MASTER

Proactivity engineering successful new products at COMPANY X to counteract commoditized markets

Verhoeven, D.G.

Award date:
2013
Proactively engineering successful new products at COMPANY X to counteract commoditized markets

by

Danny Verhoeven

BSc Industrial Engineering and Management Science — TU/e 2010
Student identity number 0640169

in partial fulfilment of the requirements for the degree of

Master of Science
in Innovation Management

Supervisors:
dr. J.A. Keizer, TU/e, ITEM
dr. ing. J.P.M. Wouters, TU/e, ITEM
dr. ir. L. Kurelec, COMPANY X Europe B.V.
dr. M. Scholle, COMPANY X Europe B.V.
Abstract

This research is aimed at developing a design to proactively counteract commoditized markets by developing new and successful products. A highly commoditized market is characterized by low product margins and non-sustainable customer loyalty. COMPANY X is selling its polymers on these kind of markets and therefore the outcome of this research is a specific design to improve COMPANY X’s new product success with an emphasis on counteracting the commoditization.

The research starts with an explanation of the commodity concept, followed by an identification of design criteria to counteract commoditization and design criteria to enhance the success rate of new product introductions from both literature and practice. All the acquired design criteria are aggregated in a design to enlarge the rate of successful product introductions at COMPANY X.
Management summary
This master thesis is executed at COMPANY X Europe B.V. (COMPANY X), located in Sittard. COMPANY X is an organization in the petrochemical sector. The scope of this research is within the polymers strategic business unit (SBU) of COMPANY X. This SBU is responsible for the product-related business units (BU’s): HDPE, LD/LLDPE, and PP. Each BU focuses on the total product management of the products that belong to their product-related BU.

Problem statement
Based on interviews held with relevant employees at COMPANY X and information sources within COMPANY X the main problem of the polymers SBU is that the products that they manage via the BU’s are mostly sold on highly commoditized markets. A commoditized market is one that competes primarily on the basis of price, characterized by low margins and low customer loyalty, which makes it very difficult to build a sustainable business (Hax, 2005). There is an indication that the polymers SBU is more than on average successful with new product introductions that counteract this commoditization, an action which may result in a higher margin rate for those new products.

The organization would like to get a better understanding whether and how to proactively steer the engineering of new products which are capable of counteracting commoditization. Therefore, COMPANY X is searching for a design to more successfully engineer this kind of new products. Based on this determination, the following main research question has been defined:

*How can COMPANY X proactively counteract commoditization by means of a high-quality NPD process?*

This main research question is answered in three consecutive steps. First, the design criteria from literature about counteracting commoditization and a high-quality NPD process are identified. Second, the design criteria from practice are identified by investigating a number of COMPANY X’s recent product introductions. Third, the acquired design criteria from literature and practice are combined into a single design to answer the main research question.

Design criteria from literature
The design criteria from literature are resolved from three different fields of theory. The first field are market opportunities, since according to D’Aveni (2010) this is one root of counteracting commoditization. The second field are disruptive innovations, since according to D’Aveni (2010) this is the other root of counteracting commoditization. The third field is the NPD process, since in highly competitive commodity markets it is not enough to only focus on what kind of new products an organization needs to develop to counteract commoditization, this focus should also result in a constant stream of high quality, successful new products (Jenkins, Forbes, Durrani, & Banerjee, 1997).

Investigating the theory about anticipating on market opportunities resulted in two categories of design criteria. First, COMPANY X should extensively map its competitive environment beyond traditional market boundaries with a focus on monitoring the movement and likelihood of attack
and response of the competitors. Based on this map of competition, COMPANY X can order the competitive environment in terms of threats and opportunities (Bergen & Peteraf, 2002). Second, COMPANY X should identify the signs of corporate failure from competitors and should communicate these signs to that competitors’ customers in order to capture market share by making use of the perceived supplier risk of that customers (Cortés, Martínez, & Rubio, 2007).

Investigating the theory about designing disruptive innovations resulted in three categories of design criteria. First, a combination of methods should be used to gather the right information from current and potential customers for creating a disruptive innovation. These methods are: the umbrella method, emphatic design, and conjoint analysis (Reinhardt & Gurtner, 2011). Second, after an initial idea for a disruptive product a few analyses should be conducted to confirm the disruptiveness of the product. These analyses are: confirming the ‘gap’ left by an incumbent product, confirming a high maturity level of the incumbent product, confirming a high rate of technology adoption of a mainstream market, and making an assessment of the utilities between the disruptive innovation and the incumbent product (Ganguly, Nilchiani, & Farr, 2010; Hang, Chen, & Yu, 2011). Third, after the development of the disruptive innovation the communication of the relative advantages of the disruptive innovation should be aimed at innovators and early adopters (Sandberg, 2002).

Investigating the theory about installing a high-quality NPD process resulted in four categories of design criteria. First, the NPD process should be conducted by a dedicated, cross-functional team which involves a strong champion (Kandemir, Calantone, & Garcia, 2006). Second, the NPD process should be complete and at least include a focus on up-front homework resulting in a business case with a sharp product definition, strong go/kill points, and a constant focus on quality (Cooper & Kleinschmidt, 2007). Third, testing should be a substantial phase in the NPD process. Examples of successful testing methods are: in-house testing, prototype testing, and pilot production of the product (Haverila & Ashill, 2011; Kandemir et al., 2006). Fourth, each new product should be aligned in a well-defined portfolio with a long term view (Cooper & Kleinschmidt, 2007).

Design criteria from practice
The design criteria from practice were derived by conducting interviews with employees associated with the past product introductions at COMPANY X which were ranked either high or low in terms of new product success (NPS). COMPANY X did introduce products on both the commodity market (by acting on market opportunities) and the specialties market (by acting on disruptive innovations). Both types of introductions did result in successful and unsuccessful product introductions. Therefore, the conclusion is that none of the two types led exclusively to a successful product introduction at COMPANY X and, as argued by Singh (2001) and Milmo (2003), COMPANY X should introduce products on both the commodity and specialties market.

The interviews resolved five categories of design criteria to enlarge NPS at COMPANY X. First, COMPANY X needs to make sure to have sufficient resources in the form of money, manpower, and knowledge dedicated to the project. Second, before entering a certain market a thorough market analysis should be performed with a focus on the size of the market (segment), the risk of an oligopoly market setting, and the degree of segmentation in the market. Third, COMPANY X should proactively search for possibilities to cooperate with large potential customers to develop a new product, these potential customers to cooperate with can possibly be attracted by actively making use of the perceived supplier risk of that customer. Fourth, the sales process of the new product
should be a combined effort of technology marketing (TM) and sales, focussing on achieving a high margin by giving the customer an overall cost reduction by using the new product. Fifth, during the NPD process COMPANY X should proactively search for possibilities to be the first to market with a certain product feature and should try to protect that feature from use by the competition.

**Design**

The design, based on the total set of design criteria, visualizes how to counteract commoditization with a new product in order to enlarge the total base of successful product introductions at COMPANY X’s polymers SBU. The design is depicted in Figure I.

