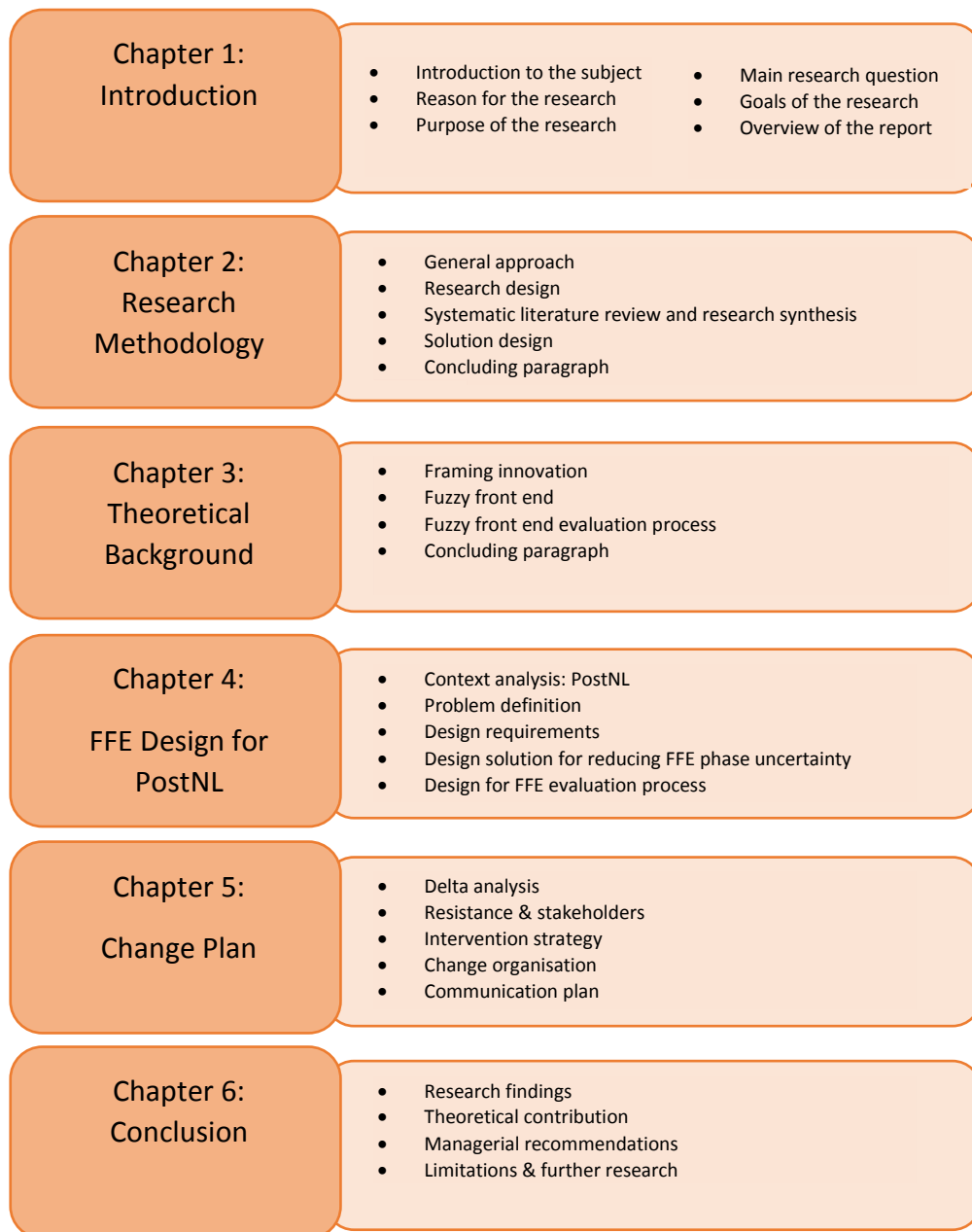


Figure 1-1: Report Overview and Structure

2. Methodology

This chapter will describe the scientific methods that are used in this research. The following paragraphs explain the general approach, research design, systematic literature review and research synthesis, solution design and the implementation of the design, and, lastly, a summary of this chapter.

2.1. The general approach

This research uses a qualitative approach. This means that the gathered data, on which this research is based, stems from literature, documents provided by PostNL, interviews with employees of PostNL and observations at PostNL.

For the first sub-question ('What insights does the literature provide us on the FFE phase of the NPD process and its evaluation process?') an extensive literature research is conducted to provide an overview of what the FFE phase and evaluation process in the NPD process entail, and what they look like. To answer the second and third sub-questions ('How should PostNL (re-)design its evaluation process in the FFE phase?' And 'How should PostNL implement its evaluation process (re-)design?') a different research approach is used. This approach is discussed in the next section.

2.2. The Research Design

The term 'designer' implies that "designers have found and described a certain structure that is suitable to perform a certain function" (Hubka & Eder, 2012), and this structure is set to meet certain demands (constraints, needs and requirements). In redesigning the evaluation process for PostNL, it is needed to describe its structure in a scientific way, and also to address the function it should perform, the demands it must meet, and to be able to implement it in practice. A scientific research method that focuses on the development of research that is useful to both theory (research) and practice, but also adjusts design contexts to generate theory in natural contexts, is a 'design-based research' approach (Barab & Squire, 2004). This term is adopted in many research papers (Anderson & Shattuck, 2012), and used under many different names (Akker, 1999; Holmström, Ketokivi, & Hameri, 2009). It is described by Van Aken (2004), who terms it 'design science', as: "a design-science is not concerned with action itself, but with knowledge to be used in designing solutions, to be followed by design-based action" (Aken J. v., 2004, p. 226). Knowledge is developed for the professionals in the field, who can then implement it. The knowledge that is developed is produced by means of expertise knowledge in the field and general theoretical knowledge (Aken J. v., 2004). The researcher that implements this approach wants to develop an artifact to a problem (Holmström, Ketokivi, & Hameri, 2009). In other words: the aim of the researcher is to eventually propose a general solution to a problem, by iteratively implementing a solution in practice. The process is an exploration through design, where the goal is: "(i) to explore new solution alternatives to solve problems, (ii) to explain this explorative process, and (iii) to improve the problem-solving process" (Holmström, Ketokivi, & Hameri, 2009).

Romme and Endenburg (2006) introduce the use of 'construction principles' and 'design rules' to guide such practitioner-theorist projects, and term this approach a 'science-based design approach' in organization science (Romme & Endenburg, 2006). The approach also links theoretical research to managerial practice. This is done to be able to, not only observe and explain organizational design, but also implement and try out new ways of organization design in real life settings. The fundamentals on which this science-based design approach is based, is "a research cycle involving organization science, construction principles, design rules, organization design, and implementation and experimentation" (Romme & Endenburg, 2006). Where organization science encompasses the body of theory and organizational practice and information, construction principles and design rules are interrelated in that they together form the fundamentals and guidelines of a (re)design, organization design is the visualization of the proposed (re)design, being (re)designed with the help of the design rules, and

implementation and experimentation engages itself with trying out and testing the proposed (re)design, while adapting and rethinking the rules and principles if necessary (Romme & Endenburg, 2006).

Van Burg and his colleagues (2008, p. 116) use two key notions in linking practice to theory: 'design principles' and 'design solutions'. Where design principles are closely related to Romme and Endenburg's (2006) construction principles and design rules, and design solutions is closely related to Romme and Endenburg's (2006) organization design. Van Burg et al. define design principles as: "*Design principles involve a coherent set of normative ideas and propositions, grounded in research, that serve to design and construct detailed solutions*". They develop principles based on practice and on research and synthesize these principles to result in a design principle (Burg, Romme, Gilsing, & Reymen, 2008). They define design solutions as: "*representations of the practices being (re)designed with help of the design principles*". Design solutions are more contextualized than design principles and can be implemented in local settings (directly tested in practice), and often are visually represented (by a e.g. diagram, model, simulation) (Burg, Romme, Gilsing, & Reymen, 2008).

The research in this report follows a science-based approach, with its focus on the development of design principles from a systematic literature review. These principles will then function as the foundation for developing and testing a design solution. Design principles follow CIMO logic in order to describe how to change existing situations into desired ones: in context C, use intervention I to invoke generative mechanisms M that produces outcome(s) O (Denyer, Tranfield, & Van Aken, 2008). The design solution will consist of tools and guidelines, which will help PostNL during the (re)design of the evaluation process in their FFE phase. Furthermore, the testing – or evaluation – of the design principles and design solution will follow Van Aken et al.'s (2012) reflective cycle methodology.

2.3. Systematic Literature Review and Research Synthesis

Existing literature does not provide us with one definite answer to the research question. Therefore, the literature needs to be systematically reviewed in order to be able to acquire insights on the relevant aspects of the research question and sub-questions.

Literature about innovation, entrepreneurship, and more specifically the FFE phase and the evaluation process in the FFE phase (of the NPD process), is studied and synthesized. For a more effective literature study of these research topics, the literature needs to be studied in a systematic manner. Therefore, the following related research subjects are identified and used to start the search: *new product development process, front end of innovation, front end models, new product development, fuzzy front end phase, new product strategy idea generation, idea selection, concept development, concept selection, evaluation process, decision-making process, market orientation, evaluation challenges, organisational learning, information system, etc.* Moreover, a combination of these subjects has been studied in order to gain insight into the fuzzy front end phase of the new product development process.

The *ProQuest database, Thomas Reuters Web of Science* and *Google Scholar* are used to search for the most significant studies on the subjects. To select the most significant publications per subject, studies with the highest individual citation score and papers published in the most influential journals in the respective field were selected. Additionally, the most influential journals in the field of NPD were also studied to find relevant publications. Furthermore, when appropriate publications are identified, a snowballing approach was applied to find more related studies.

2.4. Solution Design

In general, the (re)design follows the regulative model cycle: (1) problem definition/ identification, (2) diagnosis/ analysis, (3) design/ plan, (4) intervention (implementation in practice), and (5) evaluation (Aken, Berends, & Bij, 2012). The design (step 3, the design / plan phase in the regulative model cycle)

follows a design process approach, which consists of: a requirement definition, solution direction definition, design parameters determination, parameter value definition, a detailed design, and iterative testing. In this research the design requirements are formulated according to SMART requirements: specific, measurable, acceptable, realistic, and time-based. There are four types of design requirements: functional requirements, user requirements, boundary conditions, and design restrictions (Aken, Berends, & Bij, 2012). These requirements, which will be discussed in detail in chapter 4.3, have been determined in collaboration with the main principles of this research study, namely the IT Solutions director and Master Plan Office manager of PostNL.

This research report provides a solution for developing (new product/service development) ideas for established organisations in general, and for PostNL in particular. The design includes practical model for the evaluation process in the FFE phase of new product/service development processes.

2.4.1. Data Collection

The focus of this thesis project is in the qualitative, explorative case study method. This is done by collecting data at PostNL from semi-structured interviews, documents and archives. The gathered information is triangulated through this process (Yin, 2009; Aken, Berends, & Bij, 2012; Blumberg, Cooper, & Schindler, 2011; Berg, 2001). In the beginning a lot of semi-structured interviews were being held at PostNL to get a first general overview of the market of mail and parcel delivery services. After these first interviews, literature was studied extensively to get an understanding of the main problems at this department. Whereafter, more specified interviews were held to triangulate collected data.

Semi-structured interviews

The format of the interviews is semi-structured. This means that beforehand you formulate a set of basic and specified questions that guide you through the interview (Aken, Berends, & Bij, 2012). However, if other topics or information come up during the interview, additional questions can be asked to obtain extra, relevant information.

At PostNL the first round of exploratory interviews was held with PostNL's Growth & Innovation Manager, Product & Development Manager, IT Solutions Director, Master Plan Office Manager, MailNL Production Director, Edison Manager, MailNL Production Deputy Director, and their Product & Service Manager. The data gathered from these interviews were used to determine the focus of the research and guide further data collection.

After this first round, relevant literature was studied extensively and an initial framework was prototyped. In the following interviews this framework was tested to adapt it where needed. This process was repeated iteratively during a period of three months (from May to July in 2016). Where needed, the interviews were triangulated with literature.

Documents and Archives

At PostNL several reports were used to extend the data resources used to conduct this study. The formats of these reports were: research reports, strategic updates, and newsletters from management. These documents were studied to aid the data gathered from interviews and the studied literature, to get a good understanding of the situation at PostNL, and to research where the biggest need for improvement was necessary.

2.4.2. Data Analysis

The gathered data (semi-structured interviews, documents and archives) are used to find, select, appraise (make sense of) and synthesise the data. Triangulation is then used to combine the methods and findings from these data sources to reduce the impact of biases that can exist in a single study (Bowen, 2009).

2.4.3. Design

In order to design the solution, an iterative prototyping approach is incorporated (Naumann & Jenkins, 1982). Preece et al. (2002) argue that the basic deliverables of an iterative approach are the prototypes. The prototypes are the models, which depict the design decisions to enable the users to evaluate the design and give feedback. Two ways of prototyping can be distinguished: (1) paper prototyping, which is the fast and dirty approach, and (2) high-fidelity prototyping, which is detailed robustness testing. Due to the available time and resources, this research uses the paper prototyping approach. By using simple drawings, the rough idea of the design is communicated meetings, allowing for further development by in-depth iterations. These iterations were in the form of open-ended one on one interviews, with PostNL's Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager. Each of these managers have been interviewed for at least three times between May and July 2016 on this matter.

Limitations of the paper prototyping, is that due to its simplicity, the prototypes required the researcher to present and explain the prototype. As such the results of the meeting were highly effected by how successful the researcher was on communicating the prototypes. Another limitation of this approach is that collaborators feel like the prototype is far from the actual design, due to its simplicity, which in turn can negatively influence the feedback. However, the biggest advantage of the paper prototype is that it is very simple and fast. Therefor it is possible to roughly test the design multiple times without a lot of time passing by between testing and without a lot of resources needed.

2.5. Concluding paragraph

Literature studies, PostNL reports and other information sources that are gathered and studied to substantiate this research are qualitative of nature. In order to answer the research questions:

How can PostNL redesign and implement its evaluation process in the fuzzy front-end phase of the New Product Development process, in order to increase its effectiveness?

A 'science-based design' approach will be used. In a science-based design approach the (re)design is formed by means of design principles, these principles find their origin in organization science, but also its implementation in real life settings. The design principles, which will be synthesized based on a systematic literature research form the basis for a design solution for the new evaluation process of PostNL's FFE of the NPD process. This design solution is then implemented through prototyping and iteratively testing during multiple one on one meetings in collaboration with PostNL's Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager in order to optimize it.

The design solution in a science-based design approach is implemented locally, but should be an addition to theory in general. In other words: the eventual design solution for the evaluation process can be applied at different established, large companies, while its implementation is tested only at PostNL.

3. Theoretical Background

The theoretical background presented in this chapter is focused on answering the question:

- What insights does the literature provide us on the FFE phase of the NPD process and its evaluation process?

In order to gain knowledge on these subjects, the literature on the New Product Development (NPD) and more specifically, innovation is studied. In the next paragraph the fundamentals of these subjects are set out. Next, an elaboration on FFE phase models will be given for a better understanding. Then, findings on effectively evaluating opportunities and projects during the FFE phase are provided. And in the final paragraph, a recap of the previous sections is provided.

3.1. Framing Innovation

In this chapter, the focus lies on subjects that are related to product and service innovation. As such, research on process innovation will be left out of this study. This is due to the significant difference in nature of both of these innovations, and the focus that PostNL has: they are improving their product and service innovation success.

In the literature, innovation is seen as a necessity for the economic efficiency of organizations, as well as one of the key drivers of an organization's long-term success, especially in increasingly faster moving markets (Khurana & Rosenthal, 1998; Reid & Brentani, 2004). Innovation can also be seen as a method which can alter an organization in order to react on its internal or external environmental manipulations, or as a pro-active action taken to influence an organizations environment (Pisano, 2015). Two important types of innovation are: product or service innovation and process innovation (Edquist, Hommen, & McKelvey, 2001). Garcia and Calantone (2002, p. 112) provide a definition of innovation that captures the core of all innovations: *"innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention"*. Authors Garcia and Calantone (2002) addressed two key distinctions. Firstly, a technological discovery is combined with a successful market introduction through adoption and diffusion of the innovation. Secondly, the development process has an iterative approach, which suggests a variety in the degree of innovativeness or degree of newness. The latter has been used from different perspectives on both macro and micro level, namely: new to... the world, the adopting unit, the industry, the market, and the consumer (Garcia & Calantone, 2002). Nevertheless, the degree of newness has regularly been used as the degree of incoherence in technological and marketing factors.

3.1.1. Innovation & Uncertainty

New product development (innovation) is by nature about the unknown, possibilities and opportunities linked to doing something new, which possibly will pay back in the future. In other words, managing the NPD process means dealing with uncertainties. Galbraith's (Galbraith, 1973) defines uncertainty as: *"the difference between the amount of information required to perform the task and the amount of information already possessed by the organisation"*. More than four decades of research has led to an extensive literature on types, dimensions and sources of uncertainties. Particular attention of the organisation theorists has been on environmental uncertainty, which explains the interface between organisation and its environment (Burns & Stalker, 1961; Duncan, 1972; Thompson, 1967). Milliken (1987) proposes three different types of external uncertainties, namely: state, effect, and response. He separates the actual environment from its unpredictable characteristics. These unpredictable characteristics can affect and change the organisation, and can influence its actions, which might not always be under the organisation's control. Other researchers see NPD as a process

of reducing the knowledge gaps between user needs and technological uncertainties (Goldhar, Bragaw, & Schwartz, 1976; Rothwell & Robertson, 1973; Utterback, 1971). Another field of research focuses on the dependent uncertainties between technology, market, and competition (Duncan, 1972). Through a systematic literature review of more than hundred scientific articles, Jalonen (2012) was able to identify 18 distinct NPD uncertainty factors. Table 3-1 represent these uncertainty factors, which have been categorized in the following three categories: market, organisational resources and technology. Next, these three categories will be discussed in more detail.

Table 3-1: Innovation Uncertainty Factor (Jalonen, 2012)

Uncertainty category	Uncertainty factor
Market	Commerce
	Consumer
	Competition
	Environment
	Regulations
	Legal
	Society
	Politics
	Economics
	External acceptance
Organizational resources	Internal acceptance
	Organisation
	Resources
	Decision-making
	Tasks
Technology	Behaviour
	Technological
	Technical

Market Uncertainty

Market uncertainties arise when an organisation is uncertain about the nature of a certain market and whether the organisation has the ability to develop a new product which will succeed in that particular market. The uncertainties are related to the user’s latent or existing wants and needs as well as sales and distribution approaches (Leifer, O’Connor, & Rice, 2001). The uncertainties related to unknown customer needs, customer behaviour, pricing and the call for innovation were identified as the main sources of uncertainty initiated by users (Souder & Moenaert, 1992; Tatikonda & Montoya-Weiss, 2001). However, market uncertainties are also the result of lack of knowledge on competitors’ activities. This is typically an uncertainty for organisation active in liberalized of global markets (Ortt & Smits, 2006). In conclusion, market uncertainties in the NPD process are the result of unexpected alterations in the relationship between an organisation and its customers as well as unforeseen alternations in the relationship between the organisation and its competitors.

Organizational Uncertainty

Organisational uncertainty includes aspects of uncertainty such as resource uncertainty, acceptance uncertainty and decision-making uncertainty. The latter two aspects can be combined into task uncertainty, which is said to be the result of the non-routine nature of R&D activities and the high level of organisational and technical dependencies needed to preform them. An organisation has to reduce sources of uncertainty in order to be successful in development. However, to do so, organisation need to allocate resources, which introduces resource uncertainty. So, the less an organisation knows about a technology or market, the more likely it is that an organisation will be uncertain about the amount and the kind of resources it needs to allocate (Milliken, 1987, p. 133).

Technological Uncertainty

Developers face technology uncertainty in two different ways, firstly, in terms of product specifications, and secondly, through the production process (Harris & Woolley, 2009). It is the supplementary data regarding the components and methods an organisation needs to develop a new product or service based on a specification, one that also needs to be determined (Afuah, 2003, p. 116). The uncertainty related to product specification hinge on the level of novelty of technology required of the development, which itself leads to uncertainty because of the needed knowledge and skills for a successful usage of new technology (Tatikonda & Montoya-Weiss, 2001). In summary, the technology uncertainty in the NPD process stems from an absence of knowledge on the details of the new technology or from the gap in the knowledge needed to effectively make use of the new technology, or both (Jalonen, 2012, p. 24).

In conclusion, an organisation's development process involves managing uncertainties (e.g. market, organisational, and technological). The level of these uncertainties is argued to determine the level of newness of an innovation. In the following paragraph it is explained how researchers have implemented the level of uncertainty in order to categorize different types of innovation.

3.1.2. Types of Innovation

Through a broad literature study, Garcia and Calantone (2002) were able to reduce the variety of vaguely defined categories of product and service innovations into five classifications: (1) radical innovation, (2) really new innovations, (3) discontinuous innovations, (4) incremental innovations, and (5) imitative innovations. Garcia and Calantone define (2002, p. 120) the classifications as following: *"Radical innovations are innovations that cause marketing and technological discontinuities on both a macro and micro level. Incremental innovations occur only at a micro level and cause either a marketing or technological discontinuity but not both. Really new innovations cover the combinations in between these two extremes"* (See Figure 3-1). Garcia and Calantone (2002) found that 12,5% of innovations were radical innovations, where as 50% were really new, and the remaining 37,5% were incremental innovations. The division between radical and incremental innovation exists for a long time.

Studies like Leifer (2000) point at March's (1991) exploration and exploitation explanation. Leifer (2000) argued that incremental innovation depends on the exploitation capabilities of the organisation, whereas radical innovation would depend on exploration in order to develop new products. Radical innovations or very new innovations that are the real game changers, are also known as discontinuous innovations. Rice et al. (1998, p. 52) define discontinuous innovation as an innovation which has the potential to realize *"(1) a 5-10 times improvement in performance compared to existing products; (2) create the basis for a 30-50% reduction in costs; or (3) have new-to-the world performance features."* And finally, innovation happens only when an organisation introduces a new product into the market, but whenever the same product is introduced to the market at a later time, by a different organisation, it is no longer an innovation but an imitation.

Within PostNL, all radical innovations are managed and executed from a different location. The so called "innovation studio" is stationed in Amsterdam, away from its The Hague headquarter in order to allow innovation teams to operate more freely than they would in The Hague. As this research is being conducted, a different research team is studying how the NPD process of radical innovation should be managed. As for incremental innovation, PostNL has recently introduced the "De Klaverblad" method. Using this method, teams adhere to predefined steps that are based on predefined certainties of the development outcome. The focus of this research has therefore been narrowed, by the principal of this study, on findings related to really new innovations (Figure 3-1: framed in red). This means that innovations that cause either marketing or technological discontinuities on both a macro and micro level. In other words, PostNL would like to improve its evaluation process for innovation types that are

linked either to its current technological capabilities - while new on a market level for the firm and the market itself, - or vice versa linked to its market capabilities while being technologically discontinuous on macro level.

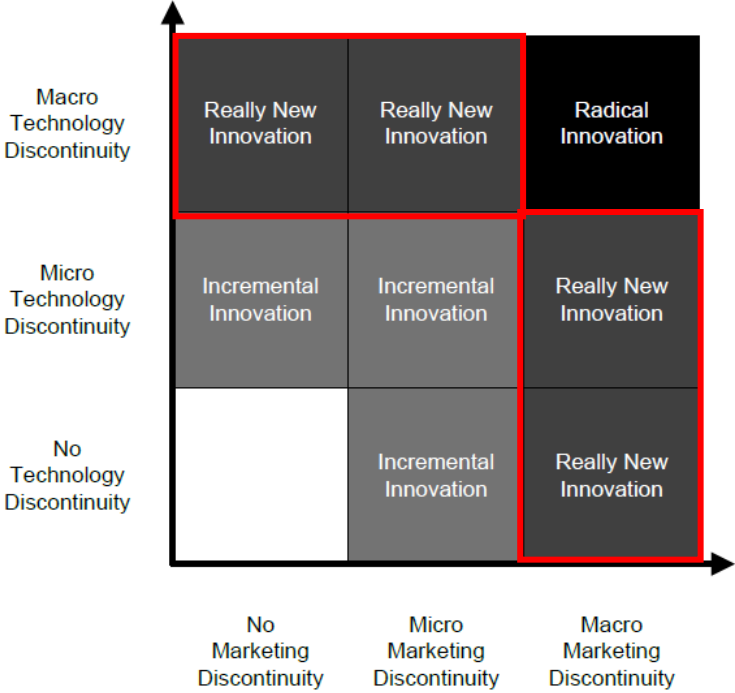


Figure 3-1: Innovation types (Gacia & Calantone, 2002). Innovation Type Framed in Red is the Focus on this Research

Having explained the fundamentals of product innovation, in the next paragraph an elaboration on FFE phase models will be given for a better understanding.

3.2. Fuzzy Front End

Murphy and Kumar (1997), argue that the Front End of Innovation is the period between detecting an opportunity in a market and the start of the new product development (NPD) execution. Koen et al. (2001) define the first stages of the NPD process as the tasks that are executed before the well-structured, formal NPD process. These first stages of the NPD process at which an opportunity is considered and the point when it is decided if the opportunity is worth continuing to the structured development process, is define by Koen et al. (2001) as the Fuzzy Front End (FFE). At this point the organisation develops the first concepts of a new product to be developed and chooses whether to continue investing resources in the further advancement of an idea. The FFE ends when an organisation agrees on starting the formal development of the product concept (Trott, 2012). In the following paragraphs the characteristics of FFE, the success factors, and the FFE models will be deliberated.

3.2.1. Characteristics of Fuzzy Front End

During the FFE of the NPD process, technological and market uncertainties are high while the level of accessible information is limited (Koen P. , et al., 2001)(See Figure 3-2). Even though, some level of equivocality and uncertainty are unavoidable, over the course of time, as data gets more reliable, uncertainty decreases (Song & Parry, 1996). Cooper and Kleinschmidt (1990) research empirically showed that the main difference between best performing and the least performing organisations, was the execution quality of the FFE activities. Moreover, authors argued that besides execution quality, a well-defined project before the formal development phase are central success factor for

products. Tasks in the FFE phase tend to be executed in an unstructured way and with limited development resources, because the importance of these tasks are generally underestimated.

Principle 1: For an effective new product development, established organisations should request a well-defined project definition before development phase, since this is a central success factor for products.

Numerous studies (Koen P., et al., 2001; Montoya-Weiss & O'Driscoll, 2000) have tried to find the main characteristics of the FFE phase. Although FFE differs in execution approach, it is possible to identify common factors. For example, formalization, documentation and clear responsibilities stick out as the factors that are less prominent in the first stages. Whereas, uncertainty (with respect to required resources, technology and strategic fit) creativity and ambiguity are commonly the characteristics that are present and essential in the first stages. Nevertheless, the effect of these and all other characteristics are dependent on the organisation and its context, changing according to its size, experience with development, the degree of novelty, and company culture. Consequently, development tasks and decisions in the FFE phase greatly influence the success of the NPD project, effecting not only development costs and time, but also all following decisions in the development process (Cooper R. G., 2011, p. 41; Zhang & Doll, 2001, p. 95).

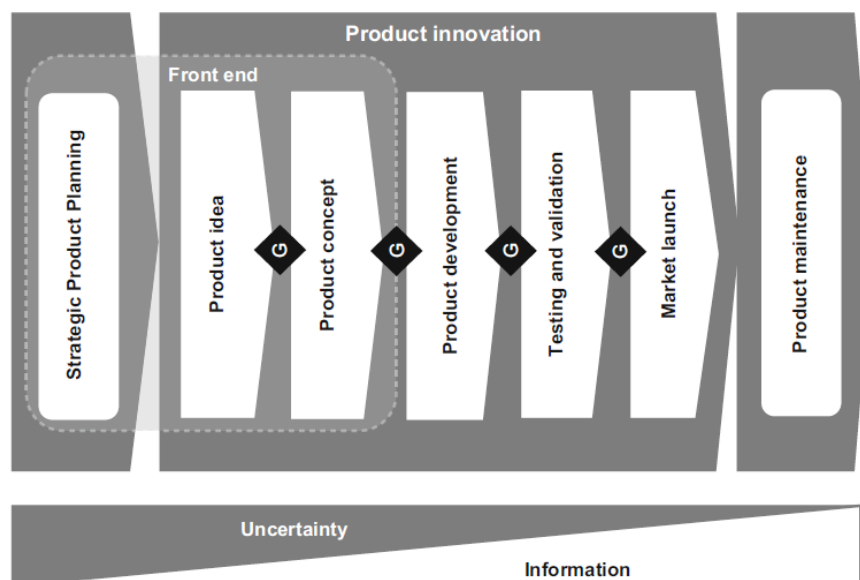


Figure 3-2: Uncertainty Reduction and Growth of Information During the Innovation Process (Gaubinger, Rabl, Swan, & Werani, 2015, p. 45)

3.2.2. Success factors of the Frond End

Multiple studies have researched the sources of success at the Front End phase (Cooper R. G., 2011, p. 41; Zhang & Doll, 2001, p. 95; Verworn, 2009, p. 1571; Smith, Busi, Ball, & Van Der Meer, 2008, p. 655). It seems that there is a significant correlation between doing things right (efficiency) in the FFE phase of an organisations NPD process and whether the right things are being done (effectiveness). Based on the literature, the FFE success factors can be separated into six categories: strategy, culture, performance, market, organisation structure, and process.

Focusing on the latter category, the process of the FFE stages is debated in the literature and can be considered roughly in two ways: whereas some studies argue that flexibility in the FFE phase as being a critical success factor (Zhang & Doll, 2001), other studies argue that a systematic process with predefined evaluation moments are a necessity for success (Cooper & Kleinschmidt, 1995, p. 374). Managing and structuring the NPD process depicts one of multiple critical process-related factors usually linked with successful development. One of the main goals of NPD models is to arrange general

activities to ensure the targeted use of work methods, technique and tools. A properly set process is transparent to all participating departments in order to achieve a common understanding of what needs to be developed, and which enables effective communication within the organisation (Gaubinger, Rabl, Swan, & Werani, 2015)

Principle 2: In order to develop new products, established organisations should implement a uniform development process to realize common understanding and effective communication for all participants, because these have shown to increase successful development.

In addition to process, it is argued that having an innovation strategy is also a critical success factor (Talke, Salomo, & Kock, 2011; Kock, Heising, & Gemünden, 2015). The innovation strategy would provide mutual direction for all development activities of the organisation, and specially would be important for FFE and the ideation procedure because it is focused on what the future of the organisation is aiming at and therefore provides the direction with which new product ideas can be evaluated (Spanjol, Mühlmeier, & Tomczak, 2012; Spanjol, Qualls, & Rosa, 2011; Kock, Heising, & Gemünden, 2015). Organisations can achieve alignment of ideation activities with innovation strategy by outlining boundaries for idea search, such as certain thematic search field or product specification criteria on which the participants can focus idea generation and upcoming development activities (Laurie, Doz, & Sheer, 2006; Salomo, Talke, & Strecker, 2008; Talke, Salomo, & Rost, 2010). The search areas focus generally on specific markets or customer need or wants which have been determined by trends, organisation's core competences, or new and upcoming technologies that are most likely going to be relevant in the future (Laurie, Doz, & Sheer, 2006; Salomo, Talke, & Strecker, 2008).

Principle 3: In order to develop new products, established organisations should have a clear innovation strategy, because it provides the direction with which new product ideas can be evaluated with.

3.2.3. Theoretical Models of Fuzzy Front End

Managing the so-called fuzzy front end (FFE) of new product development process is an ongoing battle between systematization and creativity (Verworn & Herstatt, 1999; Aken & Nagel, 2004). As previously mentioned, the first development stages involve high uncertainty and risk, vaguely defined results and vague method of setting and realising targets. Hence, it is highly recommended to manage the FFE in order to realize the right balance between creativity and flexibility on one hand and bureaucracy and structure on the other. Van Aken and Nagel (2004) argue that not having enough structure in this phase negatively influences FFE performance, whereas too much structure would kill creativity. The relationship between degree of structure and performance, as such shows an inverted u-shape curve indicating that too little as well as too much structure is negative. Crawford and Benedetto (2011) agree on this point and also argue the importance of having a balance between structured process and adequate room for creativity.

There are a large number of NPD process models that divide the FFE into stages, phases, variable in focus, number of stages, definition of the starting and ending point of the process and the level of detail required (Verworn & Herstatt, 1999). Consecutive models follow a linear path, execute one activity after another and therefore allow easy evaluation to recommended actions, enabling transparency and predictability (Khurana & Rosenthal, 1998, p. 57; Herstatt & Verworn, 2004). But, they also risk of not conforming to reality and not incorporating creative exchange and feedback loops between participants. Therefore, other studies promote flexible processes for NPD. Models which are dynamic and flexible processes, include feedback loops and allow parallel tasks. These models are referred to as iterative process models. For example, Koen et al. (2001) promote a circular shape of the FFE, which suggests that ideas are anticipated to flow and iterate between sub-phases, since the FFE is chaotic, unpredictable, poorly structured and informal in nature. Ayers et al. (1997, p. 107)

argued that ambiguity, flexibility and allowing a wide set of opportunities are especially of importance for development success. Cooper and Kleinschmidt (2007, p. 57) agree on this point and argue that best performing organisations allow for flexible and scalable development processes. Although iterative processes get close to reality, implementing these models turns out to be difficult, based on the abstract nature of these processes which do not lend themselves to planned recommendations for participants to follow. As such, organisations have the tendency to focus on sequential processes for managing the FFE, although these consecutive processes cannot effectively be transferred to the FFE.

Kim and Wilemon (2002) argue that effectively managing the FFE of the NPD process involves one of the most challenging and important activities for NPD managers. In the later phases of the NPD process, a structured stage gate process has widely been accepted in theory as well as in practise, whereas at the FFE phase a wide variety of models and concepts for managing the development process exist (Barczak, Griffin, & Kahn, 2009, p. 3; Cooper R. G., 2011, p. 42; Song & Parry, 1996). Challenges during the FFE stage arise essentially due to its fuzziness, dynamic, informal and unstructured nature (Murphy & Kumar, 1997). In order to reduce the fuzziness and visualize the early stages of development, multiple models have been suggested to structure the FFE phase. In the following paragraphs a short description of the evolution of the FFE models will be provided. It will become clear how these models strive to stabilize and predict the uncertain contents of the FFE. To do so, these models usually split the early stages of the NPD process into distinct phases with allocated responsibilities and tasks (Rothwell, 1994). However, present literature tends to display a lack of structured FFE processes to achieve an effective FFE management. The models describes here are selected from a wide variety of available models, which are frequently used and also offer an added value in terms of flexibility and structure.

Stage-Gate® Process

Cooper's Stage-Gate® process divides the NPD process into stages divided by 'gates'. At each gate go/no-go decisions are made based on information collected during the tasks of the previous stage (Figure 3-3). During the 'Discovery Phase' (stage 0) new ideas are collected, by studying internal and external sources. These new ideas are then evaluated and reduced during Gate 1 based on criteria like market attractiveness, strategic link and technical feasibility. At the 'Scoping Phase' (stage 1), teams work on a first rough description of market-related and technical-related features of an idea, which is followed by a more detailed evaluation at Gate 2. At the following stage, stage 2, development teams perform detailed tests regarding market, technology and competition aspects, which will add to the first draft of a business case describing the path from an idea to a product concept. At gate 3, which divides the FFE from the back end development phase, an even more detailed evaluation process will determine whether the organisation should decide to continue development or stop it.

Cooper's Stage-Gate® model has evolved over time. For example, his third generation model is characterized by the four fundamental F's (Cooper R. G., 1994). Changing between stages in this model is more fluid and activities can be executed increasingly in parallel. Even at the gates changes are suggested. A project can continue to some degree, even if not all criteria for the following stage have been met. And, activities of the following stage can be executed before a gate-decision has been made. Cooper refers to these gates as 'fuzzy gates'.

An ideal resource allocation between different development projects is increasingly an important factor in determining gate decisions ('focused'). Furthermore, in the third Stage-Gate® model, development projects solely have to go through certain development stages, depending on the respective project's degree of risk ('flexibility'). Moreover, the processes are supposed to be scalable, therefore development projects with a lower degree of risk can be managed in a 'leaner' method. In other words, lower risk development projects can go through less development stages and gates in

comparison to projects with a higher risk. The third generation model also has disadvantages, one of them being the loss of robustness in order to achieve the flexibility. As such, projects that have been continued under certain conditions, are less likely to be terminated on time. The last 'evolutionary stage' of the NPD process is incorporated by Cooper as 'NexGen™ Systems' (Cooper R. , 2008, p. 213). This model focuses, besides increasing the degree of flexibility and scalability, on an open innovation approach of the development process.