![Figure I: Design to proactively steer the development of successful products](image)

The design starts with the ideation phase. During this phase, two streams of new product ideas should be investigated and scoped: ideas based on market opportunities on the commodity market (with a strong emphasis on replacing competitors, and combined development with customers), and ideas based on disruptive innovations which create a specialties market (with an emphasis on latent needs). Those new product ideas are further shaped and rated by means of one or more screens and the targeted support of T&I developments. The new product ideas that pass all screens are transformed into business cases. The ideation phase ends with an initial internal check. During this check by COMPANY X’s polymers SBU top management, the business cases are controlled for their viability based on COMPANY X’s past knowledge about successful introductions and theoretical guidelines. Moreover, this is the point in time at which the SBU top management has to decide to which kind of NPD project the idea belongs and whether there are sufficient resources left for that kind of projects in the project portfolio of NPD projects.
After approval at the initial internal check and before the development phase for the NPD project starts, a cross-functional NPD team needs to be constructed to carry out the NPD project. This team should at least include representatives from the BU, TM, sales, and T&I departments at COMPANY X. During the development phase and the follow-up continuous innovation phase, the cross-functional team should remain together and dedicated to the new product that follows out of the NPD project. After the release of the new product, the selling of the product should be conducted as a combined effort from TM and sales in a combined sales team.

Conclusion and recommendations
The conclusion is that it is possible to proactively steer the engineering of successful products by focusing on counteracting commoditization by means of a high-quality NPD process. A focus on counteracting commoditization can be achieved by focusing on introducing new products on both the commodity and specialties market. New products for the commodity market should act on market opportunities, such as replacing a competitor and co-developing with potential customers. New products for the specialties market should solve a latent need by creating a disruptive innovation. A high-quality NPD process is characterized by NPD projects following a stage-gate process conducted by a cross-functional NPD team. The NPD projects should be part of a project portfolio which is monitored by top management.

The recommendations for COMPANY X are built around the most important changes imposed by the new design, and include: another structure of the NPD process, a focus on possibilities for market disruption in the front-end of the NPD process, a focus on portfolio management, a focus on the sales approach and continuous innovation in the back-end of the NPD process.

Limitations and further research
Limitations of this research include the restricted selection of scientific articles to base to design criteria from literature on and the restricted selection of COMPANY X’s past product introductions to investigate for design criteria from practice, due to the limited time available for this research. Another limitation is that the newly developed design is not implemented nor scientifically tested in its combined form.

Therefore, the first direction for further research will be to test the design after implementation at COMPANY X. The hypothesized result will be a higher number of successful new product introductions. A second direction for further research will be to test the design in other organizations that operate in highly commoditized markets to identify whether the design is generally applicable outside of the polymer market.
Preface
This report is a result of the master thesis project I have executed at COMPANY X Europe B.V., located in Sittard. This thesis report represents the end of my master in Innovation Management, and, moreover, the end of a 5,5-year study period in Industrial Engineering and Management Sciences at Eindhoven University of Technology. A period which I have experienced as a rather pleasant one.

First of all I would like to thank my primary university supervisor Jimme Keizer. During the last one and a half year he provided me with input, feedback, and discussion during this master thesis project and the preliminary activities. Moreover, I would like to thank my second supervisor at the TU/e Joost Wouters for his critical reflection on my report which resulted in an enhanced final version of the report.

Also, I would like to thank my two supervisors at COMPANY X Europe B.V.: Mario Scholle and Lada Kurelec for their support and reflection during the master thesis internship, and the time and energy they spend on guiding me during this project. My thanks also go to Marie-Jose Habets for the support she gave me in finding my way at COMPANY X. Also, I would like to thank all other colleagues at COMPANY X Europe B.V. for the good working atmosphere and the nice time during my 5-months stay in Sittard.

Finally, I would like to thank my family and friends for their support during my study and graduation project. Without their companionship it would have been five lonely months.

Danny Verhoeven
February 2013
List of abbreviations

BD.................................................................Business Director
BM.............................................................Business Manager
BU..................................................................Business Unit
HDPE..............................................................High-density Polyethylene
IBC................................................................Intermediate Bulk Container
LD/LLDPE......................................................Low-density/Linear Low-density Polyethylene
MMT................................................................Million Metric Tons
NPD................................................................New Product Development
NPI.................................................................New Product Introduction
NPS................................................................New Product Success
PP..................................................................Polypropylene
SBU................................................................Strategic Business Unit
T&I....................................................................Technology and Innovation
TAC....................................................................Technical Application Centre
TM....................................................................Technical Marketing
VT....................................................................Value Team
List of figures

Figure 1: Simplified organizational chart COMPANY X Europe ................................................................. 2
Figure 2: Regulative cycle (Van Strien, 1997) ............................................................................................ 5
Figure 3: A general model for a design process (Van Aken et al., 2007) ...................................................... 5
Figure 4: A framework for competitor identification (Bergen & Peteraf, 2002) ........................................... 9
Figure 5: A framework for competitor analysis (Bergen & Peteraf, 2002) ..................................................... 10
Figure 6: Disruptive innovation as an opportunity for growth (Gilbert, 2003) ............................................... 12
Figure 7: Results of the assessment of the customer analysis methods (Reinhardt & Gurtner, 2011) ............ 13
Figure 8: The technology S-curve (Ganguly et al., 2010) .......................................................................... 14
Figure 9: The assessment framework for disruptive innovation (Hang et al., 2011) ...................................... 15
Figure 10: An overview of a stage-gate process (Cooper, 1990) ................................................................. 19
Figure 11: Different perspectives TM and T&I ............................................................................................ 21
Figure 12: New product matrix .................................................................................................................. 47
Figure 13: Design to proactively steer the development of successful products ........................................ 77
Figure 14: Overview of the ideation and development phase of the design ............................................... 78
List of tables
Table 1: Overview of used research methods ................................................................. 6
Table 2: Classification of COMPANY X’s stage-gate processes .................................... 22
Table 3: Interview list of past product introductions ..................................................... 23
Table 4: Design criteria from literature ........................................................................ 44
Table 5: NPS categorization and main drivers .............................................................. 73
Table 6: Design criteria from practice .......................................................................... 74
Table 7: Aggregation of the design criteria per phase ................................................... 75
# Table of Contents

Abstract.......................................................................................................................... III
Management summary..................................................................................................... IV
  Problem statement ........................................................................................................ IV
  Design criteria from literature ...................................................................................... IV
  Design criteria from practice ....................................................................................... V
  The design .................................................................................................................... VI
Conclusion and recommendations .................................................................................. VII
Limitations and further research .................................................................................... VII
Preface ............................................................................................................................ VIII
List of abbreviations......................................................................................................... IX
List of figures ................................................................................................................... X
List of tables .................................................................................................................... XI

1 Introduction .................................................................................................................. 1
  1.1 Description of the organization ............................................................................ 1
  1.2 Problem description ............................................................................................ 2
  1.3 Aim of the research ............................................................................................. 3
  1.4 Research questions ............................................................................................. 3

2 Method ......................................................................................................................... 5
  2.1 Scope of the research ........................................................................................... 5
  2.2 Overview of the design process ............................................................................ 5

3 Design criteria from literature ..................................................................................... 7
  3.1 Theoretical background ....................................................................................... 7
    3.1.1 Counteracting commoditization ..................................................................... 7
    3.1.2 High-quality NPD process ........................................................................... 8
  3.2 Functional requirements of market opportunities .................................................. 8
    3.2.1 Market opportunities ................................................................................... 8
    3.2.2 Functional requirements ............................................................................ 8
  3.3 Functional requirements of disruptive innovations ............................................... 11
    3.3.1 Disruptive innovations ................................................................................. 11
    3.3.2 Functional requirements ............................................................................ 12
  3.4 Functional requirements of the NPD process ......................................................... 16
    3.4.1 NPD process ............................................................................................... 16
    3.4.2 Functional requirements ............................................................................ 17

XII
1 Introduction

This introductory chapter will start with a description of COMPANY X, the organization in which this research is based. After the organizational description, the problem that the organization faces is described in section 1.2. Followed by a determination of the aim of this research in section 1.3. This chapter concludes with section 1.4 in which multiple research questions are proposed, based on the aim of the research.