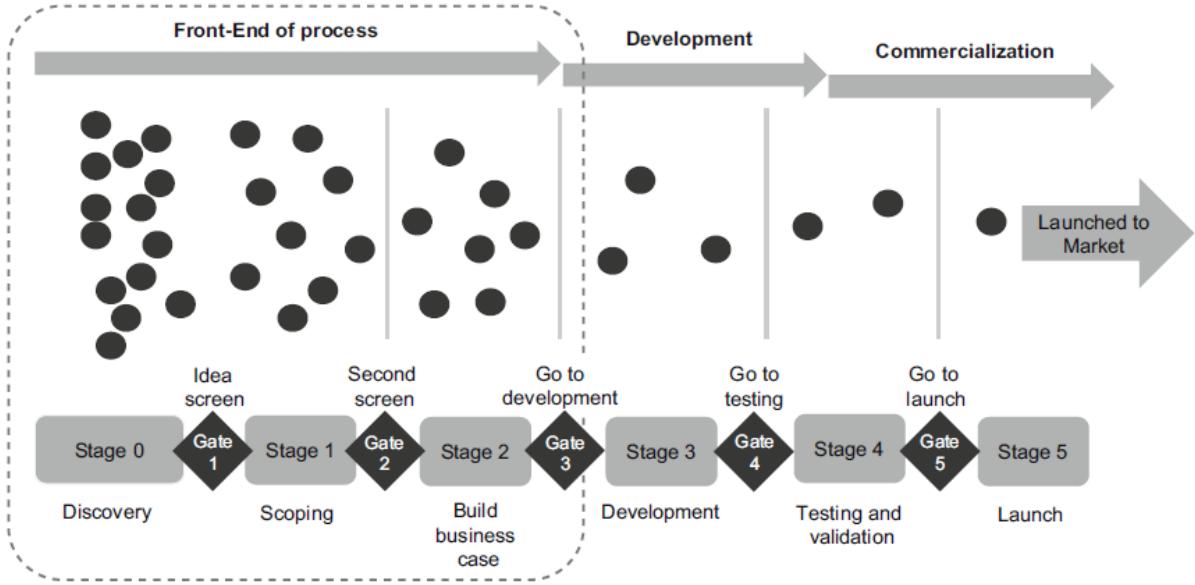


Figure 3-3: Stage-Gate Model (second generation) (Gaubinger, Rabl, Swan, & Werani, 2015)

Three Phase Front End Model

Khurana and Rosenthal (1997) divide the Front End of the NPD process in their sequential development model into three phases, namely: Pre-Phase Zero, Phase Zero, and Phase One (Figure 3-4). Aspects specific to a project, such as project definition, project planning, and product concept, are preformed indifferent of the phase. Project independent activities, the so-called 'foundation elements', also influence Pre-Phase Zero and are important push factors which determine the quality as well as the efficiency of the project's implementation. These elements include a clearly defined product portfolio strategy, and the product development organisation's roles, structure and norms. During the Pre-Phase Zero, development opportunities are being investigated for and ideas are being created based on technology and market analysis. The new NPD project is started, with a description of the concept to follow in the succeeding Phase Zero, during which customer needs, markets segments, business forecasts and competitive situation are defined. In the final phase, Phase One, the economic and technological feasibility of the product concept is evaluated and the development of the product concept is planned.

This Front End of Khurana and Rosenthal's model (1997) is concluded when management presents a decision on the continuation or termination of the presented business case in the form of a Go/No-Go decision.

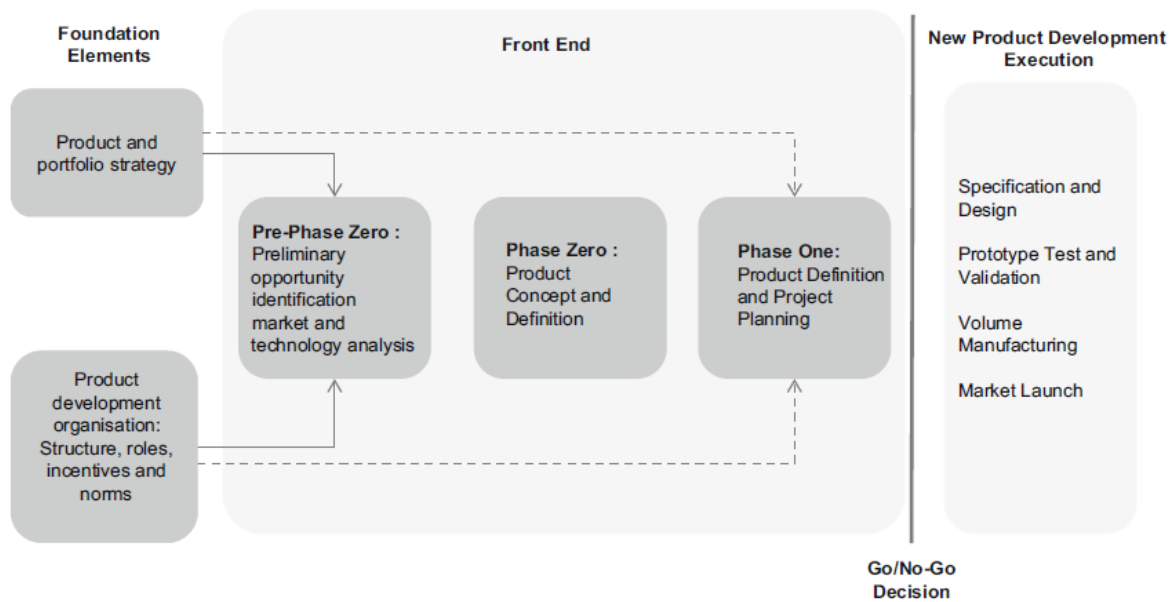


Figure 3-4: Three phase front end model (Gaubinger, Rabl, Swan, & Werani, 2015)

New Concept Development Model

Koen et al.'s (2001), New Concept Development (NCD) Model is designed to help participants of NPD to improve the management of the Front End of the NPD process and to provide a mutual language on the Front End tasks (Figure 3-5). The NCD Model can be divided into three separate parts, namely: front-end elements, engine, and manipulating factors. A distinguishing aspect of the NCD model is its circular, iterative setting of the five front-end tasks. These tasks can be executed at random, as often as one wants to, either in sequential or parallel manner. In order to increase the number of possibilities during the opportunity identification, company goals are considered along with possible tools, such as brainstorming, and problem-solving techniques like causal analysis. At the opportunity analysis stage, market and technological associated criteria are incorporated to evaluate whether the identified opportunity has any added value for the organisation. In the idea genesis phase, detailed new product ideas are developed in an iterative process. Ideas that show the most potential are selected in the succeeding idea selection process.

The core of the NCD model consists of aspects which can be manipulated by the organizations (e.g. culture, leadership, and business strategy) and which can set the basis of a situation for successful innovation. Furthermore, internal (e.g. strategy, organisational skills, and technology) as well as external factors out of the organisation's control (e.g. customers, channels of distribution, and competitors) influence the NPD's front end phase as well. And finally, Koen et al. (2001), focus their NCD model on the product development aspect and moderately include the technology process development. Koen et al. (2001) argue that the larger the investment in the technology development process is, the more development resources will be needed, the more the structure is needed for choices and the less probable the incorporation of technology development into the outline for the NCD model is (Koen P. , et al., 2001; Koen P. A., et al., 2002; Deppe, Kohn, Paoletti, & Levermann, 2002).

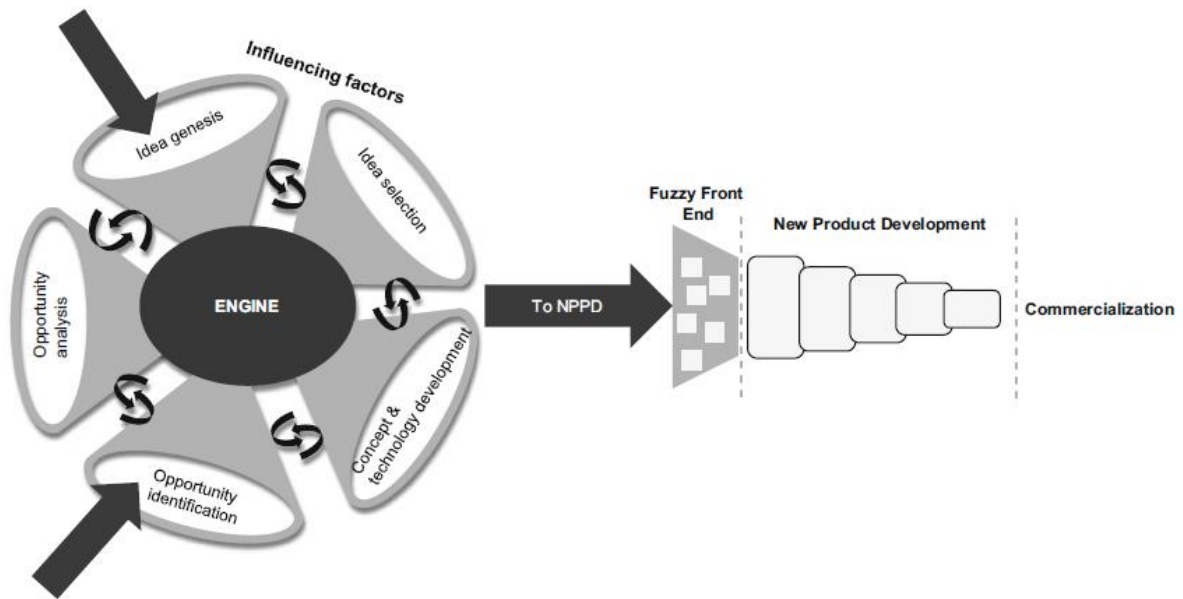


Figure 3-5: New concept development model (Gaubinger, Rabl, Swan, & Werani, 2015)

Concept Exploration Phase of the Innovation Process

Geschka (2006) differentiates four successive phases in his holistic development process model (Figure 3-6). These phases are the concept generation phase, development of innovation elements phase, creation of market readiness and market introduction phase. Geschka (2006) argues that the concept generation phase starts with strategic orientation. In other words, organisation's senior management should clarify what they are trying to achieve with development. In the following phases, two and three, new product ideas are being generated, gathered, analysed and selected. The selected ideas turn into a pre-project including an overview of costs and increased input, while being developed further. These pre-projects are then subjected to a thorough analysis. At the final step, the decision gate, one of the pre-projects is selected for further development in the back end NPD process.

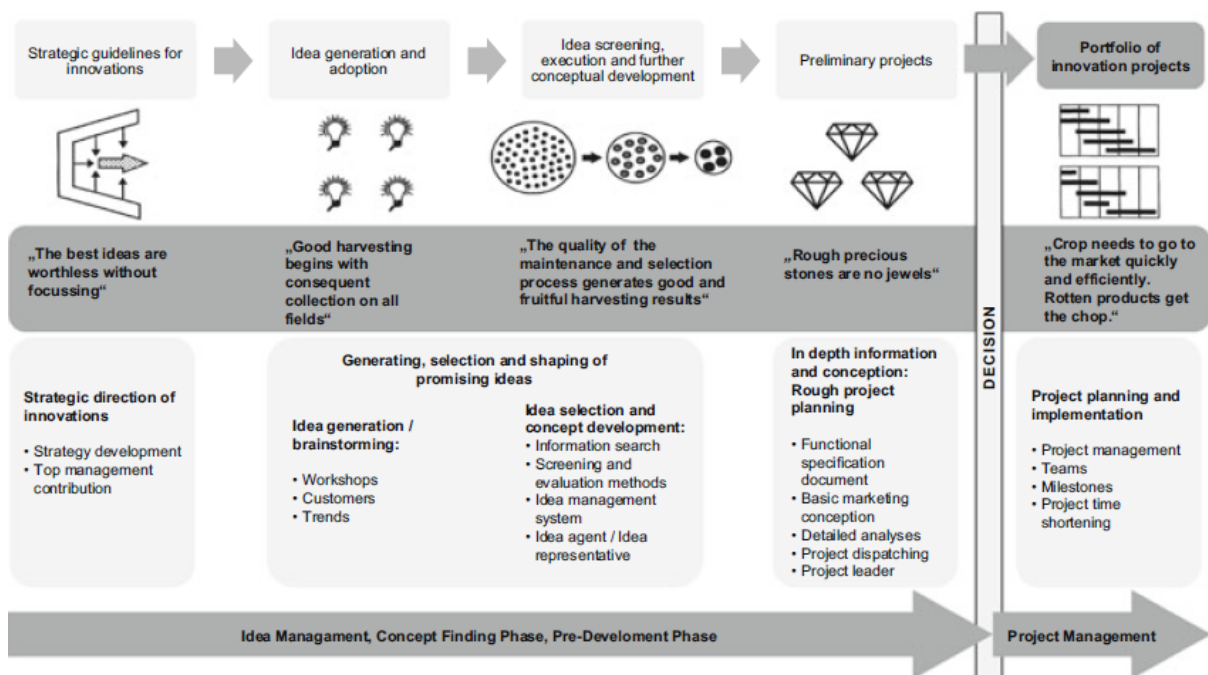


Figure 3-6: Concept Exploration Phase of the Innovation Process

Integrated Front End

Sandmeier et al.'s (2004) Integrated Front End Process Model can be seen as a checklist or a guided process, making sure that all the necessary front end activities are executed while leaving room for creativity (Figure 3-7). The model includes three phases in which activities are linked to each other through screens which are not necessarily gone through in a pre-set order. During the first stage, technological and economic opportunities are identified, and an innovation strategy, that is closely associated with the organisation's strategy, is formulated. At the same time, innovation targets are set based on the organisation's short- and long-term goals. Furthermore, as new technology and market ideas are being created during the first phase, new product ideas need continuous tuning with the organisation's strategy. Consequently, few search areas and opportunities reach phase two (idea management), which focuses on creating, gathering, and evaluating ideas and consequently on achieving a balanced business and product method with selected ideas.

In the following phase three, a preliminary product concept and a business case are designed for the selected ideas. The dominant success factor of the Integrated Front-End Process model is argued to be: the integration of customer knowledge all through the front end. Feedback loops link the phases, which enables an ongoing development and improvement of the entire process. This model is in its core a structured development process model with predefined paths and tasks, but on the other hand an iterative and flexible process due to its feedback loops (Sandmeier, et al., 2004).

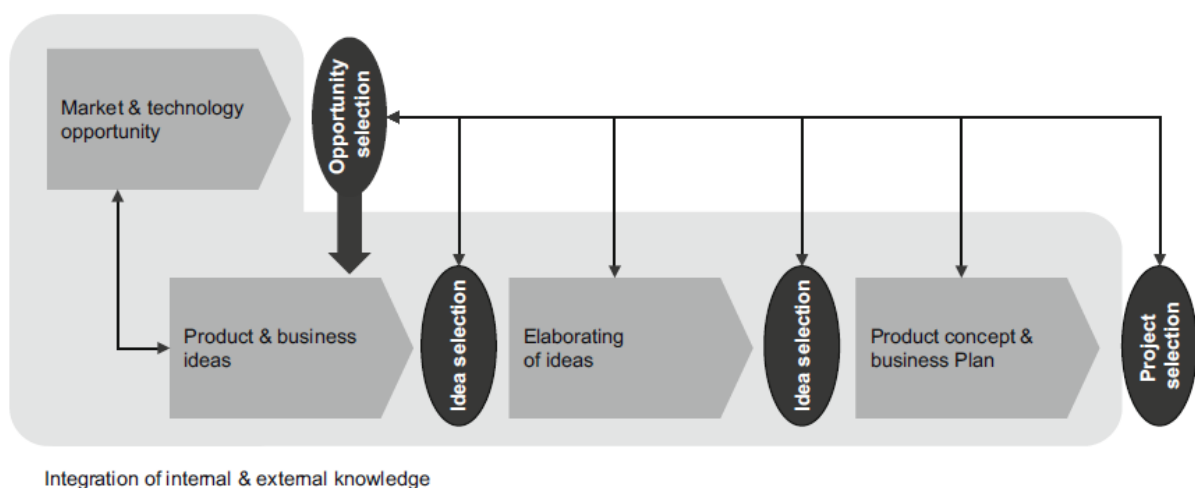


Figure 3-7: Integrated Front-End Process Model (Gaubinger, Rabl, Swan, & Werani, 2015)

3.3. Front End Evaluation Process

Due to scarcity of development resources, organisations need to reduce the number of identifying new product ideas and focus on the most valuable ones. Selecting the best new product ideas is a difficult multistage procedure. An effective evaluation process is essential for sound portfolio management. Firstly, by having tough gates in place, poor projects are eliminated early in the process and thus the overall result is a better portfolio. Secondly, without a proper evaluation process, with key tasks and deliverables built in, project teams are left on their own in knowledge about what data to gather and how to obtain them. The end result is that inconsistent data are gathered on projects (Cooper & Kleinschmidt, 2007).

Once development teams have been provide with these guidelines, they could start with generating as much new product ideas as possible. These new product ideas could then be evaluation in order to assess whether they have the potential for further development. After this initial evaluation, selected new product ideas are further developed into new business plans which possibly could be accepted

for realisation and market introduction. The evaluation approach should therefore depend on the stage of the development. Hall and Hofer (1993) studied the evaluation processes and found that this process during the first stages of development consist of at least two separate steps, namely an initial and a thorough evaluation.

Principle 4: In order to develop new products, established organisations should execute no less than two assessments: (1) an preliminary assessment to determine further investments, and (2) a thorough assessment when the new product concept is developed into a business plan, because having more assessment prevent really new innovations ideas from being kill too soon, and increases the chance for selecting the best ideas.

However, it is important that organisations make a clear distinction between evaluating a single project and portfolio evaluation. The difference between the two is that one evaluates each projects itself, whereas the other evaluates the projects in relation to each other in order to create a balanced project portfolio (Cooper R. G., 2001). Furthermore, Rice et al. (1998) argue that since the FFE of the NPD process is the most challenging and uncertain part of the development process, organisations should use a preliminary assessment which allows a larger level of uncertainty in new product proposal, in order to allow more radical opportunities of which the commercial value is highly uncertain.