1.1 Description of the organization

COMPANY X is an organization active in the petrochemical sector and created in 1976 by royal decree of the king of Saudi Arabia in order to efficiently use the by-products of oil extraction to produce value-added commodities, such as chemicals, polymers, and fertilizers – for export. This export would help Saudi Arabia to develop and diversify their economy. During the 1980s COMPANY X started growing and expanding at a very high rate, from a total production of 6.3 million metric tons (MMT) in 1985 to a forecasted total production of 69 MMT by the end of 2012 and a net profit of 7.80 billion US Dollar in 2011 with a workforce of over 40,000 employees. Also during that period, in 2002, COMPANY X acquired DSM’s petrochemicals business to provide itself with a strong entry position in the European market and a springboard for the ambition to become a market leader worldwide.

The simplified organizational chart in Figure 1 shows all the relevant information in order to clarify the scope of this research. The scope of this research is within the once purchased European polymers strategic business unit (SBU) of COMPANY X. Below, the different product-related business units (BU’s) within the polymers SBU are described with an emphasis on the different product groups that they are responsible for.

**HDPE**

HDPE stands for high-density polyethylene and this polymer has a closely packed structure with a high density, which can withstand rather high temperatures up to 120° Celsius. This material can be modified by the use of multiple manufacturing processes; with each process leading to a different result. The most used manufacturing processes are: blow moulding, injection moulding, and pipe extrusion. Blow moulding is used for the production of bottles, jerry cans, drums, IBC’s, and sheets. The injection moulding process is mainly used for the production of crates, dustbins, and caps. Pipe extrusion is a manufacturing process used to produce all kinds of pipes.

**LD/LLDPE**

LD/LLDPE stands for low-density and linear low-density polyethylene. This polymer has a much lower density than the HDPE polymer and it is made in translucent or opaque variations. It is quite flexible, and tough but breakable. LD/LLDPE is mainly used for the production of plastic bags, film packaging, and plastic wraps.

**PP**

PP stands for polypropylene and that material has an intermediate level of crystallinity between that of LDPE and HDPE. Polypropylene is normally tough and flexible, especially when copolymerized with
ethylene, and can withstand rather high temperatures. This allows polypropylene to be used as an engineering plastic. Applications of PP reach from the production of furniture to packaging.

As can be seen in Figure 1, COMPANY X is highly functionally structured. The employees within the functional departments of the organization tend to perform a specialised set of tasks. For instance, the sales offices are staffed only with salespeople who sell the products to customers and the technology and innovation (T&I) department is only staffed with researchers who are concerned with research activities within COMPANY X.

The different BU’s form an exception on this functional structure, since they are built around a specific product group and are operating in a divisional structure. The HDPE BU, for instance, is responsible for all the products that are produced with the HDPE polymer and is separated into uni-modal and bi-modal HDPE. This BU is headed by a business director (BD). The BD is hierarchical responsible for two business managers (BM’s), one for uni-modal and one for bi-modal HDPE, who are responsible for a product-market asset combination related to the product group, and for a manager technical marketing (TM). TM is responsible for identifying and translating market needs into development of new applications and products, conducting promotional activities, and delivering technical service and process support to customers in cooperation with the sales department.

Figure 1: Simplified organizational chart COMPANY X Europe

1.2 Problem description

All the product-related BU’s of the polymers SBU, are operating on the European market for polymers. This market is under great pressure due to the European debt crisis, slowing emerging
market growth, and increased competition\(^1\). The polymer market is mainly characterized by very large volume products, with price as the major buy criterion for customers (Singh, 2001). This last determination leads to the conclusion that the polymer market is highly commoditized. A commoditized market is one that competes primarily on the basis of price and in the long run it is very difficult to build a sustainable business on low margins and low customer loyalty (Hax, 2005).

In an attempt to build a more sustainable business, COMPANY X is introducing new products. But this new product development (NPD) does not always deliver the success that was hoped for. Based on recent product introductions, there is an indication that the polymers SBU is mainly successful with new products that are counteracting the commoditization. This counteracting of commoditization can be achieved in two ways: by selecting the threats on the commoditized market or by outflanking the threats on the commoditized market (D’Aveni 2010). Selecting the threats is achieved by scanning for and proactively acting on market opportunities on the commoditized market and outflanking the threats is achieved by introducing disruptive innovations outside of the commoditized market. Market opportunities are events that occur in the commoditized market that are providing chances for an organization to sustainably capture competitors’ market share (Fahey, 1999), and disruptive innovations are new products that will define their own specialties market, outside the commodity market, with high profit margins and high barriers to entry based on technology (Singh, 2001), eventually able to capture market share from competitors in the commoditized market (Govindarajan, Kopalle, & Danneels, 2011).

Recently, COMPANY X has started a major project in order to redefine their future strategy and a substantial part of this project focuses on the question whether COMPANY X is capable of serving both commoditized and specialties markets. Also part of this major project is the search for a high-quality NPD process resulting in a higher rate of new product success (NPS).

1.3 Aim of the research

The aim of this research is to develop a design for COMPANY X to give the organization a better understanding whether and how to proactively steer the engineering of products introductions via a high-quality NPD process with an emphasis on counteracting the commoditized markets on which COMPANY X is mainly operating. Motivated by COMPANY X’s major project, this design should also provide insights about the possibilities to serve both commodity and specialties markets and how the development of disruptive innovations should be incorporated within COMPANY X.

1.4 Research questions

Based on the aim of the research, the main research question is formulated. In order to adequately answer this main research question, it is fragmented into multiple research questions.

**Main research question:** How can COMPANY X proactively counteract commoditization by means of a high-quality NPD process?

\(^1\) Global polymers to face heightened competition. (http://www.icis.com/Articles/2012/03/26/9544287/global-polymers-to-face-heightened-competition.html)
In order to answer the main research question it is important to explore the functional requirements of counteracting commoditization and the functional requirements of installing a high-quality NPD process, both from a theoretical perspective. These sets of functional requirement should be used to identify the design criteria from literature for the final design.

Research question (a): What are the design criteria from literature of counteracting commoditization and of installing a high-quality NPD process?

The current situation related to NPD at COMPANY X will be explored by a critical analysis of the past performance of that NPD process. This analysis will be used to explore functional requirements which can be used to identify design criteria from practice for the final design.

Research question (b): What is the current process and performance of COMPANY X related to NPD and what are the design criteria from practice following from the past performance in NPD?

When the design criteria of counteracting commoditization and developing successful new products via a high-quality NPD process have been found in both theory and practice, research question (c) will lead to a final design which will be the core input for answering the main research question.

Research question (c): How can both groups of design criteria be combined into a (theoretically grounded) design to engineer successful new product introductions which counteract commoditization?
2 Method
This chapter starts with determining the scope of this research in section 2.1, followed by a detailed explanation of the steps and associated methods to come to the final design section 2.2.

2.1 Scope of the research
This research is constructive, since the described problem needs a newly constructed design as a solution to counteract commoditized markets via a high-quality NPD process which delivers successful products. Therefore, this research follows the logic of the problem-solving cycle in the form of the regulative cycle as proposed by Van Strien (1997). This regulative cycle is displayed in Figure 2.

![Figure 2: Regulative cycle (Van Strien, 1997)]

The scope of this research is within the design part of the regulative cycle, this part covers the problem definition phase, the analysis and diagnosis phase, and the plan of action phase of Figure 2 (Van Aken et al., 2007). The intervention phase of the regulative cycle, in which the actual implementation of the design takes place, and the evaluation phase of the regulative cycle, in which the organization learns to operate within the new design, are outside the scope of this research due to time constraints. A generalization of the design part of the regulative cycle in the form of a design process is given in Figure 3. In the next section, the design process is described in more detail.