Principle 5: In order to develop new products, established organisations should decide whether they are evaluating a single project or performing a portfolio evaluation, because they are both essential but different assessments.

In the case of PostNL, the organisation is aiming at selecting the most valuable new product ideas available. Therefore, the most suitable evaluation approach would be the portfolio evaluation approach. In this way, PostNL will be able to select the most valuable new product idea combination based on development resources available.

As mention in the previous paragraph, the FFE phase which most would fit PostNL includes two evaluation gates. In the following two paragraph these two gates, and more specifically the selection criteria, will be elaborated in more detail.

3.3.1. Preliminary Assessment

The first test for organisations in order to decide whether they should proceed further development of a new product opportunity, is the preliminary assessment. In the following, the preliminary assessment approach will be discussed from the NPD and entrepreneurship perspective, and different methods for the preliminary assessment process are compared. The reason for including the entrepreneurship literature is PostNL's preference in altering its current development approach from being risk adverse and highly focused on financial features of development, to a more risk taking, flexible and forward looking approach. In other words, PostNL is aiming at becoming more entrepreneurial surely now they are aiming at "*really new innovations*" which cause either marketing or technological discontinuities on both a macro and micro level.

The NPD literature describes that the preliminary assessment generally includes rules of thumb or rough heuristics (Crawford & Di Benedetto, 2011). McGrath (1995) suggests that the preliminary assessment should evaluate how a new product ideas scores on: competitive protection, organisation worth, and market worth. In addition, Haynie et al. (2009) argued that the preliminary assessment should provide insights on: whether the new product idea is valuable to the person evaluating the new product idea, what the future gains of the idea would be if it would be launched into the market, and if the new product idea would be able to create competitive advantage for the organisation. Moreover, Haynie et al. (2009) established five factors, based on the principles of the resource based view, on

which new product ideas could be assessed. These factors are: uniqueness, imitability, value, relatedness, and limits on competition.

The entrepreneurship literature argues that new product ideas, which have higher expected value, are the ones that generally are selected for further development. More specifically, when industry profit margins are high, the competition concentration within certain markets is neither too high nor too low, the expected customer demand is high, cost of capital is low, the technology life cycle is at its beginning, and population level learning from other entrants is available (Shane & Venkataraman, 2000). Bryant's (2007) study showed that entrepreneurs commonly base their decision to whether to proceed with a new product idea on factors like: how well they know the market, their gut feeling, whether they trust their development partner, what the worst case scenario will be, and the degree to which the new product opportunity fits their core strategy.

Combining the abovementioned literature insights, provides us three main factors which could be used for the preliminary assessment. As mentioned by McGrath (1995), studies agree that the preliminary assessment should assess new product opportunities on: competitive protection, market worth, and organisation worth. The degree of competitive protection shows how well the organisation is in protecting and maintaining their competitive power by safeguarding their business activities from potential rivals. Market worth refers to the value (e.g. high product demand, high profit margins, future gains, etc.) which may be seized from the new product opportunity. Finally, firm worth refers to level of relatedness of the new product opportunity to the organisation's existing competences and NPD strategy.

Principle 6: In order to develop new products, established organisations should assess the concepts during the preliminary assessment on: competitive protection, market worth, and organisational worth, because these assessment criteria have shown to select the best really new innovative product ideas.

Several studies in the field of NPD present models and methods to be used for the preliminary assessment of the new product idea. One of these studies is from Cooper (2001), which argued that there are different approaches in assessing a new product idea. Organisations could assess an idea based on: portfolio selection and management models; benefit and measurement techniques; and economic models. Since sufficient financial data are missing in the FFE phase of the NPD process, subjective measures like benefit and measurement models are more suitable for assessment of new product ideas (Cooper, 2001). Furthermore, Crawford and Di Benedetto (2011) suggest organisations make use of scoring models, checklists, or profile sheets when assessing new product ideas since these models make it easy for the organisations to compare new product ideas and select the most valuable ones with the resources at hand.

Principle 7: In order to evaluate new products, established organisations should use subjective or objective models, for the preliminary assessment similar to scoring models, checklists or profile sheets, because they have shown to be the most effective for the preliminary new product idea assessment.

3.3.2. Thorough Assessment

Once new product ideas have been approved for further development, at the end of the next development phase new product ideas have to be evaluated again. Crawford and Di Benedetto (2011) recommend organisations to do a thorough assessment on the new product ideas for various reasons. Authors (Crawford & Di Benedetto, 2011) argue that a thorough assessment would not only help organisations in deciding whether they should continue development, it would also improve the

effectivity of how FFE phase is managed, and stimulate cross-functional communication. The following sections elaborate on the criteria and the applicable models for the thorough assessment activity.

Resources play an important role in the evaluation decisions (Haynie, Shepherd, & McMullen, 2009). In order to execute a good evaluation of a new product idea, it is necessary to look at possible decisions in the future, which might influence the success of the new product idea. Therefore it should involve both an evaluation of existing resources as well as future required resources. Studies have also focused on the criteria the venture capitalists use when assessing an investment decision (Hall & Hofer, 1993; May & Simons, 2001). They found that the venture capitalists (VC) base their decision on: characteristics of the new product proposal, VC firm requirements, features of the development team, economic environment of the target market, organisation's vision, and product strategy. However, since VC's focus is to gain significant financial returns during a short period of time, not all of the before mentioned criteria are suitable for the developing organisations. Based on years of studying top performing organisations, Cooper (2001) managed to create a different set of criteria which would help organisations in selecting the best new product opportunities. His list includes 19 criteria which can be categorized into the following five categories: strategy, product advantage, market attractiveness, synergies, technical feasibility, and risk and return (see Table 3-2).

Principle 8: In order to select NPD projects, established organisations should assess the business plan through a thorough assessment on criteria from the categories: strategy, product advantage, market attractiveness, synergies, technical feasibility, and risk and return, because these criteria are known to be important for a thorough NPD project assessment.

Table 3-2: NPD evaluation criteria (Cooper, 2001: 237)

Evaluation Criteria	
1) Strategic	<ul style="list-style-type: none"> a) Degree to which project aligns with the business's strategy b) Strategic importance of project to the business
2) Product advantage	<ul style="list-style-type: none"> a) Extent to which the new product b) Offers unique benefits to users/customers c) Meets customer needs better than competitive products d) Provides excellent value for money to the customer
3) Market Attractiveness	<ul style="list-style-type: none"> a) Market size b) Market growth rate c) Competitive situation (tough, intense, prize-based competition is a low score)
4) Synergies	<ul style="list-style-type: none"> a) Leverages our business's marketing, distribution, and selling strengths/resources b) Leverages our technical know-how, expertise, and experience c) Leverages our operations capabilities, expertise, and facilities
5) Technical Feasibility	<ul style="list-style-type: none"> a) Size of the technical gap (small gap is high score) b) Complexity of the project, technically (less complex is a high score) c) Technical uncertainty of outcome (high certainty is a high score)
6) Risk versus Return	<ul style="list-style-type: none"> a) Expected profitability (magnitude: NPV in €) b) Percent return (IRR% or ROI%) c) Payback period (or BET) how fast you recover your initial expenditure / investment (years) d) Certainty of return/profit/sales estimates (pure guess to highly predictable) e) Degree to which project is low cost and fast to do

The subject of tools and methods for evaluating new product opportunities has been the focus of various researchers. Whitney (2007) study illustrated that organisations have a variety of approaches which they could use to evaluate opportunities, that is: economical models, mathematical models, peer assessments, decision analysis, artificial intelligence, scoring models, portfolio optimization, and interactive methods. Although, a distinction between must-meet and should-met criteria can be made when evaluating (Cooper R. G., 2001; Crawford & Di Benedetto, 2011), scoring models provide more flexibility as different weights can be allocated to each criterion, and in combination in scoring scale, resulting in a relative score. Consequently, scoring models reduce the risk of killing a project which scores badly on just one of the criterion (Cooper, 2001).

Principle 9: In order to evaluate business plans, established organisations should use scoring models for the thorough assessment, because they have shown to be very effective in preventing NPD projects from being stopped based on a single criteria and permit comparing multiple NPD based on their score.

3.3.3. Termination Decision

Termination decisions are critical for a balanced NPD project distribution, as these decisions kill NPD projects which either are not expected to deliver appropriate gains, or are no longer aligned with predefined organisational strategy. Termination decisions free up resources, and create room for other possibly valuable initiatives. However, studies show that termination decisions are one of the most difficult decisions to make (Balachandra, Brockhoff, & Pearson, 1996; Schmidt & Calantone, 2002). Balachandra and Friar (1997, p. 92) study showed that, “*Individuals get emotionally involved in the project and are very reluctant to terminate it, even if there are many clear signals that the project is not going to be successful*”. Signs of termination issues have also been indicated by the 27 PostNL managers that participated in the organisation study on NPD activities (Hoogkamer, 2015). For a better understanding of this subject, in the following section the phenomenon of Escalation of Commitment (EoC) will be discussed in more detail. In the second section, methods which could reduce EoC will be explained.

Escalation of Commitment

Several studies have tried to explain the concept of EoC and to explain what causes it. EoC research has mainly been focused on project specific causes, like negative feedback (Leatherwood & Conlon, 1985) and the level of required resources to achieve development targets (Brockner, Rubin, & Lang, 1981). However, psychological causes, such as the effect of optimism and the belief of having the control and self-justification tendencies as result of framing effects, have also been identified (Schoorman, Mayer, Douglas, & Hetrick, 1994). Furthermore, research on psychological causes EoC within NPD environments, have found that managers are more likely to demonstrate EoC behaviour when they are convinced of outcome success (Biyalogorsky, Boulding, & Staelin, 2006), misunderstands project information (Boulding, Morgan, & Staelin, 1997), or when they feel personally responsible for the new product (Schmidt & Calantone, 2002). Staw and Ross (1987, p. 72) argue that “*much of what causes escalation lies in the nature of organizations, not people*”. Several (Drummond, 1994; Keil, Depledge, & Rai, 2007) studies agree with Staw and Ross (1987), and argue that the structural causes may have a bigger impact on causing EoC than situational and psychological causes may have.

Studies have determined three structural causes, namely: innovation strategy, decision risk and project cycle time. As for innovation strategy, Schmidt and Calantone (2002) showed that managers are more likely to escalate commitment when they are managing a radical product development project compared to an incremental product development project. Although conducted in an IT project setting, Pan et al. (2006) finding support these findings. Decision risk is similar as to the perceived risk

during a situation (Wong, 2005), or the complexity of a situation. Research findings show that decision risk has a reversed effect on EoC (He & Mittal, 2007; McNamara, Moon & Bromiley, 2002; Schaubroeck & Davis, 1994; Staw, Barsade & Koput, 1997). In other words, the more complicated the decision-making situation is, the higher the probability that EoC will occur (Schaubroeck & Davis, 1994; Wong, 2005). Moon's (2001) study showed that the closer the project is to its completion, the more managers are tended to escalate commitment. It is therefore assumed that managers are more likely to escalate commitment when they are managing NPD projects which have shorter timeframes, since project end point of shorter NPD projects would be in the near future in contrast to long-term NPD projects.

In summary, EoC is more prevalent when organisations pursue radical innovations. Generally the NPD process of radical innovation is characterized as being highly uncertain. This means that the development process could be experienced as being complex and risky. Furthermore, in organisations like PostNL, in which NPD managers are expected to periodically evaluate a broad range of NPD projects, managers are also forced to make decisions on shorter timeframes. As such, established organisations, like PostNL, which aim at developing "really new innovation" are more likely to experience EoC. The next paragraph describes which options organisations have in order to prevent EoC.

Preventing Escalation of Commitment

In order to prevent EoC, managers require the capability of redirecting a course of action in which resources already have been allocated (Keil & Robey, 2001; Montealegre & Keil, 2000). Compared to research focused on the causes of EoC, little research has been done on how organisations could prevent EoC (Keil & Robey, 2001; Mahring, Keil, Mathiassen, & Pries-Heje, 2008; Pan, Pan, & Flynn, 2004). In the following section a selection of methods to prevent EoC are discussed.

Keil (1995) argues that in order to prevent EoC, organisations should create a tracking system which provides senior management full insights on all active projects and the stage which these projects are in. Furthermore, organisations need to reduce the complexity of the development process through establishing clear guidelines on what is expected at each development stage when projects move from one stage to another (Jani, 2010). Behrens and Ernst (2014), showed that when organisations use visual aids they generally improve the quality and structure of project information. Furthermore, visualizing project data are argued to be a good information sources for decision-makers, as they help clarify complex relationships, provide an overview of business activities, and visualize trends. Visualizations also help improve available information by structuring underlining uncertainties. So, by providing the managers with data visualization, instead of detailed statistical analyses, it is easier for them to understand the information they are presented.

Principle 10: In order to select NPD projects, established organisations should implement an information system which provides full insights on all active NPD projects, because they have shown to improve decision-making quality.

In the NPD environment, Schmidt et al. (2001) found that EoC was less likely when "stop or go" decisions were made by teams, particularly virtual teams, instead of individual decision-makers. Crawford and Benedetto (2010) also emphasize that the evaluation should be a multi-person evaluation in order to prevent a single person bias. Researchers indicates that (1) some people are always optimistic, (2) some are sometimes optimistic and sometimes pessimistic, (3) some are "neutrals" who score to the middle of scales, (4) some are far more reliable and accurate than others, (5) some are easily swayed by the group, and (6) some are capable but inconsistent. Technical people generally feel more optimistic about probable technical success, whereas marketers are more pessimistic. Moreover, authors argue that evaluation team should be selected like members of NPD

team. The four foremost functions: operations, technical, marketing, and finance, as well as new products managers and staff specialists from information technology, distribution, procurement, public relations, human resources depending on organisation's development process should be involved. Furthermore, authors argue that in established organisations top management, like presidents and general managers, should be excluded from the evaluation process as these individuals generally prevent open discussions needed during the first evaluations.

Principle 11: In order to select NPD projects, established organisations should make sure the thorough assessment involves a multiple-disciplinary expert team, because this has shown to increase assessment effectiveness.

3.4. Summary

Organisations should decide which NPD model suits them best based on their environment, their core competences and their goals. Organisations should always a structured NPD for a successful development, since this creates focus and clarity. An innovation strategy is also essential. Next to focus at development, IS makes the evaluation process more effective because it sets boundaries to the development, and thus everything that falls outside those boundaries is not regarded anymore in further development.

The evaluation process in the FFE phase differs for each innovation type. In the case of PostNL, who is focussed on the development of 'really new innovation', an evaluation process with two gate moments would suit best. Via these evaluation moments, an organisation can succeed in an effective deployment of scarce resources, while there is also space for radical development. At the first evaluation moment (gate), the categories that are most important to analyse are: market worth, organisation link, and protectability. At the second gate, after which large investments will be made, the categories are extended with: product advantage, technical feasibility, and risk versus return.

To evaluate the projects, there are models available, such as a checklist, scoring model etc. A scoring model is useful because it outputs a weighted score, which makes a comparison between a large number of projects easy to do. Here it is advisable to execute the evaluation process with several people, to reduce the possible 'first person bias' or 'escalation of commitment'.

Another thing that comes in useful to improve the development process, is the application of a communication system. This enhances a development overview, which furthers the mutual communication, and makes the boundaries or conditions that need to be met very insightful.

In the Table 3-3 an overview of all the design principles is shown.

Table 3-3: All Design Principles

Design Principles	Sources:	Design Parameters:
<i>Principle 1: For an effective new product development, established organisations should request a well-defined project definition before development phase, since this is a central success factor for products.</i>	Song & Perry (1996), Cooper & Kleinschmidt (1990)	Project definition
<i>Principle 2: In order to develop new products, established organisations should implement a uniform development process to realize common understanding and effective communication for all participants, because these have shown to increase successful development.</i>	Zang & Doll (2001), Cooper & Kleinschmidt (1995), Gaubinger et al. (2015)	Structured NPD process
<i>Principle 3: In order to develop new products, established organisations should have a clear innovation strategy, because it provides the direction with which new product ideas can be evaluated with.</i>	Crawford & Di Benedetto (2011)	Innovation strategy
<i>Principle 4: In order to develop new products, established organisations should execute no less than two assessments: (1) an preliminary assessment to determine further investments, and (2) a thorough assessment when the new product concept is developed into a business plan, because having more assessment prevent really new innovations ideas from being kill too soon, and increases the chance for selecting the best ideas.</i>	Hall & Hofer (1993)	Evaluation frequency
<i>Principle 5: In order to develop new products, established organisations should decide whether they are evaluating a single project or performing a portfolio evaluation, because they are both essential but different assessments.</i>	Cooper (2001), Crawford & Di Benedetto (2011)	Evaluation level
<i>Principle 6: In order to develop new products, established organisations should assess the concepts during the preliminary assessment on: competitive protection, market worth, and organisational worth, because these assessment criteria have shown to select the best really new innovative product ideas.</i>	Shane & Venkataraman (2000), Bryant (2007), McGrath (1995), Haynie et al. (2009)	Market worth Relatedness Competitive protection
<i>Principle 7: In order to evaluate new products, established organisations should use subjective or objective models, for the preliminary assessment similar to scoring models, checklists or profile sheets, because they have shown to be the most effective for the preliminary new product idea assessment.</i>	Cooper (2001), Crawford & Di Benedetto (2011)	Subjective evaluation model for preliminary assessment; Preliminary assessment weights; Value to continue after preliminary assessment
<i>Principle 8: In order to select NPD projects, established organisations should assess the business plan through a thorough assessment on criteria from the categories: strategy, product advantage, market attractiveness, synergies, technical feasibility, and risk and return, because these criteria are known to be important for a thorough NPD project assessment.</i>	Hall & Hofer (1993), Cooper (2001)	Evaluation criteria thorough evaluation

<i>Principle 9: In order to evaluate business plans, established organisations should use scoring models for the thorough assessment, because they have shown to be very effective in preventing NPD projects from being stopped based on a single criteria and permit comparing multiple NPD based on their score.</i>	Whitney (2007), Cooper (2001), Crawford & Di Benedetto (2011)	Weights for the thorough evaluation criteria
<i>Principle 10: In order to select NPD projects, established organisations should implement an information system which provides full insights on all active NPD projects, because they have shown to improve decision-making quality.</i>	Keil (1995) Behrens and Holst (2014),	Information system
<i>Principle 11: In order to select NPD projects, established organisations should make sure the thorough assessment involves a multiple-disciplinary expert team, because this has shown to increase assessment effectiveness.</i>	Crawford & Di Benedetto (2011) Schmidt et al. (2001)	People involved in the evaluation

4. Solution Design

This chapter elaborates on a design for PostNL of the fuzzy front end (FFE) approach in the new product development (NPD) process. The first section describes the problem context. In the second section the design requirements are defined. And the third section describes the design solution.