![Figure 3: A general model for a design process (Van Aken et al., 2007)]

2.2 Overview of the design process
An overview of all the used research methods per process step and the corresponding sections can be found in Table 1. The first process step of the model by Van Aken et al. (2007) is the problem analysis. The problem is analyzed via a literature study and has two focus areas: counteracting commoditization and a high-quality NPD process. First, the focus is on the theoretical background of commoditized markets and the two possibilities to counteract commoditization: market
opportunities and disruptive innovation (D’Aveni, 2010). Thereafter, the focus is on the theoretical background of having a high-quality NPD process.

Table 1: Overview of used research methods

<table>
<thead>
<tr>
<th>Process step</th>
<th>Method</th>
<th>Description</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem analysis</td>
<td>1</td>
<td>Literature study</td>
<td>3.1</td>
</tr>
<tr>
<td>Developing specifications</td>
<td>2a</td>
<td>Literature study</td>
<td>3.2/3.3/3.4</td>
</tr>
<tr>
<td></td>
<td>2b</td>
<td>Desk research</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>2c</td>
<td>Semi-structured interviews</td>
<td>4.1/4.2</td>
</tr>
<tr>
<td>Sketching</td>
<td>3</td>
<td>Integrative approach</td>
<td>3.5/4.3</td>
</tr>
<tr>
<td>Outline design</td>
<td>4</td>
<td>Integrative approach</td>
<td>5.1</td>
</tr>
<tr>
<td>Detailing</td>
<td>5a</td>
<td>Literature study</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>5b</td>
<td>Discussion sessions</td>
<td>5.2</td>
</tr>
<tr>
<td>Design</td>
<td>6</td>
<td>Integrative approach</td>
<td>5.2</td>
</tr>
</tbody>
</table>

The second process step is the developing of specifications for the design by an exploration of functional requirements from theory and practice. The set of functional requirements from theory is developed in section 3.2, 3.3, and 3.4, by a literature study concerning the focus areas identified during the problem analysis. This is related to the answering of research question (a). The set of functional requirements from practice is developed by looking at the current NPD process at COMPANY X in section 4.1 and the performance of this process in section 4.2. This is related to the answering of research question (b). The current NPD process is mapped by a combination of desk research and semi-structured interviews with employees who are knowledgeable about that process. The performance of the current NPD process is measured by conducting semi-structured interview with multiple employees associated with a number of recent product introductions.

Both the functional requirements from literature and from practice are transformed into design criteria during the third process step: sketching. This is an integrative approach leading to two sets of design criteria: those from literature in section 3.5 and those from COMPANY X’s practice in section 4.3.

The fourth process step is the outline design. The outline design is a formal design containing all the design decisions with respect to the key dilemmas (Van Aken et al., 2007). This formal design is acquired via an integrative approach in which the two sets of design criteria are combined into one set of decisions which shape the final design in section 5.1. This is related to the answering of research question (c). During the detailing process step, the set of decisions is further shaped by iterations following from an oriented literature study and a discussion session with relevant employees from COMPANY X. The final process step is the delivering of the design. This design is acquired by an integrative approach which involves the newly found literature and remarks from COMPANY X employees into a description of the final design of this research in section 5.2. The final design is used to answer the main research question.
3 Design criteria from literature
This chapter starts with an overview of the theoretical background related to the aim of this research in section 3.1. The theoretical background will resolve three focus areas: market opportunities, disruptive innovations, and a high-quality NPD process. Functional requirements relating to these areas are given in section 3.2, 3.3, and 3.4. The last section of this chapter will integrate the identified functional requirements into an overview of design criteria from literature. These design criteria will form the input for the design in chapter 5.

3.1 Theoretical background
In this section, the theoretical backgrounds related to the aim of this research are given: counteracting commoditization in section 3.1.1 and installing a high-quality NPD process in section 3.1.2.

3.1.1 Counteracting commoditization
In 1994, Richard D’Aveni introduced the concept of hypercompetition; a market with a lot of very strong competition between organizations. In this situation, competitive advantages are brief and rapidly lost, industry boundaries are constantly breached, and customer loyalty is capricious. Hypercompetition is an ever present threat for organizations (McNamara, Vaaler, & Devers, 2003). In hypercompetitive markets, sustainable competitive advantages are replaced by a series of temporary and unsustainable advantages (Williams, 1992). These unsustainable advantages are mostly acquired by bringing products to the market with minor adjustments compared to the existing products from competitors. As competitors produce products that overlap with each other, brands blur and competition intensifies. Consequently, competitors must reduce price to hold onto market share, or lose market share to hold onto their price. Ultimately, this leads to commoditization (D’Aveni, 2010). A commoditized market is one that competes primarily on the basis of price and in the long run it is very difficult to build a sustainable business on low margins and low customer loyalty (Hax, 2005).

Because of the negative effects of commoditization as mentioned above, it is important to counteract this commoditization. D’Aveni (2010) proposes three primary ways to do this: select the threats, overwhelm the threats, and outflank the threats. The option to overwhelm the threats is only used when selecting or outflanking of threats is impossible. Overwhelming the threats includes directly attacking the competitors in the commoditized market. This is a costly course of action and the risk is that a price war is started with this behaviour, resulting in even lower product margins. Therefore, for the remainder of this research, the focus is on the selecting of the threats and the outflanking of the threats as two roots to counteract commoditization.

Selecting the threats is a course of action whereby an organization selects certain commodity markets to focus on (D’Aveni, 2010). The selected commodity markets should be positions on the price-benefit map with relatively low competitive intensity or positions where the organization has certain advantages over rivals. In these markets the organization can profit from market opportunities and try to sustainably raise their market share by acting upon those opportunities. Market opportunities are events that occur in the commoditized market that provide chances for an organization to capture competitors’ market share. In section 3.2 the market opportunity concept is
explained in more detail, followed by the development of functional requirements related to this concept.

Outflanking the threats is a course of action whereby an organization outflanks the competition by finding white space for their products or repositioning their products outside of the commoditized markets (D’Aveni, 2010). This involves disrupting the current set of capabilities and attributes required by a commoditized market by introducing disruptive innovations (Walsh, Kirchhoff, & Newbert, 2002). Disruptive innovations are new products that will define their own specialties market with higher margins and high barriers to enter (Singh, 2001). In section 3.3 the disruptive innovation concept is explained in more detail, followed by the development of functional requirements related to this concept.

3.1.2 High-quality NPD process
Besides the functional requirements related to the two roots of counteracting commoditized markets, it is also important to include functional requirements for a high-quality NPD process into the design. The reason therefore is that the success of a new product introduction is not only dependent on how well the product introduction itself counteracts commoditization. The success of a new product production is also dependent on other features, such as an innovative climate and culture, which should be present at the organizational level by having a high-quality NPD process (Cooper & Kleinschmidt, 2007). In section 3.4 the NPD process concept is explained in more detail, followed by the development of functional requirements related to this concept.

3.2 Functional requirements of market opportunities
This section starts with an explanation of the market opportunities concept in section 3.2.1, followed by an overview of a relevant body of literature concerning market opportunities in section 3.2.2. This body of literature is used to resolve the functional requirements which will form the input of the design criteria relating to market opportunities in section 3.5.