4.1. Context Analysis: PostNL

PostNL is the parcel and mail delivery service market leader in the Netherlands and one of the main players on the market in Germany, Italy and Belgium. Their mission is “to serve customers through excellent service and offer the highest level of quality in the market” (PostNL 2020: Committed to sustainable delivery, 2015). PostNL delivers value to its clients by providing reliable and efficient solutions through their delivery networks. PostNL has a long history (Figure 4-1), which started in 1799 when the postal service was transformed to a national service and the firm was established. In 1807 the Dutch postal act awarded PostNL the exclusive rights to collect, convey and deliver mail. By the end of the 19th century, the whole country could be reached and served by the mail company. Mail delivery changed a lot during the 20th century, as it was subject to several developments and trends, such as technological developments, increased automation and the digitization of society. During the Great Recession, a more commercial attitude was needed and the first advertising campaigns were launched under the name PTT.

The role of the organisation was continuously changing and with these new developments, so was the name of the company. In 2006 the main activities were restructured and the name was changed to TNT Post. TNT’s main activities lay in the mail and express business. In 2011 it was decided to split into a mail and an express part, as it proved to be difficult to align the two entities, due to their different activities and focus. This also enabled the possibility to collaborate with, and take over, supplementary companies. The express part continued under the name TNT due to its more international character and the mail part continued under the name PostNL (PostNL, 2016).

In 2015 PostNL had a market share of around 75% and a yearly revenue of €4.25 billion (PostNL 2020: Committed to sustainable delivery, 2015). PostNL offers products and services on the mail, parcel and e-commerce markets. In the mail and parcel market PostNL offers solutions for the sending and receiving of mail and small sized packages. PostNL sends

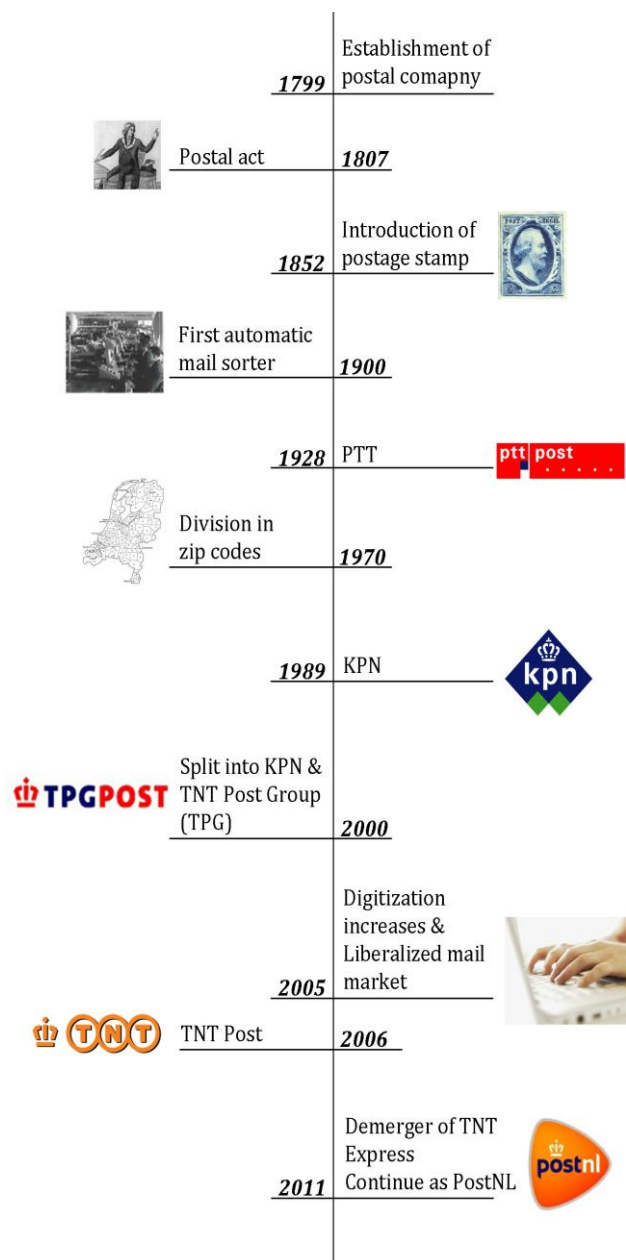


Figure 4-1: PostNL's History (Kool, 2013)

around 11 million mail items on daily basis (PostNL, 2016). These mail volumes are declining as communication becomes more and more digitalized. On the other hand, the parcel market is growing rapidly as an increasing number of web shops are launched. This leads to an increase in the number of packages that are being sent. Within the e-commerce market, PostNL offers a wide range of products and services, such as online billing systems and web shop solutions.

During the Strategy Update (PostNL 2020: Committed to sustainable delivery, 2015) it is mentioned that, in order to maintain a sustainable business model and cash flow after 2020, extending the current product portfolio is a necessity. To do so, PostNL will look for value creating growth opportunities that are driven by market and technological trends. Therefore, PostNL has increased its focus on development of *“really new innovations”*. The scope of this research report is focused on the MailNL division at PostNL, because at their department staying innovative is more necessary due to decreasing revenue streams.

4.2. Problem Definition

In order to improve the success rate of its NPD activities, 27 project managers and department leaders at PostNL which were involved in NPD were interviewed in 2015. This research showed that the participants agreed on several aspects. Firstly, they indicated that there was a lack of a uniform NPD process, and therefore used their own approach in order to manage NPD projects. Moreover, they argue that the management process is overly focused on the current product portfolio, due to the focus on financial evaluation criteria being used. In doing so, PostNL would limit the introduction of *“really new innovations”*. Moreover, different project types are being evaluated based on the same aspects, in particular the project financials. Solely evaluating project value on its financials will not fully represent the project’s value, due to a high level of outcome uncertainty for innovative products (Crawford & Di Benedetto, 2011). Thus, PostNL risks eliminating valuable opportunities because project value is misinterpreted.

Furthermore, since development projects are executed in various departments at different locations – who each have their own development approach – information exchange throughout the organisation is limited. Consequently, an overview of on-going development projects is missing. Managers argue that, as a result of this, too many projects are active, but also project overlap, which indicates unnecessary resource allocation. Besides issues with the allocation of resources, project members are struggling to manage to perform all the project tasks within the available time. This puts pressure on the quality of the executed tasks.

Furthermore, the 27 project managers and department leaders at PostNL argue that the current evaluation process is too subjective. There are hardly any formal processes in which NPD projects are being evaluated or managed. Generally, decisions are based on the experience and intuition of senior management. This does not have to be a bad thing, but employees have experienced actions relating to the phenomenon known as escalation of commitment (Behrens & Ernst, 2014). Managers are in this case too reluctant to terminate underperforming NPD projects as they become psychologically committed to, and invested in, the initial course of action they choose. Even though this is a losing course of action. Moreover, employees indicated that at some occasions they perceived that some projects received special treatment compared to others. Therefore, employees do not always accept, understand or share the GO/Kill decision because they suspect there to be a hidden agenda. Consequently, the productivity of employees is effected, which in turn leads to delays in the project execution (Eling, Griffin, & Langerak, 2014). Although it is repeatedly said that the focus of the organisation is ‘the creation of excellent services at the highest industry level quality’ and ‘extending the product portfolio with really new innovations’, this is not reflected during project selection or execution. Development projects seem to miss a clear development direction, which results in unclear

project requirements. Moreover, project selection was highly based on financial aspects of new product rather than on new product potential. Participants also argued that NPD teams lacked focus on value adding activities or are not fully aware of these activities. Therefore, it is assumed that redundant activities are performed, which can lead to project delays.

In conclusion, a preliminary company analysis at PostNL depicts several issues that can be generalized to two challenges, namely:

- Creating a formal NPD process in order to reduce process uncertainty and subjectivity. The formal processes will help in setting clear project measurements needed for a more fact-based project assessment; and
- Creating a suitable evaluation process. This design will help in getting insight into project value, which in turn will result in a more effective selection of valuable NPD projects.

Tackling these challenge will result in better organisational performance.

Problem Definition:

The absence of a clear FFE phase of the NPD process and a relevant evaluation process leads to an ineffective decision-making process and therefore to a lower organisational performance.

4.3. Design Requirements

Having defined the problem definition for PostNL, the knowledge gained by the literature review can be used for designing a solution. However, according to Van Aken and colleagues (2012), for a successful design, one should first assess the design requirements in collaboration with the research principal. The following design requirements in the categories functional, user, boundary, and design restrictions, have been established in collaboration with PostNL's research principals:

Functional requirements

- The design should help PostNL maximize the effectivity of selecting new product ideas for further development;
- The design should be easy to implement. This regards the compatibility with other existing designs and the amount of time needed to implement the design; and
- The design should encompass transparency concerning progress of projects and other tasks.

User requirements

- The design must be easy to learn and use for all PostNL personnel; and
- The design should be user-friendly for NPD developers and managers at PostNL.

Boundary conditions

- The design should respect the PostNL culture and strategy. Every change made to the PostNL culture must be done with the greatest considerations to preserve the organisational culture as much as possible;
- The design focuses on the fuzzy front end (FFE) phase of the development process within the MailNL division of PostNL Corporation; and
- The design should provide models that support decision-makers in the evaluation process after the concept generation and concept evaluation phase.

Design restrictions

- The design should be ready to be presented to the PostNL representatives before May 2017.

After determining the design requirements, now the design solution for PostNL's problem will be shaped. In the next paragraph a detailed description of the solution design will be given.

4.4. Design Solution

In addition to earlier analysis' (Hoogkamer, 2015), this research also analysed PostNL (e.g. Strategy & Development, Basic Products & Services, and Development and Projects departments) in order to define the problem definition. The results of this problem analysis can be generalized into two issues, namely: (1) a high level of NPD process uncertainty, and (2) an ineffective NPD project selection process due to ineffective design and subjectivity. In this chapter, solutions for these issues will be designed, based on the design principles gathered through the systematic literature review. Firstly, it will explain which design principles will help the organisation in reducing NPD process uncertainty and implemented for the solution design. Secondly, the design principles that will help PostNL to create a more suitable evaluation process are recalled and implemented for the solution design as well.

4.4.1. Design Solution for Reducing FFE Phase Uncertainty

Interviews with PostNL's employees (e.g. Strategy & Development, Basic Products & Services, and Development and Projects departments' employees) showed, that there is a lack of a uniform FFE phase, which resulted in ineffective development execution and collaboration among the collaborating departments. Depending on the NPD project manager, NPD processes differ in their required deliverables and execution flexibility. Therefore, when a development project is relocated to a different department, execution challenges occur due to differing management approaches. As mentioned before, managing and structuring the FFE phase depicts one of multiple critical process-related factors usually linked with successful development. One of the main goals of NPD models is to arrange general activities to ensure the targeted use of work methods, techniques and tools. A properly arranged process is transparent to all participating departments in order to achieve a common understanding of what needs to be developed, and it enables effective communication within the organisation (Gaubinger, Rabl, Swan, & Werani, 2015)(*Principle 2*).

Although some level of equivocality and uncertainty are unavoidable, over the course of time, as data gets more reliable, uncertainty decreases (Song & Parry, 1996). Cooper and Kleinschmidt's (1990) research empirically showed that the main difference between the best performing and worst performing organisations, was the execution quality of the FFE activities. Moreover, the authors argued that besides execution quality, having a well-defined project before the formal development phase is a central success factor for products (*Principle 1*).

In addition to a good evaluation process, it is argued that having an innovation strategy is also a critical success factor (Talke, Salomo, & Kock, 2011; Kock, Heising, & Gemünden, 2015). The innovation strategy would provide mutual direction for all development activities of the organisation, and would be especially important for the FFE and the ideation procedure, because it is focused on what the future of the organisation is aiming at and therefore provides the direction with which new product ideas can be evaluated (Spanjol, Mühlmeier, & Tomczak, 2012; Spanjol, Qualls, & Rosa, 2011; Kock, Heising, & Gemünden, 2015) (*Principle 3*). Furthermore, organisations reduce the complexity of the development process by establishing clear guidelines on what is expected at each development stage when projects move from one stage to another (Jani, 2010) (*Principle 10*). Crawford and Di Benedetto (2011, p.69), suggest that management should prepare a "product innovation charter (PIC). This is a document that sets the boundaries on the role that innovation should fulfil. The conditions, under which an organization will operate, are also included in the file. The PIC provides the direction(s) the team should concentrate on in NPD. In other words, it defines which sandbox the team is in, or wants

to be in, and also where it does not want to be. The PIC document consists of four sections: background, focus, goals and objectives, and guidelines. The background section should answer the question: “*why did we develop this strategy?*” This section should clarify the analysis behind the chosen strategy. In today’s competitive marketplaces, it takes focus to unlock the necessary power of innovation. An excellent place to start defining charter focus (section focus) is at the core competencies of an organization. Marketers narrow their focus by targeting and segmentation. Focus is generally achieved by the use of four types of strengths or leverage capabilities: technology, product experience, customer franchise, and end-use experience. Licensing or acquisition to acquire technologies or market strengths are also fair game for inclusion in strategies. The ‘goals and objectives’ section should include the goals and the objectives for the NPD projects. Everyone that participates in the development process should know its purpose, because development activities can change in multiple ways if the purpose changes. Goals are defined as longer-range, general directions of movement, whereas objectives are short-term, specific measures of accomplishment. Both goals and objectives are of three types: profit, growth, and market status. The fourth and final section: ‘guidelines’, includes the guidelines the management or the development team sets for the development process. Crawford and Di Benedetto (2011) mentioned three of such possible guidelines: 1) Degree of innovativeness, the options range from first-to-market to strict imitation; 2) Timing, this category of guidelines variation has four options: first, quick second, slower, and late; 3) Miscellaneous guidelines, include special needs of the organization. For example, that a product should integrate, meaning that all aspects of the product are internally consistent.

In order to reduce development uncertainty during the FFE phase of the NPD process, and to maximize the probability of successful new products, the solution as depicted in Figure 4-2 has been designed. It shows how the FFE phase should be implemented throughout PostNL. In this way, the departments get a better overview of how to execute the development process. This design also makes it easier to communicate progress with other departments, surely now the NPD teams are required to communicate a well-defined project report at each development stage.

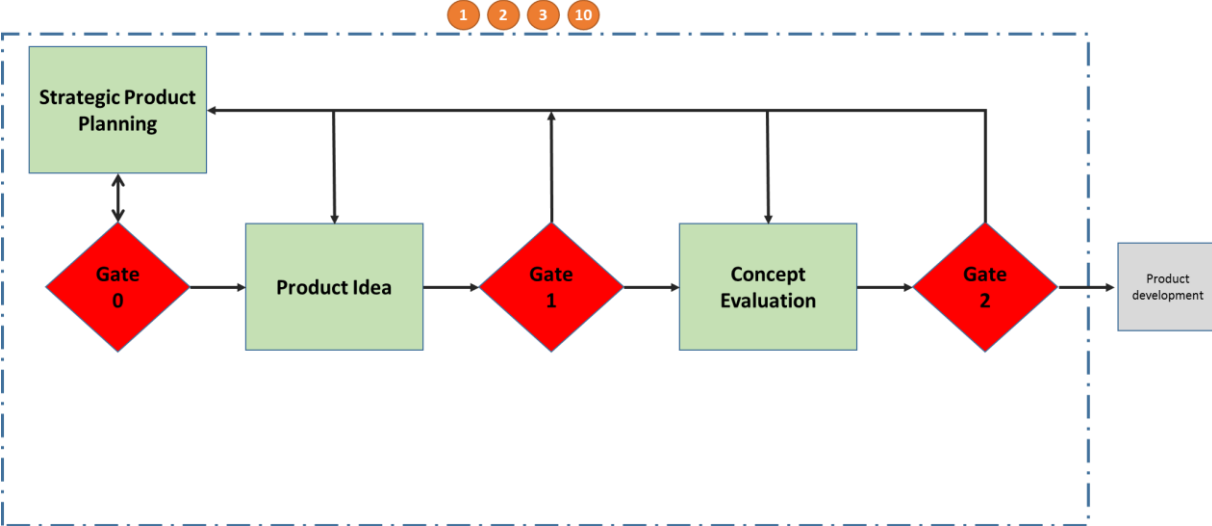


Figure 4-2: Design Solution for Reducing FFE Phase Uncertainty Including the Used Design Principles

4.4.2. Design for Evaluation Process

Besides development challenges, PostNL also showed evaluation process issues. Interviewed Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager among Strategy & Development, Basic Products & Services, and Development and Projects departments’ employees at PostNL argue that the current evaluation process is too subjective. There

are hardly any formal processes in which NPD projects are being evaluated or managed. Furthermore, the evaluation process is generally performed by department managers themselves, and occasionally in a group form. Employees indicated that at some occasions they perceived that some projects received special treatment compared to others. Therefore, employees do not always accept, understand or share the GO/Kill decision because they suspect there to be a hidden agenda.

In the following paragraphs, a solution will be designed in order to maximize the effectivity of PostNL's evaluation process. An overview of the solution design and the incorporated design principles are depicted in Figure 4-3. At first, the next paragraph will explain how PostNL should design its evaluation process, and which evaluation criteria it should implement in order to realize a more structured evaluation process. Secondly, the contribution of a tracking system is elaborated. Finally, it is explained whom should be involved when NPD projects are evaluated and what their role would be.