3.2.1 Market opportunities
Market opportunities are situations on a commoditized market that provide chances for an organization to sustainably capture competitors’ market share. In order to profit from market opportunities, it is important that an organization identifies these opportunities in the commoditized market and react upon them. Fahey (1999) mentions this as: outwitting the competitors. Outwitting the competitors occurs when an organization detects, investigates, understands, and anticipates on changes in the marketplace more quickly than its competitors. A very important aspect of this course of action is the analysis of the key competitors in the marketplace, since this information may be a helpful tool in the strategic decisions to outwit a competitor (Fahey, 1999; Lefter & Dima, 2009).

3.2.2 Functional requirements
In order to resolve design criteria to proactively counteract commoditized markets by means of market opportunities, functional requirements to identify market opportunities should be explored. Therefore, the next section presents findings from Bergen & Peteraf (2002), Cortés, Martínez & Rubio (2007), and Siomkos, Triantafillidou, Vassilikopoulou, and Tsiamis (2010). First, the article by Bergen & Peteraf (2002) focuses on the functional requirements to identify market opportunities. Thereafter, the articles by Cortés et al. (2007) and Siomkos et al. (2010) have a focus on functional
requirements to anticipate on an important market opportunity: a corporate crisis associated with a competitor.

Identifying market opportunities

According to Bergen & Peteraf (2002) market threats and opportunities can be identified by comparing competitors’ capabilities to meet market needs. Therefore, they developed a two-stage model which includes a competitor identification, followed by a competitor analysis. The first stage is initiated by making a categorization of competitors based on the framework in Figure 4. In this figure, market commonality is defined as: the degree to which a given competitor overlaps with a new product idea of an organization in terms of customer needs served. Resource similarity is defined as: the extent to which a given competitor possesses comparable strategic endowments of an organization (Bergen & Peteraf, 2002).

![Figure 4: A framework for competitor identification (Bergen & Peteraf, 2002)](image)

By the use of Figure 4, the competitive landscape of a new product idea can be mapped. Direct competitors serve the same market needs with the same types of resources. Potential competitors possess the same types of resources, but currently serve different market needs. Indirect competitors or substitutes serve the same market needs, but with different type of resources. This last group of competitors is the most important to notice, since they are often utilizing new technologies, whose cost are likely to decline due to the learning curve. When that happens they represent a major market threat for the new product idea (Bergen & Peteraf, 2002). Ultimately, the first stage of the Bergen & Peteraf (2002) framework can be used to view competition dynamically and track competitors’ movements over time. In order to also identify the competitors who represent the strongest market threat to a new product idea and the competitors which are representing market opportunities for an organization with a new product idea, the second stage of the Bergen & Peteraf (2002) two-stage model is used.

In the second stage of their model, Bergen & Peteraf (2002) introduce the resource equivalence concept: the extent to which a given competitor possesses strategic endowments within that organization, capable of satisfying the same customer needs as the strategic endowments of the organization with a new product idea. The concept of resource equivalence is applied to the different types of competitors identified during the first stage of the model. This results in the framework for competitor analysis given in Figure 5. Bergen & Peteraf (2002) gave two important premises about the framework in Figure 5. First, it is important to notice is that the degree of competitive balance between an existing product and a new product idea is directly proportional to
the resource equivalence between the associated organizations. Another important premise is that
the awareness of a focal organization about its competitors decreases as we move from the class of
direct competitors to the class of indirect competitors.

![Figure 5: A framework for competitor analysis (Bergen & Peteraf, 2002)](image)

The two-stage model from Bergen & Peteraf (2002) is helpful to in providing functional requirements
for three reasons. First, the first stage of the framework provides organizations with a method to
survey the competitive environment beyond traditional product market boundaries. Second, the
first stage of the framework can be used to provide a dynamic outlook on how the competitive
situation for the new product idea is changing, by monitoring the movements of competitors to new
positions. Third, the second stage of the framework has predictive power regarding the likelihood of
competitive attack and response, and can be used to order the competitive environment of the new
product idea in terms of market threats and opportunities. Following the reasoning of Bergen &
Peteraf (2002), under the situation of equivalent resources between organizations, the greatest
market threats for the new product idea are among the indirect competitors. Under the situation
that an organization is the holder of resources that are less capable of meeting market needs than
its competitors, the greatest market threats for the new product idea are among the direct
competitors. But, in case that an organization has resources that are better capable of meeting
market needs than its competitors, the greatest opportunities to capture market share from
competitors with a new product idea are also among the direct competitors. If this situation
emerges, the organization should start the development of that new product idea and should start
raising awareness of that product’s future presence. The most important example of such a superior
position in terms of organizational resources is in case of a corporate crisis associated with a
competitor.

**Anticipating on a corporate crisis of a competitor**

According to Siomkos et al. (2010), in a corporate crisis, subjective perceptions of danger and risk
seem to guide customer behaviour. Customers that are facing dangerous situations tend to be risk
averse and try to decrease the degree of danger in their minds. This degree of danger does mainly
relate to the supply risk that customers perceive caused by a corporate crisis of their supplier. When
a corporate crisis occurs at a competitor, this brings opportunities for other organizations to develop
new products to replace a product from that competitor. During a corporate crisis of their supplier,
customers will be more apt to buy a similar product from another supplier as a risk aversive action
(Siomkos et al., 2010). Therefore, predicting corporate crisis is an important functional requirement
to anticipate on market opportunities. The main goal of predicting corporate crisis is to differentiate between those competitors with high probability of distress in the future and healthy competitors (Cortés et al., 2007).

Cortés et al. (2007) did an attempt to develop a model to predict a corporate crisis. Their model is based on the differences between financial ratios of failed organizations and those of non-failed organizations. This method is known as the Z-score model (Uebergang, 2006). In the Z-score model a number of financial ratios is assigned a weight and summed together to produce a Z-score. Based on the Z-score, an organization can be categorized in terms of financial health. Below a certain Z-score organizations are considered to be certain to fail. Research from Appiah & Abor (2009) confirmed the high prediction value of the Z-score model. It predicted bankruptcy correctly in 97.3 per cent of the cases. The model developed by Cortés et al. (2007) showed that the most relevant ratios are indebtedness and profitability. When organizations are predicting a corporate crisis, with an emphasis on the indebtedness and profitability of a competitor, they may be able to proactively capture market share by taking advantage of the high chances of corporate crisis of a competitor and the supply risk that their customers associate with buying that competitor’s product.

3.3 Functional requirements of disruptive innovations
This section starts with an explanation of the disruptive innovations concept in section 3.3.1, followed by an overview of a relevant body of literature concerning disruptive innovations in section 3.3.2. This body of literature is used to resolve the functional requirements which will form the input of the design criteria relating to disruptive innovations in section 3.5.

3.3.1 Disruptive innovations
A new product idea can either sustain the current set of manufacturing practices and technological capabilities required by a market, or alternatively, can disrupt the current set of capabilities and attributes required by a given market (Walsh et al, 2002). The later product idea is an example of a disruptive innovation. Govindarajan & Kopalle (2006) identified two types of disruptive innovations: low-end disruption and high-end disruption.

Low-end disruptive innovations attract the more price sensitive mainstream market by offering a lower priced product by sacrificing performance on the traditional attributes. Examples of low-end disruptions are steel mini-mills, discount retailing, and Korean car manufacturers in North America (Reinhardt & Gurtner, 2011). On the other hand, high-end disruptive innovations attract a new customer segment by offering an initially higher priced product with new value propositions and at the same time sacrificing performance on the traditional attributes. Examples of high-end disruptions are Sony’s first portable transistor radio and the first personal computer (Reinhardt & Gurtner, 2011). This means that, according to Govindarajan & Kopalle (2006), disruptive innovations can either focus on serving over served customers from the commoditized market or delivering new value propositions to attract a new customer segment.

Both types of disruptive innovations introduce a different set of performance attributes relative to what already exists, and this set of attributes is usually initially attractive to an emerging segment of customers but unattractive to mainstream customers (Govindarajan et al, 2011). This means that a disruptive innovation in the beginning creates a new, non-competitive specialties market.
independent of the commoditized market (Gilbert, 2003). Subsequently, the new specialties market expands and slows the growth of the established commoditized market. Eventually, the disruptive innovation, having improved greatly over time, will significantly reduce the size of the established commodity market. This process is shown in Figure 6. This figure shows that the disruptive innovation is first originated on a specialties market outside of the established commodity market and will only at a later time capture market share from the established commodity market (the area of displacement in Figure 6).

![Figure 6: Disruptive innovation as an opportunity for growth (Gilbert, 2003)](image)

Attacking the established commodity market is a process that takes time to allow the disruptive innovation to improve in terms of what customers do value in the commoditized market. When the product does meet these customer expectations, the disruptive innovation begins to replace the competitors on the commoditized market as the new market leader (Reinhardt & Gurtner, 2011). Therefore, as confirmed by Yu & Hang (2010), a disruptive innovation might be a powerful tool to broaden and develop markets with new functionality, which may eventually disrupt existing market linkages. This holds for incumbents as well as for start-ups (Gilbert, 2003).

### 3.3.2 Functional requirements

In order to resolve design criteria to proactively counteract commoditized markets by means of disruptive innovations, the functional requirements to identify disruptive innovations, how to evaluate disruptive innovations, and how to create the market for disruptive innovations should be assessed. Therefore, the next section combines models from Kostoff, Boylan & Simons (2004) and Reinhardt & Gurtner (2011) about the identification of disruptive innovations, followed by an explanation of the models from Ganguly, Nilchiani, & Farr (2010) and Hang, Chen, & Yu (2011) about the evaluation of disruptive innovations. The description of these models is followed by a description of the article by Sandberg (2002), which focuses on creating the market for disruptive innovations.

**Identifying disruptive innovations**

Kostoff et al. (2004) propose a model containing functional requirements for the identification of potentially disruptive innovations by a systematic approach. Their model is mainly technology-based and roughly consists of two parts: evaluating and prioritizing candidate technologies and the generation of a systematic process to develop one or more candidate technologies into a proposal for a disruptive innovation.

The first part of the model is to define the problem or opportunity that needs to be addressed by a disruptive innovation (Kostoff et al., 2004). A helpful tool to identify these possibilities for a
disruptive innovation is the Reinhardt & Gurtner (2011) model. This model has a strong emphasis on customer analysis methods, since an essential part of identifying potentially disruptive innovations is gathering the right information on potential and current customers (Reinhardt & Gurtner, 2011). The model should be able to measure four requirements. First, the contextual factors that influence customers, such as environmental impacts and multiple emerging markets. Second, the perspectives on customers’ needs and preferences; they form the basis of the analysis. Third, the constraints; current customers possess saturation levels and potential customers might face barriers to consumption. Fourth, the effects; show the results of the identified constraints.

As can be seen in Figure 7, it turned out that no single customer analysis methods is able to measure all the requirements of the model. Nevertheless, a combination of the umbrella method, emphatic design, and conjoint analysis seems to have the potential to successfully analyze both current and potential customers to identify possibilities for disruptive innovation (Reinhardt & Gurtner, 2011). The umbrella method compares various scenarios with different environmental parameters and their associated user needs and requirements (Noori, Munro, Deszca, & McWilliams, 1999). The environmental parameters are monitored in order to determine which scenario will emerge and, as a consequence, which product features will be most valued by the users. The emphatic design method focuses on observing customers in their natural environment (Leonard & Rayport, 1997). Afterwards, the observation team reflects upon their observations and analyses the results in order to uncover latent needs. The conjoint analysis is a technique that identifies the customers’ preferences and values with regard to certain product attributes (Green, Krieger, & Wind, 2001). When this analysis is conducted multiple times, customer preference shifts may be identified the problem or opportunity that needs to be addressed by a disruptive innovation might be defined.

Once the problem is defined, a literature study and the consulting of associated experts should lead to a prioritization of various clustered potential solutions to the problem. Normally, two broad categories of potential solutions can be identified: one would be technology based, and the other

---

**Figure 7: Results of the assessment of the customer analysis methods (Reinhardt & Gurtner, 2011)**
not technology based. For the second part of their model, Kostoff et al. (2004) have a focus on the technology based solutions.

The second part of the Kostoff et al. (2004) model identifies the technology components of the technology based solutions. This is done in four steps. First, a literature-based discovery is conducted in order to identify critical technology components. The assumption of the literature-based discovery is that innovative solutions to problems can be obtained through literature paths that indirectly relate the problem to the solution (Kostoff et al., 2004). Second, experts of the major technical solutions need to be identified to increase the chances for innovation. Third, those experts need to be involved in workshops. During these workshops, an idea about which advances in multiple disciplines are required to solve the central technology problem should be crafted. Fourth, as a result of the outcomes of the workshops, a four-level roadmap needs to be constructed. This roadmap should consist of nodes about research, development, capability, and requirement, including appropriate links among the nodes. The result of this roadmap should be a potential disruptive innovation (Kostoff et al., 2004).

Evaluating disruptive innovations

The model by Ganguly et al. (2010) has a slightly different approach than the models by Kostoff et al. (2004) and Reinhardt & Gurtner (2011), since it is specifically designed to evaluate a potential disruptive innovation. The model consists of four metrics, both qualitative and quantitative. The first metric is qualitative and measures the comparative target market segment. By analyzing the “gap” in requirements left by a commodity product, the target market for a disruptive innovation can be determined. The outcome of this evaluation depends on to what extent the disruptive innovation targets at a customer segment that is not being satisfied by the commodity product. The second metric is both qualitative and quantitative and measures the maturity level of the commodity product (Ganguly et al., 2010). Although a disruptive innovation usually targets at a different market segment, its long-term success is still depended on the level of maturity of a commodity product. If the commodity product is very mature and has reached a high point in the technology S-curve (see: Figure 8), it has very little room for further improvement and is vulnerable to being displaced by a specialities product which is the result of a disruptive innovation.

![Figure 8: The technology S-curve (Ganguly et al., 2010)](image-url)
The third metric proposed by Ganguly et al. (2010) is both qualitative and quantitative and measures the rate of technology adoption in the commodity market. Because the disruptive innovation will ultimately diffuse through the commodity market and displace the commodity product, the willingness of those customers to adopt a new technology should be evaluated in order to determine the potential disruptiveness of an innovation. A helpful tool to assess the diffusion of the innovation into the mainstream market is the Bass Model of Innovation Diffusion (Bass, 1969). This model states how an innovation might be adopted, based on the interaction between early users and potential users. The fourth metric is quantitative and measures the comparative expected utility (Ganguly et al., 2010). An assessment of the utilities between the disruptive innovation and the commodity product can be an indicator of the disruptiveness of the innovation. The assessment starts with selecting a number of utilities that are crucial for the customers in the decision-making process and their relative importance to each other. Cost should always be considered as one of these utilities; since it serves as a very important component in determining the overall expected utility of any technology. Thereafter, the utility of both the disruptive innovation and the commodity product is measured on a scale of 1-5. If the utility value of the disruptive innovation is greater than that of the commodity product, it signifies the popularity of the disruptive innovation over the commodity product.