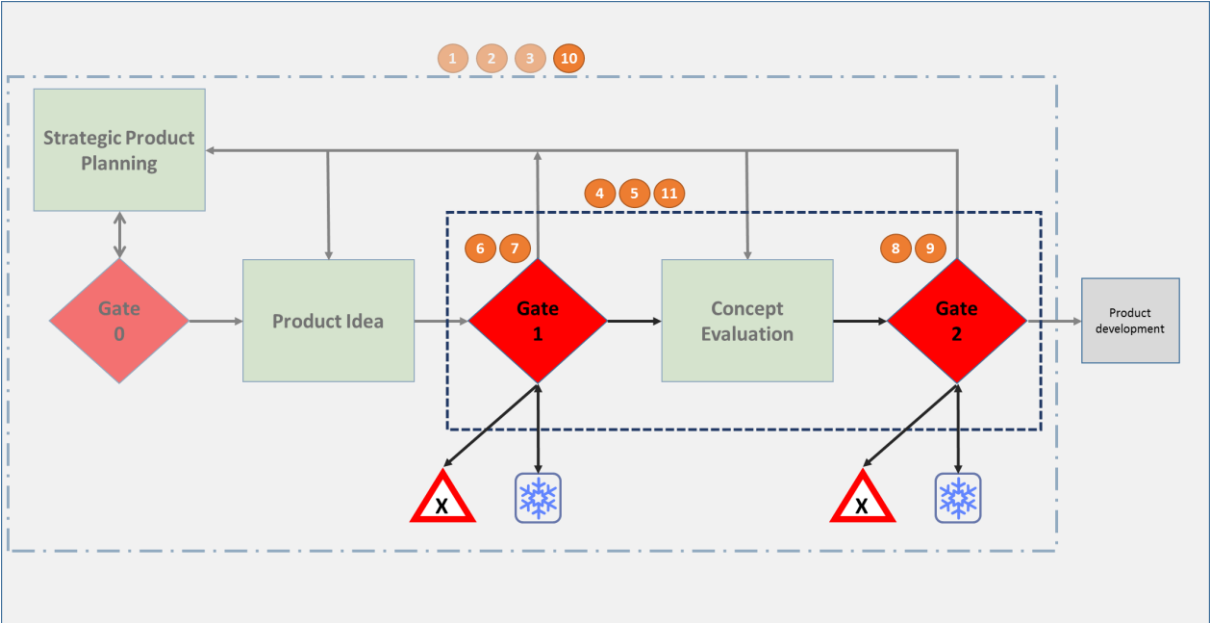


Figure 4-3: Design for Evaluation Process Including Used Design Principles

Preliminary Assessment (Gate 1)

Since PostNL is aiming at selecting the most valuable new product ideas available, the most suitable evaluation approach would be the portfolio evaluation approach (Principle 5). In this way, PostNL will be able to select the most valuable “really new innovative” new product idea combination based on the development resources available. PostNL should execute no less than two assessments: (1) a preliminary assessment to determine further investments, and (2) a thorough assessment when the new product concept is developed into a business plan, because having more assessment prevents really new innovations ideas from being kill too soon, and increases the chance for selecting the best ideas (Hall & Hofer, 1993) (Principle 4).

As mentioned by McGrath (1995), the preliminary assessment should assess new product opportunities on: competitive protection, market worth, and organisation worth. Competitive protection assesses the degree to which PostNL is able to protect the gained competitive advantage made possible by the opportunity. PostNL should score a concept or opportunity “excellent” in case it is in its current industry while exploiting and increasing its competitive advantage. In case PostNL is able to gain a large market share, but cannot maintain this because of a large threat of imitation, it should score the opportunity “bad” on protectability. Organisational worth factors assesses the opportunity on its connection to the core competences and strategy of PostNL. PostNL's core

competences are: its full coverage of mail and parcel networks in an innovative and efficient way, giving her the opportunity to serve a broad customer base, and - due to her 200 years network experience with different stakeholders - its outstanding knowledge on network logistic. Furthermore, PostNL aims at providing high quality products and service to its customers. Concepts with limited organisational worth score “bad” while concepts that are highly related to the core competences of PostNL score “excellent”. And finally, market worth denotes the value which may be gained by the opportunity. In this case a minor market worth scores “bad” whereas high market worth scores “excellent”. Market worth is equal to the probable profit an organisation can achieve; it is calculated based on market size (total sales) multiplied with market share (percentage estimated market share).

In addition, research suggests that organisations should make use of scoring models, checklists, or profile sheets when assessing new product ideas as these models make it easy for the organisations to compare new product ideas and select the most valuable ones with the resources at hand (Crawford & Di Benedetto, 2011; Cooper R. G., *Winning At New Products: Accelerating The Process From Idea To Launch*, 2001) (*Principle 6 & 7*). Therefore, the previously mentioned evaluation criteria were processed into a scoring model. Next, these evaluation criteria were valued in collaboration with PostNL’s Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager. Participants valued the factors as following; strategic fit (38%), market potential (31%), and protectability (31%) (See Table 4-1).

Table 4-1: Preliminary Assessment Template (Gate 1)

Preliminary Assessment Template		Weight	1 Bad	2 Moderate	3 Sufficient	4 Good	5 Excellent	Weighted Score
Organisational worth	Level of relatedness to the current organizational competences	0.20						
	Level of relatedness to the current organizational strategy	0.18						
Market worth	Value which may be seized by the opportunity	0.31						
Protectability	The product’s advantage can be maintained against competition	0.31						

Thorough Assessment (Gate 2)

Resources play an important role in evaluation decisions (Haynie, Shepherd, & McMullen, 2009). In order to execute a good evaluation of a new product idea, it is necessary to look at possible future decisions, which might influence the success of the new product idea. As such, the evaluation decision should involve both an evaluation of existing resources as well as required resources in the future.

Based on years of studying top performing organisations, Cooper (2001) managed to create a different set of criteria, which help organisations in selecting the best new product opportunities. His list includes 19 criteria that can be categorized into the following five categories: strategy, product advantage, market attractiveness, synergies, technical feasibility, and risk and return. Although, a distinction between must-meet and should-meet criteria can be made when evaluating (Cooper R. G., 2001; Crawford & Di Benedetto, 2011), scoring models provide more flexibility as different weights can be allocated to each criterion, and in combing a scoring scale, resulting in a relative score.

Consequently, scoring models reduce the risk of killing a project that scores badly on just one of the criteria (Cooper, 2001).

Once a new product idea is selected for further development, a thorough assessment is implemented. The extensive evaluation is very similar to the procedure of the preliminary assessment; it also has a scorecard-based assessment, but now there are more criteria to assess on. In addition to protectability, organisational worth, and market worth, it includes criteria from the categories: risk versus return, and technical feasibility. The weights assigned by PostNL's Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager can be seen in Table 4-2.'

Table 4-2: Thorough Assessment Template as Scored by PostNL's Management (Gate 2)

Thorough Assessment Template		Weight	Bad 1	Moderate 2	Sufficient 3	Good 4	Excellent 5	Weighted Score
Strategy fit								
	Degree to which project aligns with the business's strategy	0.06						
	Strategic importance of project to the business	0.08						
Product/service advantage								
	Degree of unique benefits offered to end-users by the new product/service	0.10						
	Degree to which the new product/service meets end-users' needs better than competitive products	0.10						
	Degree to which the new product/service provides excellent value for money to the end-user	0.04						
Market potential								
	Market size	0.07						
	Market growth rate	0.07						
	Competitive situation (tough, intense, prize-based competition is a low score)	0.10						
Synergies								
	Leverages our business's marketing, distribution, and selling strengths/resources	0.04						
	Leverages our technical know-how, expertise, and experience	0.02						
	Leverages our operations capabilities, expertise, and facilities	0.07						
Technical feasibility								
	Size of the technical gap (small gap is high score)	0.05						
	Complexity of the project, technically (less complex is a high score)	0.05						
	Technical uncertainty of outcome (high certainty is a high score)	0.02						
Risk versus Return								
	Expected profitability (magnitude: NPV in €)	0.05						
	Percent return (IRR% or ROI%)	0.02						
	Payback period (or BET) how fast you recover your initial expenditure/investment (years)	0.04						
	Certainty of return/profit/sales estimates (pure guess to highly predictable)	0.04						
Total								

Design for Tracking System

Keil (1995) argues that in order to prevent EoC, organisations should create a tracking system, which provides senior management with full insights on all active projects and the stage that these projects are in. Furthermore, organisations need to reduce the complexity of the development process through establishing clear guidelines on what is expected at each development stage when projects move from

one stage to another (Jani, 2010). Behrens and Ernst (2014), showed that when organisations use visual aids they generally improve the quality and structure of project information. Furthermore, visualizing project data is argued to be a good information source for decision-makers, as it helps to clarify complex relationships, provide an overview of business activities, and visualize trends. Visualizations also help improve available information by structuring underlining uncertainties. So, by providing the managers with data visualizations, instead of detailed statistical analyses, it is easier for them to understand the information that is presented to them (*Principle 10*).

Given these design principles, a solution is designed to increase transparency and knowledge on NPD activities during the FFE phase within PostNL. The design supports the organisation's FFE phase evaluation decision-making through different aspects. The design consists of a digital information system (IS) that supports communication, facilitates knowledge sharing and data storing. The existence of this IS will help PostNL's employees to coordinate development activities, to gain insight on project progress, project stakeholders, and provides the organisation with insights on the allocation of resources for each project. The goal is to add more structure to the current development process, but not at the expense of PostNL's informality. For example, the project documentation will still be in the well know Microsoft Office files. But by adding Lync software to the platform, the information sharing improves instantly. Developers will be able to post questions on the platform or directly contact persons of interest in order to gather needed information.

In a dynamic and complex environment, in which PostNL development activities take place, various things can change instantly during the development process; from the addition of new tasks or the rework of the existing ones, all through to the re-allocation of resources. For example, if a new task occurs, or the project priority changes, or even if the project resources are adjusted, the whole development situation will have to change. Having a collaboration platform in place will provide development teams with real time information, making it much easier for them to adapt to the new situation without reducing development performance. The collaboration platform will provide insights on the required project activities, allocated resources and the priority activities, which will be accessible for all stakeholders within PostNL. This is an important feature, because PostNL's employees are generally involved in multiple (complex) projects, making resource allocation a challenging activity for managers. Insights on employees' availability will increase effective resource allocation and therefore project execution. Another advantage of the collaboration platform, is the feedback loop between the different development stages. The platform will immediately process and inform stakeholders of all alterations in resources, project activities and prioritizations, leading to an effective project fulfilment.

Further, all project documents produced and gathered during development activities will be saved on the organisation's server and will be accessible on the platform. This data will be accessible for all stakeholders during or after the development stages, and will act as reference work for later development activities. As increasingly more NPD information becomes available, PostNL will be able to further improve the quality of her decision-making support system (see Figure 4-6).

Design for Evaluation Team

In organisations like PostNL, in which NPD managers are expected to periodically evaluate a broad range of NPD projects, managers are often forced to make decisions on shorter timeframes. As such, established organisations, like PostNL, which aim at developing "*really new innovation*" are more likely to experience EoC. In the NPD environment, Schmidt et al. (2001) found that EoC was less likely when "stop or go" decisions were made by teams, particularly virtual teams, instead of individual decision-makers. Crawford and Benedetto (2010) also emphasize that the evaluation should be a multi-person evaluation in order to prevent a single person bias (*Principle 11*).

Therefore, for an effective and efficient evaluation process of new products in the FFE phase, PostNL is recommended to design its evaluation team as explained below. This design has been shaped in collaboration with PostNL's Growth & Innovation manager, Product & Development manager, IT Solutions director, Master Plan Office manager in order to increase its feasibility.

The designed evaluation team for PostNL's FFE phase consists of four units: Management Team MailNL (MT Mail), Management Team Growth & Innovation (MT G&I), Support Office and Expert Group (see Figure 4-4). The next section will describe the responsibilities and activities of each of these units.

MT Mail

- Strategic decision on:
 - Which firm's core competences to focus on during the development;
 - Size of the total development budget;
 - Resource allocation guidelines for each development stage;
 - Financial gap organisation is aiming at;
- Selecting the MT G&I board members;
- Participate in high profile, large gate meetings.

MT G&I

This committee is responsible for all development funding decisions and ensuring that the managers apply the structure FFE phase guidelines appropriately. A number of responsibilities include:

- Monitoring the link between the development activities and the development strategy;
- Compose project development teams;
- Allocate development resources at each stage of approved projects;
- Providing clear decisions and recommendations during and at each gate meeting;
- Approving detailed stage plans;
- Managing team and project issues;
- Identifying and selecting Expert Team pool;
- Identifying and selecting Developers;

Support Office

- Verifying that gatekeepers' comments have been documented and addressed;
- Tracking project progress, funding and planning;
- Providing (periodic) development activities reporting for the EC and MT G&I;
- Providing workshops and training programmes for MT G&I, development teams, and expert teams.

Expert Team

- Evaluate project results on pre-defined gate criteria;
- Giving recommendations on modifying the development plan for the next stage;
- Providing clear decisions and recommendations to the MT G&I.

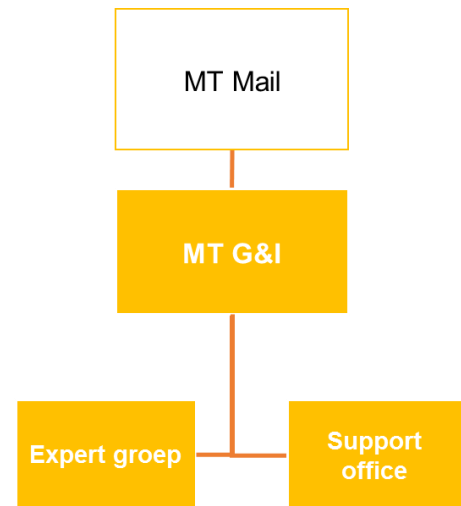


Figure 4-4: PostNL's Evaluation Team

When following the proposed management structure, there will be a greater distance in an organisation between NPD projects and the people who evaluate the projects. This will presumably result in a reduction in the escalation of commitment, which will lead to a more effective evaluation process.

4.5. Summary

The results of the problem analysis revealed two general issues, namely: (1) a high level of NPD process uncertainty, and (2) an ineffective NPD project selection process due to ineffective design and subjectivity. To tackle these issues several solution designs were introduced. Firstly, to reduce a high level of NPD process uncertainty, a structured FFE phase was introduced. This development process starts with the definition of the innovation strategy, which sets the guidelines for further new product development. Furthermore, this structured development process will reduce development uncertainty, as participants of the process are required to exchange relevant information depending on the stage they are in. Moreover, by implementing an information system, insights on development activities are increased, which in turn results in the reduction of development uncertainty.

In order to reduce the NPD project selection issue during the FFE phase, three solutions were proposed. At first, two new evaluation gates were implemented. The first evaluation gate is supposed to select the best new product idea based on: competitive protection, market worth, and organisation worth. The second evaluation gate, is a more thorough evaluation step, in which the organisations uses 19 criteria in order to decide whether it should develop the new product concept or stop further development. Secondly, a new information system was designed in order to increase insights on development activities and progress for decision-makers. This should help PostNL in reducing the likelihood of escalation of commitment by its decision-makers, and therefore increasing the possibility of selecting the best new product ideas. Finally, a new design of the evaluation team was provided. In contrast to their previous situation, now PostNL has an overview of whom to engage in its evaluation process and what to expect from them. An overview of the total solution design for PostNL is illustrated in Figure 4-5.

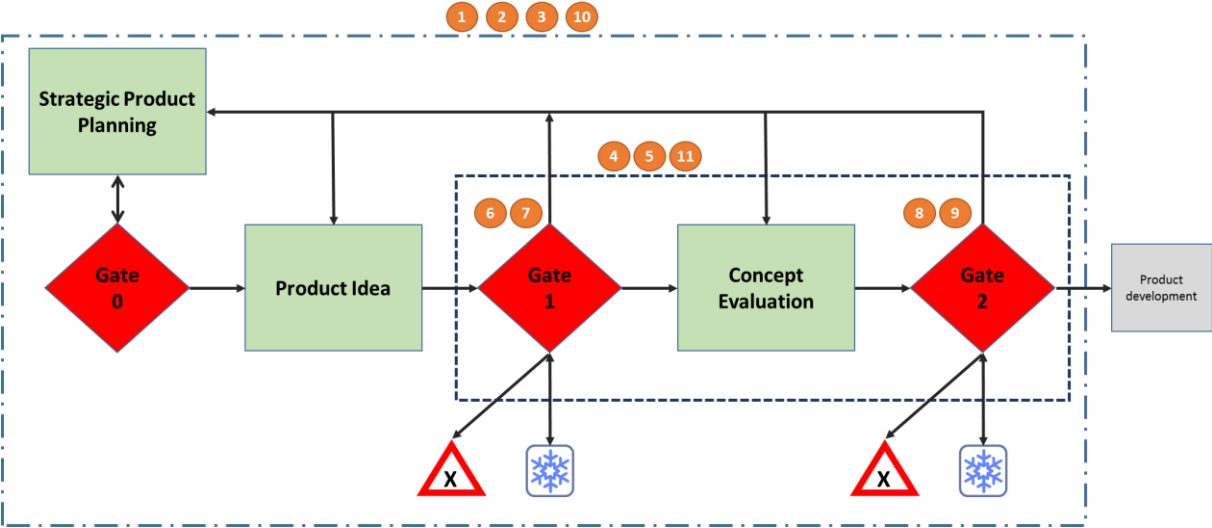


Figure 4-5: Total Solution Design for PostNL Including the Design Principles

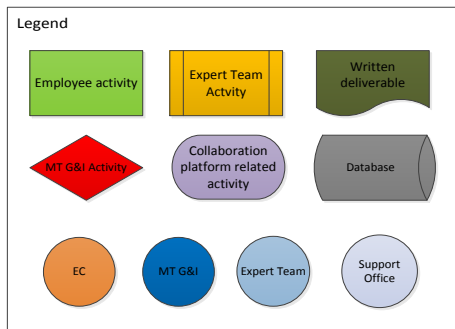
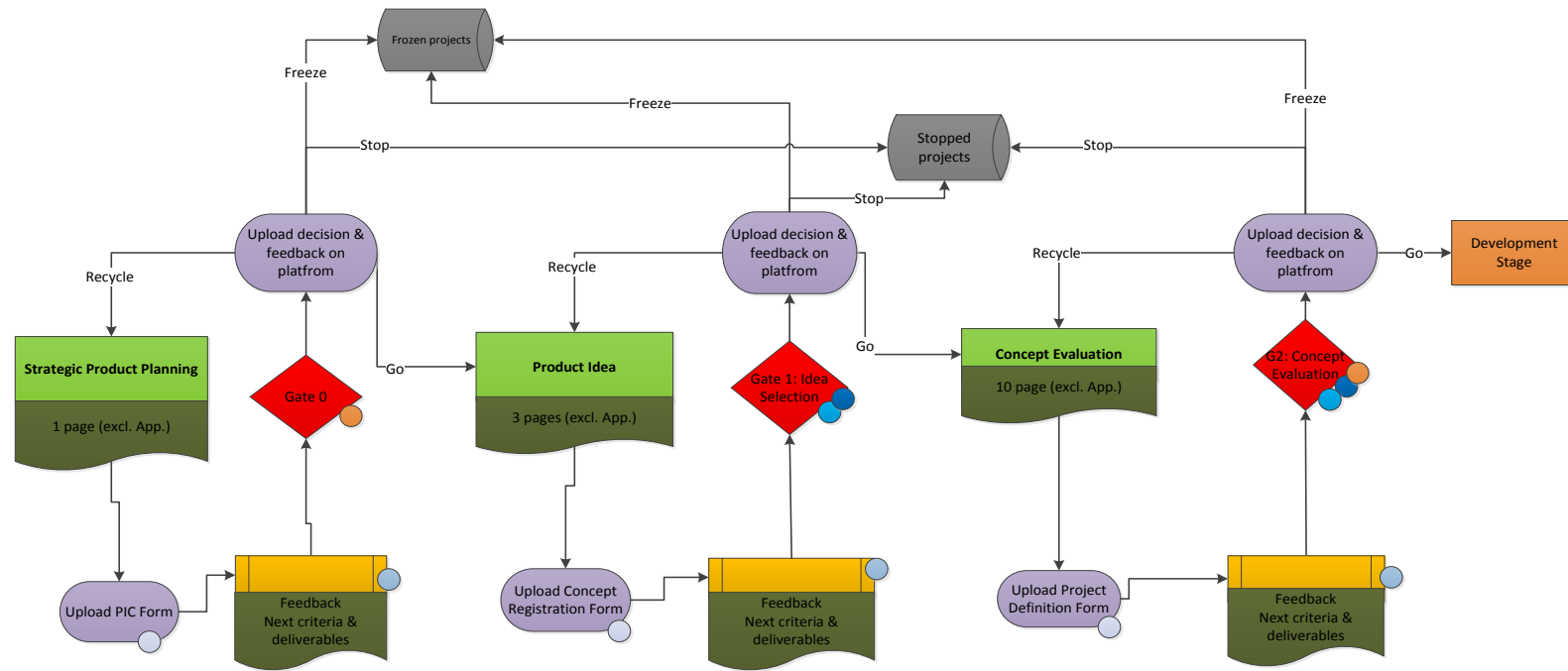