Hang et al. (2011) propose a model which has the same purpose as the Ganguly et al. (2010) model, but with a different approach. Hang et al. (2011) developed a systematic and simple framework for assessing the success factors for disruptive innovation which can be found in Figure 9.

The Hang et al. (2011) framework consists of three main parts: market positioning, technology, and other favorable drivers. The market positioning part of the framework should assess the type of market to introduce the disruptive innovation and whether the incumbents on the commodity market will be prepared for a head-on encounter with the disruptive innovation. The technology part of the framework should assess the existence of an overshoot in the commoditized market, the adequateness of the product for a foothold in a certain market, the possibilities for further improvement and the research needed for those improvements. Possibly, there are also other favorable drivers that could influence the pace or faith of the disruptive innovation over time.

An in-depth study of the disruptive innovation is needed in order to fill in the framework in Figure 9 with sufficient confidence (Hang et al., 2011). Once the framework is completed, the following conclusions can be made: if all answers are ‘yes’, the innovation is simultaneously a low-end and a
high-end disruption. If all answers are ‘yes’, with only two ‘no’ being ticked for low-end market, than the innovation is a high-end disruption. If all answers are ‘yes’, with only two ‘no’ being ticked for high-end market, than the innovation is a low-end disruption. If there are any other ticks of ‘no’, there exist doubts about the success of the disruptive innovation.

Both the Hang et al. (2011) and the Ganguly et al. (2010) model are designed to evaluate the potential disruptiveness of an innovation. The Hang et al. (2011) model includes all the metrics of the Ganguly et al. (2010) model in a simple framework, and adds also the assessment of other favorable drivers, such as helpful legislations and life-style changes, to their framework which contains functional requirements for evaluating a disruptive innovation.

Creating the market for disruptive innovations
After the identification and evaluation of possibilities for a disruptive innovation, a disruptive innovation may be launched on the market eventually. In order to make this a commercially successful launch, proactiveness related to the market is required. An article by Sandberg (2002) contains functional requirements about this proactiveness.

The launch stage is of critical importance in creating a successful disruptive innovation (Sandberg, 2002). It is the pre-launch information focusing on the relative advantage and compatibility of the disruptive innovation that has the biggest direct influence on trial and adoption by customers. Communicating the relative advantages seems to work best by positioning the benefits against those of other products. For this purpose, it is common to use opinion leaders and reference sites to make the market aware of, and accept the disruptive innovation.

Innovative adopters are an appropriate target group for disruptive innovations at the launch stage. This group consists of two subgroups: innovators and early adopters. Innovators are genuinely interested in learning about new innovations for their own sake. Early adopters are looking for breakthrough improvements of their current productivity and customer service and exploit the disruptive innovation to achieve a new competitive advantage (Sandberg, 2002). Raising awareness is rather easy among this group of innovative adopters, since they are actively looking for knowledge about new disruptive innovations. This group is usually very willing to participate in conferences and seminars. The education about the disruptive innovation has to emphasize on the technical details for the innovators and on the potential for the early adopters.

3.4 Functional requirements of the NPD process
This section starts with an explanation of the NPD process concept in section 3.4.1, followed by an overview of a relevant body of literature concerning the NPD process in section 3.4.2. This body of literature is used to resolve the functional requirements which will be the input of the design criteria relating to the NPD process in section 3.5.

3.4.1 NPD process
In highly competitive commodity markets it is not enough to only focus on what kind of new products an organization need to develop to counteract commoditization, this focus should also result in a constant stream of high quality, successful new products (Jenkins, Forbes, Durrani, & Banerjee, 1997). There is thus a requirement for developing a methodology that will ensure a high rate of NPS. A well-functioning NPD process is such a methodology (Nadeem, Sarwar, Javaid, &
Mehnaz, 2011). It is a process in which first the needs and wants of customers are determined and according to them the new products are tailored (Meybodi, 2003).

### 3.4.2 Functional requirements

In order to resolve design criteria for a high-quality NPD process, the next section presents findings from Di Benedetto (1999), Boer & Gertsen (2003), Kandemir, Calantone & Garcia (2006), Cooper & Kleinschmidt (2007), and Haverila & Ashill (2011) about functional requirements that enhance the outcome of the NPD process. The articles by Kandemir et al. (2006), Cooper & Kleinschmidt (2007), and Haverila & Ashill (2011) have a macro view on installing a high-quality NPD process. Whereas the article by Di Benedetto (1999) has a micro view on one of the most critical phases in the NPD process, namely: new product launch decisions (Wren, Souder, & Berkowitz, 2000). Lastly, the article by Boer & Gertsen (2003) focuses on continuous innovation, which they argue should be an on-going process at the back-end of the NPD process after the launch of a new product.

**Installing a high-quality NPD process**

Cooper & Kleinschmidt (2007) performed their research among a total of 161 BU’s in a variety of industries. They identified four key success factors that distinguished the BU’s which were more successful in NPD. These four key success factors are: a high quality new product process, a defined new product strategy for the BU, adequate resources of people and money, and R&D spending for NPD.

The most important key success factor among high performing BU’s was a high-quality NPD process. The existence of a formal NPD process alone has no effect on NPS, the quality and nature of the NPD process determines the performance. Cooper & Kleinschmidt (2007) gave six factors of a high-quality NPD process. First, high-performing BU’s had an emphasis on up-front homework, before NPD projects move into the development phase (Kandemir et al., 2006). The result of this up-front homework should be a sound business case. Second, at high-performing BU’s, the NPD process included sharp, early product definitions, before the development phase starts. Third, the NPD process should include strong go/kill decisions, where NPD projects really do get killed in order to prevent wasting resources on the wrong NPD projects. Fourth, it turned out to be important to have a constant focus on quality during the NPD process. According to Kandemir et al. (2006) this focus could be achieved by putting adequate testing resources into the NPD process. The testing resources are composed of in-house product testing, prototype testing with the final customer, market testing, and pilot production. Fifth, the NPD process should be complete; all relevant tasks should be carried out. Last, the NPD process must be flexible.

The second most important key success factor for a better performance in NPD is having a defined new product strategy for the BU (Cooper & Kleinschmidt, 2007). This key success factor consists of four factors. First, there should be goals or objectives for the BU’s total new product effort. Second, the role of new products in achieving BU goals must be clearly communicated to all. Third, it is important to have defined areas of strategic focus. This gives direction to the BU’s total new product effort, preventing it from an unfocused search for new product ideas, leading to an unrelated portfolio of NPD projects. Last, the NPD effort should have a long-term thrust and focus, including some longer-term NPD projects. An efficient way to define a clear new product strategy for a BU is with project portfolio management.
Project portfolio management will identify, analyze, and quantify project value to evaluate which business cases to initiate, reprioritize, or terminate (Rad & Levin, 2008). According to Killen, Hunt & Kleinschmidt (2008), the focus should be on strategic methods (such as using strategy to drive top-down allocation of resource bundles of money, manpower and knowledge) and portfolio maps (such as portfolio grids or matrices), because financial methods rely on data that is usually not very accurate at the stage where new product project portfolio decisions need to be made. An organization’s top management could use the portfolio management method by MacMilan & McGrath (2002) which combines strategic and portfolio map methods.