Figure 4-6: Information System Design

5. Change Plan

After having designed a solution for PostNL’s FFE phase problem, next a change plan should be outlined. Van Aken et al. (2012) state that two requirements need to be met, in order to have an adequate change plan; (1) the relevant technical-economical information for designing a solution should be provided, and (2) a collaboration with stakeholders should take place from the start of the change project on. The main goal is to have a prompt understanding of possible project costs and timely planning to counter possible risks. In this case, PostNL is eager to alter its current methods in order to reduce the number of unsuccessful projects as soon as possible, and is willing to invest in promising new FFE phase design. However, on several occasions, PostNL employees have mentioned that they would not prefer to apply alterations that might affect their corporate culture or time-consuming initiatives. This is because skilled resources within large organisations like PostNL generally lack time to drive the new change and implementation. Furthermore, it was clear that some resistance might be faced due to changes in the way FFE phase of the NPD processes should be organized and managed. Although a practical and user-friendly solution is suggested, a change plan is required to minimize, among others, these possible risks.

In this section the outline of the change plan is given, based on Van Aken et al.’s (2012) approach. At first, a delta and stakeholders analysis are performed to get an understanding of what type of resistance can be expected and from whom. Thereafter, two methods will be incorporated to address the intervention strategy. These methods are; the eight-step change approach from Kotter (1996) and the Tichy’s Technical Political Cultural framework explained in Van Aken et al. (2012). Lastly, the deliverables of the change plan are mentioned and represented. Figure 5-1 illustrates the change plan approach.

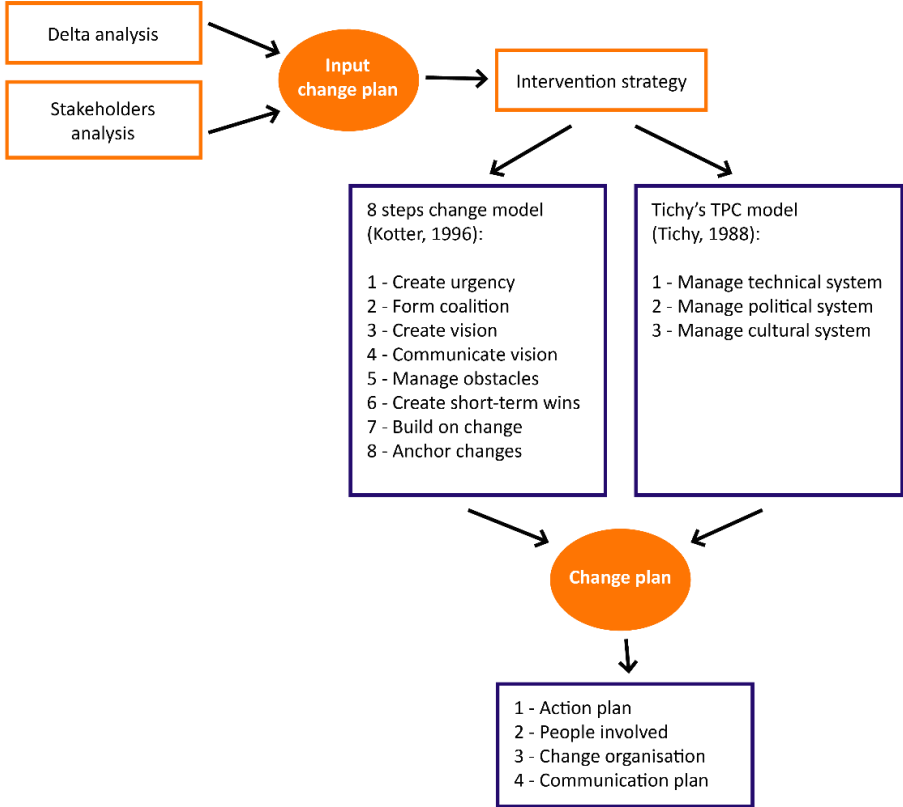


Figure 5-1: Change Plan Approach

5.1. Delta Analysis

The delta analysis discusses the differences between the current state at PostNL and the redesigned state. It identifies the main elements of the proposed redesigned change (Aken, Berends, & Bij, Problem solving in organizations, 2012). In the following section alternation in the current organisational processes as result of the new FFE phase design will be discussed.

5.1.1. Implementing a Uniform Structured Fuzzy Front End

The new FFE phase design involves the implementation of a uniform structured FFE phase. This means that managers as well as employees from different departments will have to adjust their current working processes to a certain level so they all work in the same manner. But having said that, these changes are a welcome change in order to reduce project delays caused by ineffective collaboration and project execution (see Figure 5-2). The use of a uniform process will provide insight on the status of the project, making it easier to communicate project information to others. Moreover, it will increase development effectivity as goal clarity for development teams will increase.

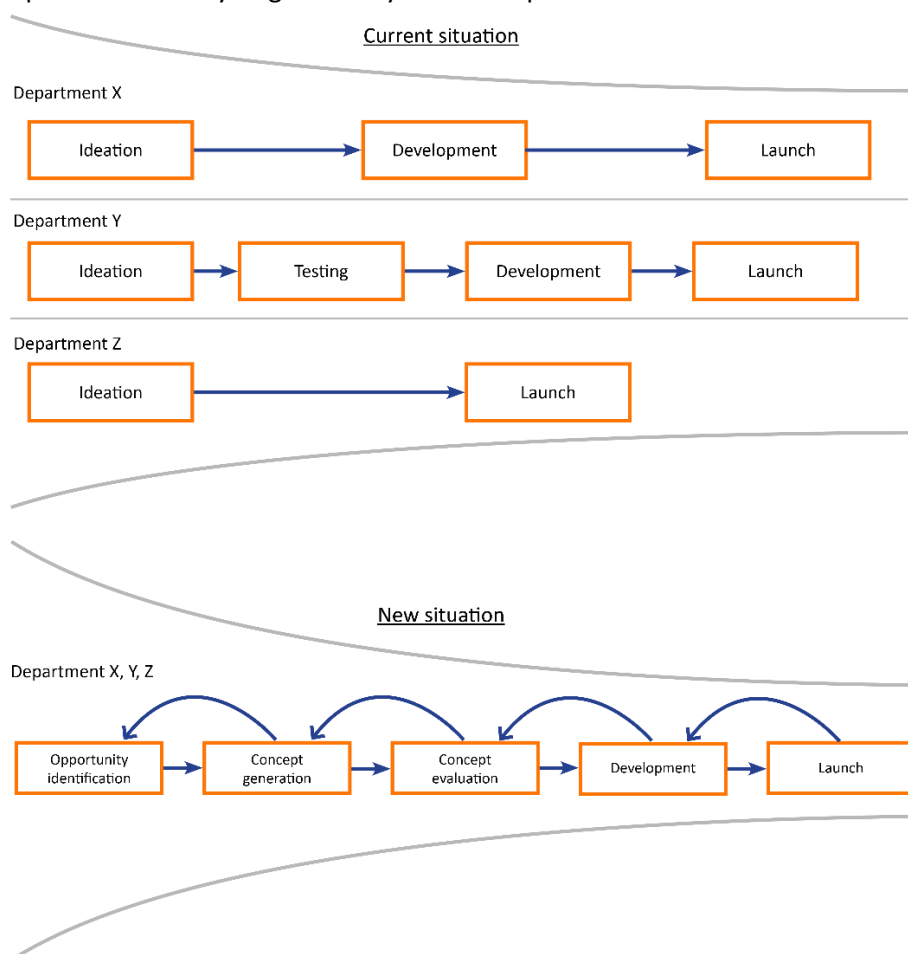


Figure 5-2: Current Development Processes vs. New Development Process

5.1.2. Changing Evaluation Process

As discussed in chapter 4.2: Problem Analysis, project selection is currently believed to be (among other things) lacking clear assessment guidelines and to be prone to escalation of commitment. Furthermore, the evaluation process is generally performed by department managers itself, and occasionally in a group form, periodically.

The suggested design alters these approaches through multiple ways. First, it modifies the evaluation process from being time related to a process which is related to the development stage. Although both

of the process involve time, the new design allows PostNL to incorporate relevant assessment criteria. This could mean that “really new innovation” new product ideas will have more time to prove their overall value, reducing the probability of being stopped based on solely their financial results. Second, experts will in contrast to current situation have to use standard assessment forms for their evaluation (Table 4-1 and Table 4-2). This helps decision-makers in evaluation projects with using the relevant criteria and leads to more consistency in their evaluation. Which in turn should lead to a more successful and fair evaluation. Another significant change to the current situation, will be the inclusion of the multidisciplinary expert teams for evaluation in order to reduce the likelihood of escalation of commitment (see Figure 5-3).

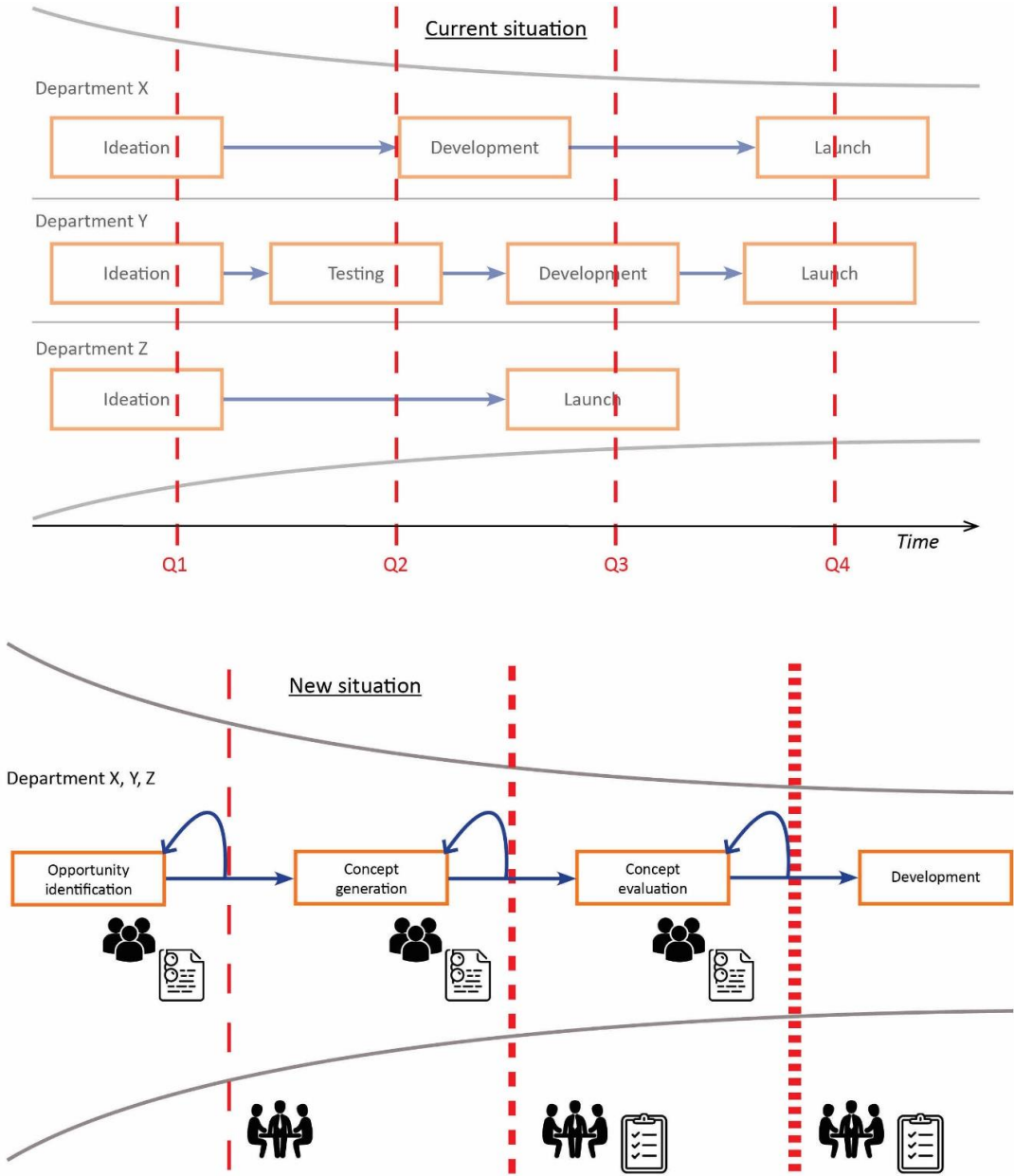


Figure 5-3: Current Evaluation Approach vs. New Evaluation Method

5.1.3. NPD Project Information System

PostNL’s project teams currently use Microsoft SharePoint to exchange project information. In order to do so, one of the team members is required to set-up a page and invite other team members, or other relevant participants, to join this page or documents. In other words, team members decide who

will have access to project information. Managers can get access to project documents, when they request for it.

By introducing an information system (IS), management will instantly have access to all necessary project data without a problem. In addition, teams will have access to information that can help them with an effective project execution. The use of such a system will help NPD team members, as well as managers with a simple and fast exchange of information, which in turn will improve the outcome of a project. An additional advantage of such a system is that it facilitates an organisational knowledge database. In time, teams will be able to learn from previously performed NPD projects as data is being stored in one place. Furthermore, development teams will be able to ask for peer support throughout the whole organisation without actually being on site. This is needed, as PostNL's offices and their development teams are scattered all over the Netherlands (Figure 5-4).

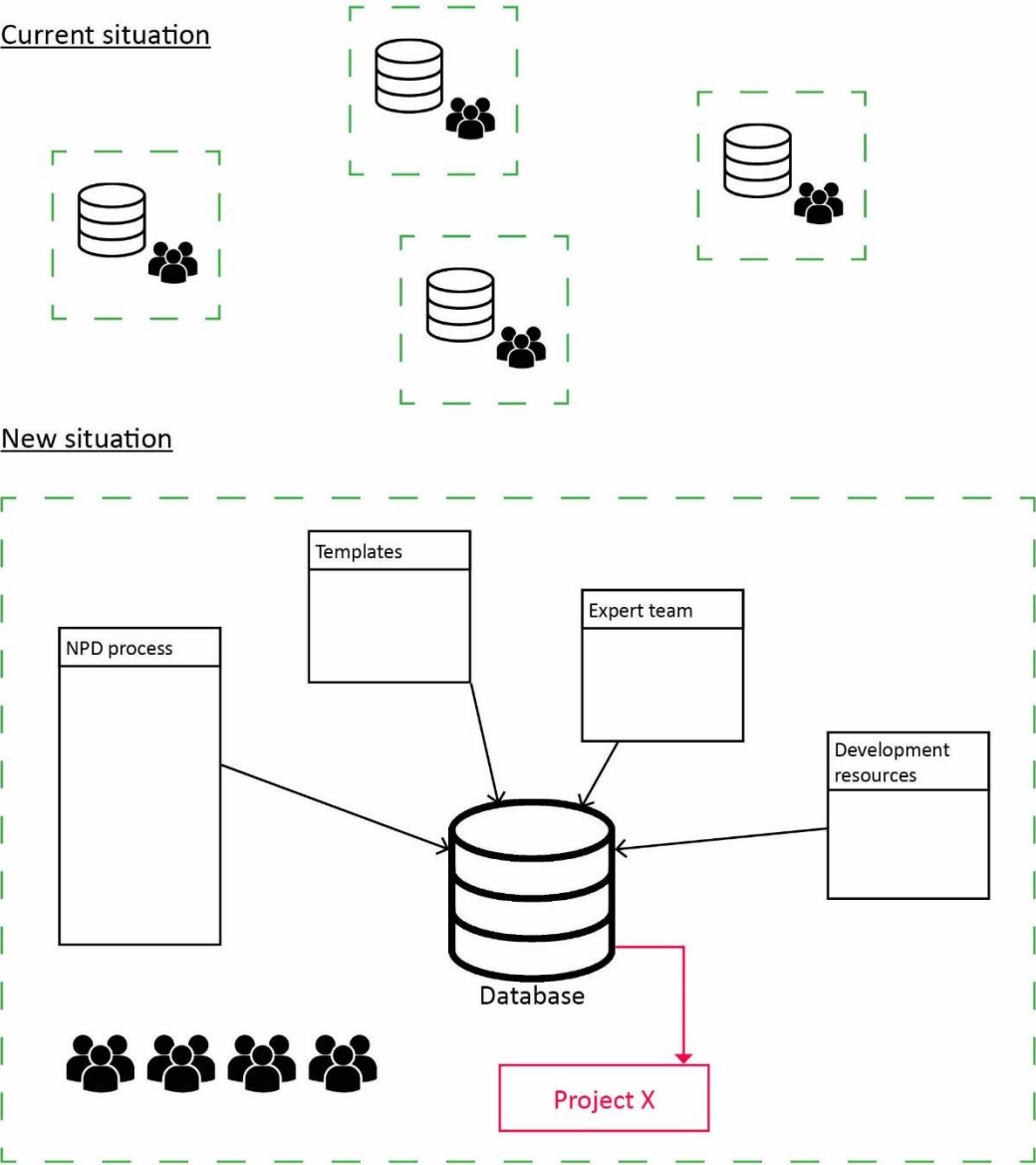


Figure 5-4: Current Communication Approach vs. New Communication System

5.2. Stakeholder Resistance Analysis

Resistance for organisational changes, like is the case when a new design solution is introduced, occurs at different levels; at an individual, group, functional, and organizational level. In order to successfully

implement the suggested solution design for PostNL, an investigation of the different stakeholders and the possible resistances from these stakeholders are required (Jones, 2010). In this paragraph each of these resistances levels will be discussed.

Individual level resistance

- Cognitive biases can occur, if stakeholders think that a change will affect their authority. They might perceive a decrease in their responsibilities, while in practice this intervention is trying to achieve the opposite. **Employees** might even think that new changes will mean that they lose their jobs.
- Selective perception and retention between **managers** and **project members** might arise if these stakeholders disagree with a changed design, due to technical, economical or personal reasons (Aken, Berends, & Bij, Problem solving in organizations: A methodological handbook for business students, 2012)
- The lack of trust to the proposal of an outsider. An unknown third party developing and suggesting a solution can seem threatening to **PostNL employees**, and therefore they might have difficulties with adopting the solution.
- Uncertainty and insecurity is a manifestation of the “fear of the unknown” from the stakeholders, showing a preference for maintaining their current way of doing things and organisational environment. In this case, it is important to make the **employees at PostNL** realize that the way the solution is designed, aligns with their current processes.
- **Employees** have a preference for familiar events and actions. New styles and habits are hard to implement and, thus, hard to change.

Group level

- Due to group thinking, some **team members** might disagree with a change, and persuade the **whole team** to disagree.

Functional level

- Different sub-units at PostNL, who each have a different orientation/function, see the way to success from their own viewpoint, this is also known as tunnel vision. It might result in a lack of a consistent outlook on how a change should be implemented. It is a constraining factor in the effectivity of the NPD process.
- A change might benefit some people, functions or divisions at the expense of others. The change can cause power struggles, which are likely to result in a functional resistance. This will happen for example, if the changes cause benefits for the **sales department**, while at the same time harm the cost reductions of the **development department**.

Organisational level

- The current organisational structure of PostNL as it is known today should change. It is necessary to give insight into the allocation of resources of all departments; this can be done at the monthly board meetings. This causes more transparency, which leads to more people being involved in decision-making, which in turn can lead to an improvement of the allocation of resources. However, the problem that can arise is that it takes a lot of time and effort to change the organisational structure. Partly because it has to be approved by a lot of stakeholders.

- The organisational strategy of PostNL will not directly be affected by the changes. The solution design will give an overview of the progress of the development activities and a guideline of how they should be managed, without influencing PostNL's organisational strategy.
- The solution design aims at improving the fuzzy front end (FFE) phase of the development process, which means that a change in the organisational culture is also necessary. Because such an improvement requires a different – more flexible, adaptive, progressive and creative – mind-set.

5.3. Intervention Strategy

According to the obtained delta analysis and stakeholders analysis data, an intervention strategy should be prepared that focuses on different aspects. An intervention strategy is an *“outline plan of steps to be taken, along with a mix of interventions to be used in the change process”* (Aken, Berends, & Bij, 2012, p. 143). By means of Kotter's eight-step approach and Tichy's TPC model, this section aims at providing insight into how the expected outcomes of the solution design can be achieved. For each of Kotter's steps (1996) an explanation of how it should be implemented at PostNL is given.

Step 1: Create Urgency

PostNL's NPD teams and project managers need to welcome the solution and feel the urge to change, in order to prevent future loss of business. PostNL's staff should understand that the organisation can only secure its future existence if they improve their rate of successful product introductions while available development resources decrease. Although future risks are not perceived to be a major issue, they should not be underestimated and should be a dominant argument for PostNL to create urgency to adapt to change. In order to achieve this, PostNL should create an open discussion in which the current NPD results are discussed. Employees should get more access to the recent development results for a better understanding of the need for change. This step is comparable with the technical system dimension of Tichy's model.

Step 2: Form a Powerful Coalition

Kotter (1996) recommends forming a coalition or a group of significant people, whose power is determined by different factors. These factors could be: competence, job title or organisational position and its related political importance. In case of PostNL, it refers to individuals from the senior management team and the Groei & Innovation board which have the power to implement process changes. These individuals have decision-making power, but should also have an emotional commitment to change. The most suitable team would also include people who are affected by the current situation. For example, the development projects' members whose task it is to develop a concept, but who are instead spending a lot of time on doing a technical and customer analysis should join each other to form a powerful coalition. Together these individuals can create momentum for change. This step refers to the cultural system factor of Tichy's model.

Step 3: Create a Vision for Change

A clear vision of the necessity of change will help the employees in understanding why actions are taken. PostNL's Groei & Innovation board could for instance set a future vision in order to continue the growth through change. This vision could for example be: At PostNL, we aim at incorporating the customer's input early on in the development process, and every project represents an opportunity to learn from and an opportunity to incorporate improvements in future products and projects. This vision for change will motivate employees towards a more open minded attitude for change, making it easier in future to adapt to changes. This step refers to the technical dimension system of the Tichy's model.

Step 4: Communicate the Vision

It is unsatisfactory to have a written vision when employees do not talk about it. PostNL should aim at a situation at which employees talk about its vision on a daily basis. Since the solution design involves some changes in behaviour, the best way to communicate the vision is to lead by example. Seniors and department managers at PostNL should themselves discuss PostNL's vision regularly to set a good example. In doing so, employees will follow their example and start actively discussing about the vision as well. Actively discussing the vision will prepare employees for change, making it easier in future for them to adapt to changes. Tichy's model refers to this as cultural system dimension.

Step 5: Remove Obstacles

In general, organisational change will result in some form of resistance. Earlier, the possible types of resistance within PostNL were mentioned. In order to manage resistance, Kotter (1996) suggests collaboration and the rewarding of employees who are willing to change. For employees who are less willing to change, Kotter (1996) proposes support or help in the change process. Removing employees from organisations because they are not cooperating is not an option, because it has a negative side effect on the organisation; the organisational climate should at all times be safe and pleasant in order to realize a productive environment. PostNL's managers should use coaching techniques to make those who have a resistance towards change alter their view on change. This is mentioned in the political system dimension of Tichy's model.

Step 6: Create Short-Term Wins

Almost nothing motivates people more than success. By creating short-term targets – and not just one long-term goal – PostNL employees will see the value of change more effectively; they will feel more satisfaction and motivation with the overall change. Furthermore, short-term targets can help in realizing a more effective implementation of changes; Changes are gradually introduced, which makes them more acceptable and supportable for PostNL's employees. PostNL should incorporate a change plan, which includes multiple milestones. These serve as reference point and short-term achievements. It should be noted that some aspects of the overall solution are implemented relatively faster than others. For example, it is much easier to implement an evaluation form than a communication platform at the gates. So the short-term wins apply to rapidly implemented activities, while long-term activities require partition in smaller tasks, which results in short-term milestones. This is also mentioned in the political and cultural system dimensions of Tichy's model.

Step 7: Build on the Change

During the change process, Kotter (1996) suggests to be aware of what went right and what went wrong, and strive for continuous improvement. Again, having an open and safe working environment will improve the productivity of employees. Therefore, PostNL should aim to realize a situation in which employees feel free to openly provide feedback on organisational activities, more specifically: the change process. PostNL's future is depending on continuous improvement, so this aim should be observable across the organization in order to achieve changes.

Step 8: Anchor the Changes in Corporate Culture

Change has to be sustainable over time and should become part of the core of the organization. Since organisational culture often determines what gets done within the organisation, the standards behind organisation's vision need to be explicit in everyday work. PostNL should therefore continuously invest in showing the effects of changes throughout the organisation. This will help PostNL in placing change on PostNL's culture. It's essential that PostNL's managers support the change. If the managers stop supporting the change, this design solution will probably fail successful implementation. In order to anchor change in organisations culture, PostNL should grab every chance to talk about progress it makes by change. Furthermore, should PostNL recognize key individuals of the change organisation,

and make sure people know what their contribution was. This is refer to as cultural system dimension in Tichy’s model.

5.4. Change Organisation

Besides the delta analysis, stakeholders analysis, and the intervention strategies, a change plan also needs to specify the individuals whom will put the actions into practice and realise the proposed design. This is the so-called change organisation. The action plan and people involved concerning the planned changes for PostNL, are addressed and combined in the roadmap below (see Table 5-1). It sets and defines the actions and goals to accomplish for PostNL and which individuals should be involved in each action.

Table 5-1: Action Plan

Context	Action	People Involved
NPD Process	Determine which development teams, field experts, decision-makers to involve in this project.	MT G&I, Marketing, Program office
	Determine timing and the method to collaborate with each abovementioned group	G&I board, Marketing, Program office
	Announce within the organization the possibility and conditions for getting involved with NPDP change project	G&I board, Marketing, Program office, Communication office
	Select lead users to collaborate with	G&I board, Marketing, Program office
	Run Pilot Test within different departments	G&I board, Marketing, Program office
	Roll out to all development teams/ departments	G&I board, Program office
	Developing Information System	Start determining people responsible for developing the platform and dealing with the whole setup of it
Define the size, design, structure, usage, content etc. of the platform		G&I board, IT-department
Set the roadmap for the database meaning when to start developing and finishing it		G&I board, IT-department
After having assigned all the tasks, the outline, roadmap and people involved, start developing it		IT-department
Training employees	Start developing a training plan and schedule for employees	G&I board, Program office, Employees
	Encourage Strategy and Development department in collaborating in the training sessions	G&I board, Program office, Employees
	Start training all (development) employees	G&I board, Program office, Employees

5.5. Communication Plan

For an affective and successful change, PostNL should also have a communication plan. This is useful because it helps to eliminate any abovementioned pitfalls within the organisation, which are accountable for the resistance of the employees towards those changes. A communication plan is crucial for the organisation to ensure that all employees fully understand the aim of the design. Moreover, the communication plan will enhance employee motivation and it will increase the likelihood of active participation throughout the change process. To ensure that employees are motivated in actively participating in implementing the new design, organisation needs a communication strategy. This research suggests the following communication strategy for PostNL.

The communication plan should consist of three activities. First, the management has to prepare employees for the upcoming organizational changes in the company. To do so, a short message will

have to be send via the internal communication platform in order to inform employees to expect changes in business processes related to NPD. Second, the management has to give a detailed presentation to the employees about PostNL's current financial status and growth expectations. PostNL has to underline the need for more structure for her NPD activities in order to achieve organisational goals. The presentation has to include all the strong points of the new FFE phase of NPD process, and how it tackles the selected challenges within PostNL. Third, management has to promote the solution design within the organization, and allow employees an active role in the changes and ask them for feedback and suggestions. The latter will also lead to the direction of optimization. Since employees have different values and personalities, asking for feedback and suggestions will lead to an improvement of the designed solution and fit it more properly in the culture of PostNL.

To conclude, a detailed and well organised communication plan will be the medium for the success of the change plan, because it will decrease the resistance from the side of employees and it will increase their motivation to be an active part of the required changes, by aligning their goals to the organisation's goal.

6. Conclusions

In this final chapter the main conclusions that can be drawn from this research, as well as the contributions to both the literature and management involved in new product development are addressed. The final section discusses the main limitations and provides directions for further research.

6.1. Research Findings

The goal of this research was to design and implement a new evaluation process – for the FFE phase of the NPD process – for PostNL in order to improve development effectivity.

The theory says that organisations should decide which NPD model suits them best based on their environment, their core competences and their goals. Organisations should always use a structured NPD process for a successful development, since this creates focus and clarity. An innovation strategy is also essential. Next to a focus at development, an innovation strategy makes the evaluation process more effective because it sets conditions to development, and thus everything that does not meet those conditions is not regarded anymore in further development.

The evaluation process in the FFE phase differs for each innovation type. In the case of PostNL, where the focus lies on the development of ‘really new innovation’, an evaluation process with two gate moments would suit best. Via these evaluation moments, an organisation can succeed in an effective deployment of scarce resources, while there is also space for relatively new ideas. At the first evaluation moment (gate 1), the categories that are most important to analyse are: market worth, organisation link, and protectability. At the second gate (gate 2), after which large investments will be made, the categories are extended with: product advantage, technical feasibility, and risk versus return.

To evaluate the projects, there are models available, such as a checklist, scoring model etc. A scoring model is useful because it outputs a weighted score, which makes a comparison between large numbers of projects easy to do. Moreover, it is advisable to execute the evaluation process with several people, to reduce the possible ‘first person bias’ or ‘escalation of commitment’. Another thing that can be done to improve the development process, is the application of a communication system. This enhances a development overview, which furthers the mutual communication, and makes the boundaries or conditions that need to be met very insightful.

For a successful implementation of the solution design, PostNL should pursue the predefined change plan as described in chapter five. As mentioned in the change plan, PostNL should be aware of the major alternations to its current NPD process, evaluation process, and collaboration structure. These alternations are expected to create resistance on individual, group, functional, and organisational level. In order to intervene with these resistances, the eight-step change approach from Kotter (1996) and the Tichy’s Technical Political Cultural framework are incorporated. Furthermore, a change organisation has been determined in order to manage smooth transitions of the major business process alternations. Finally, a communication strategy has been determined for PostNL in order to effectively communicate the change process to the stakeholders.

6.2. Theoretical Contribution

Although innovation and NPD are very important for an organisations’ survival, existing literature is still limited on the subject of FFE and its evaluation process for establishes organisations. This research contributes to the existing literature in two ways. Firstly, by discussing the FFE phase of the NPD process for established organisations, therefore providing further insights on this subject. It explained

that managing the FFE phase of the NPD process is an ongoing battle between systematization and creativity (Verworn & Herstatt, 1999; Aken & Nagel, 2004). To realize a balance between creativity and flexibility on one hand and bureaucracy and structure on the other, a two phase FFE model was introduced which consists of a product idea phase and a concept evaluation phase. Secondly, a framework for how to deal with the evaluation process during the FFE phase of the NPD process was provided. A different design of the evaluation process was proposed: it makes use of two gates and required criteria. In addition, a management structure was designed to successfully support this evaluation process.

As argued by Khurana and Rosenthal (1997), failures during the FFE phase occur because organisations often fail in specifying their product strategy, product and project definition, and distribution of responsibilities. Especially, they lack a good framework for evaluation in the FFE phase. The design presented here for PostNL contributes in (re-)structuring the evaluation process by explaining which factors to focus on at which point, where uncertainties lie and how to manage them during the evaluation process in the FFE phase. Furthermore, the contribution of this research to the existing literature is not to find the cause of the current business problem, as this topic has been researched extensively, but rather to combine literature and fieldwork to improve the framework, which in turn extends the literature with a practical implementation.

6.3. Managerial Recommendations

Managers within large established organisations, which aim at improving their FFE phase effectivity for consumer products and services, are advised to design their FFE phase of the NPD process based on the science-based design principles provided in this research. Managers are recommended to assess the differences between their current FFE phase and the design principles provided in this research in order to improve the FFE phase. Or to use the designed assessment templates when evaluating the concept generation and concept evaluation stage of the FFE phase. By implementing the research findings, managers of the FFE phase could achieve an evaluation process which is more rational due to its predefined sets of assessment criteria and the method used to assess the projects.

The findings of this research will help managers of established organisations with improving the evaluation process in the FFE phase. Especially, the selection procedure of new product ideas for '*really new innovations*'. The usefulness of a scoring model evaluation for managers lies in the fact that they can now easily compare multiple new product ideas, and quantify qualitative data in a set out way, in order to select the best idea at hand. Furthermore, insights into the possible distribution of roles and responsibilities gives the manager information on how to assemble a proper evaluation team, to improve the effectivity of the evaluation process.

6.4. Limitations and Further Research

Although the proposed design is expected to contribute to the way established organisations shape their evaluation process in the FFE phase, this research also has some limitations.

A first important limitation of this research is that the design and its scorecards have only been tested by a selection of PostNL's senior management and the researcher, and not yet been used for any actual project's evaluation. Therefore, design's functioning requires further testing through execution of all the FFE stages with actual projects. The results of this execution should then be compared to the actual results of the established projects. In case of significant differences, it should be examined what sources might have caused the differences in outcome and if the design should have predicted the differences. If the design could have foreseen the differences, then it should be questioned whether this flaw is due to the functioning of the design. A source of ineffective functioning could be its usability and purpose, inappropriate content, or the combination of both. Usability and purpose issues can be

managed by including more stakeholders and further customization of the design. As mentioned before, PostNL's senior management has been involved in defining the content of the design, by collaborating with external experts, content issues could be further reduced.

Although this research provides established organisations with insights on the evaluation process in the FFE phase of the NPD process based on an extensive literature study, empirical research should establish whether identified science-based design principles improve an organisation's performance for other organisation than just PostNL alone. Furthermore, further research into the FFE phase should determine which development methods best fit this phase. These insights could help organisations in selecting the most appropriate development approach for a successful FFE phase execution.

As for the designed evaluation process, the assessment scorecards require further development and testing. The assessment criteria need to be calibrated by running actual projects through the design and assessing to what degree predicted outcomes beforehand match the actual outcomes. Moreover, a distinction may be made between must-meet and should-meet criteria, and between objective and subjective measures. Doing this has the intention of focusing the design even further in the right direction of carrying out a successful NPD process.

Finally, further research into the product- versus the service development FFE phase can provide information on if the FFE phase should be designed differently for both development processes. Although the FFE phase for products and for services are highly similar, the characteristics of products versus services differ, which might indicate a further diversification in the development process of products and of services.

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