According to MacMilan & McGrath (2002) all the NPD projects described in the business cases can be characterised as one out of four types. From relatively certain to highly uncertain, these different types are: launches, positioning options, scouting options, and stepping-stone options. The most important decision to make is how many resources to put into each category. A good starting point for the resource allocation process is to look at how the portfolio of NPD projects is crafted at the moment. The second step is to determine whether the organization has enough capacity, in terms of employees and financially, to handle the existing portfolio and new initiatives that the organization wishes to start. If it turns out that the organization is out of capacity, it has to find more resources or cut back on what it is doing (MacMilan & McGrath, 2002). Finally, the organization will be able to find their target number of projects within each category. Knowing this target number, the organization can compare potential NPD projects per category, this means that launches will be compared with launches and positioning options are only compared with positioning options. A NPD project will only become selected in case it has more potential than other NPD projects of the same category and there are resources left for that specific category. The primary benefits of project portfolio management are that only the right NPD projects will be selected and/or continued, a better competitive positioning, an improvement in the effectiveness of NPD project teams, and a lower overall cost of NPD projects.

Another important key success factor for a better performance in NPD is putting adequate resources of people and money in place. Cooper & Kleinschmidt (2007) gave three success factors of putting the adequate resources in place. First, top management should devote the necessary resources to achieve the organization’s new product objectives. Second, R&D budgets must be adequate to achieve the stated objectives. Last, the necessary people should be in place, and sufficient release time should be given to specific NPD projects. According to Kandemir et al. (2006) the key factors among the people resources are: the involvement of a strong champion, the use of a multi-disciplinary team, and the focus of a dedicated team. The fourth and last important key success factor for a better performance in NPD is R&D spending. But, according to Cooper & Kleinschmidt (2007), R&D expenditure does only have a positive effect on new product impact and not on new product profitability.

Cooper & Kleinschmidt (2007) conclude their research by stating that the stage-gate process (Cooper, 1990), emphasizes many of the key succes factors for a better performance in NPD, such as: homework, voice of the customer, tough gates, quality of execution, and flexibility. A typical stage-gate process is shown in Figure 10. This process, first designed by Cooper (1990) divides the innovation process into a predetermined set of stages, consisting of a series of activities. These
activities will result in the input for a gate. A set of quality criteria upon which the product will be judged are specified for each gate. The output of a gate will be a go/kill/hold/recycle decision.

**Figure 10**: An overview of a stage-gate process (Cooper, 1990)

**Making launch decisions**
A specific phase of the NPD process is the launch. Di Benedetto (1999) investigated the key success drivers in new product launch and found that a complete launch strategy should include both strategic and tactical launch decisions. The most important strategic launch decisions turned out to be the use of cross-functional teams and the involvement of logistics in the launch process. Especially for high-competitive launches, the involvement of the logistics functions (for example in after-sales service) related to higher market share. The most important tactical launch decisions were: quality of selling effort, technical support, sales force training, managing the distribution channel, and timing of the launch (Di Benedetto, 1999). Of these tactical decisions, the timing of the launch turned out to be the most critical factor for a successful launch. Finally, Di Benedetto (1999) concludes that virtually all the market information-gathering activities are very highly related to new product launch success.

**Conducting continuous innovation**
The result of a high-quality NPD process should be the launch of a successful product. It is usually not enough to launch and maintain one successful product. Customers demand a high variety of fairly priced, but high-quality and even increasingly customized products. Therefore, an organization should combine operational effectiveness and strategic flexibility in the continuous innovation phase which starts right after the first launch of a new product (Boer & Gertsen, 2003). Operational effectiveness is the capability to enable the satisfaction of today’s customers, and requires excellent exploitation activities such as a top class service level. Strategic flexibility is the ability to develop new configurations of products, processes, and technologies that enable the satisfaction of tomorrow’s customers (Boer & Gertsen, 2003).

Chapman, O’Mara, Ronchi & Corso (2001) found that large organizations which operate in global markets, most preferably place an emphasis on an organizational integrative mechanism to adopt a continuous innovation approach. This organization integration could be achieved by making small cross-functional teams responsible to manage the strategic development and operational
effectiveness of a product. These self-organizing teams should work in customer-driven work cycles to deliver value to customers during each iteration (Denning, 2010).

3.5 Design criteria

Based on the exploration of the body of literature concerning functional requirements of market opportunities, disruptive innovations, and a high-quality NPD process, design criteria can be given for those three areas. These design criteria are aggregated in Table 4 in Appendix 1. Similar functional requirements among different sources are integrated into a single design criterion.
4  Design criteria from practice
This chapter starts with a description of the NPD context, process and performance at COMPANY X in section 4.1. Based on this description, functional requirements from practice could be identified. The last section of this chapter will integrate the identified functional requirements into an overview of design criteria from practice. These design criteria will form the input for the design in chapter 5.

4.1  Functional requirements of COMPANY X
The benchmarking of the NPD at COMPANY X starts with a critical reflection on the NPD context and NPD process in section 4.1.1, leading to the identification of functional requirements relating to the NPD context and process at COMPANY X. The information given in these sections is acquired by desk research and by consulting relevant employees at COMPANY X via a semi-structured interview. The manuscript of this semi-structured interview can be found in Appendix 2. The benchmarking of the NPD at COMPANY X concludes with an analysis of past performance of NPD at COMPANY X in section 4.1.2. This section is also the starting point to identify functional requirements relating to this past performance at COMPANY X.

4.1.1  NPD context and process
As can be seen in Figure 1, COMPANY X is highly functionally structured. The employees within the functional divisions of the organization tend to perform a specialised set of tasks. The different BU’s form an exception on this functional structure, since they are built around a specific product group and are operating in a divisional structure. The HDPE BU, for instance, is responsible for all the product categories that can be produced with the HDPE polymer. A BU is directed by a BD. The BD is hierarchical responsible for a BM, who is responsible for a product-market asset combination related to the product group, and a manager TM. TM is responsible for identifying and translating market needs into the development of new applications and products, conducting promotional activities, and delivering technical service and process support to customers. According to a manager at COMPANY X (see: Appendix 3), the TM employees are representing the voice of the customer.

This partly functional, partly divisional structure calls for a lot of collaboration between the different departments of COMPANY X. According to a senior manager at COMPANY X (see: Appendix 4), TM and T&I are both important actors at COMPANY X in initiating the NPD process with idea inputs. They do so by bringing in new ideas and concepts, both from a different perspective, as can be seen in Figure 11.

![Figure 11: Different perspectives TM and T&I](image)

According to a manager at COMPANY X (see: Appendix 5), T&I is seldom initiating the NPD process with new ideas, but occasionally they do. For example via the ‘blue sky’ or ‘new platform’ long-term research projects that T&I conduct. These fundamental research projects should lead to new
techniques to support the development of new products. However, TM is the leading department in generating new ideas. These idea inputs are generated via direct contact with current or potential customers and market research.

According to a manager at COMPANY X related to the T&I department (see: Appendix 6), the reason for the low input into the NPD process from T&I is that this department can only deliver input if there is a clear strategy on which areas to provide research output for. This statement is confirmed by Cooper, Edgett & Kleinschmidt (2002) who state that in order to enhance the fit between research and the engineering of new products, a formalized process and strategy to bring more direction and focus to the research department may be presented. This formalized process should have the form of a stage-gate system and should typically include multiple screens, a technical assessment, and detailed investigation (Cooper et al., 2002). After the detailed investigation, the results of a T&I project can most-likely support the ideation phase of developing new products, prior to the generation of a business case.

At COMPANY X three different types of stage-gate processes for NPD are currently in place, which are all variants of the basic stage-gate process developed by Cooper (1990). An employee explains that the type of stage-gate process for a NPD project depends on the radicalness and the level of technological uncertainty of the associated idea input. A classification of COMPANY X’s stage-gate processes can be found in Table 2.

<table>
<thead>
<tr>
<th>Idea radicalness</th>
<th>Leading department</th>
<th>Stage-gate type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>TM</td>
<td>NPI</td>
</tr>
<tr>
<td>High</td>
<td>T&amp;I</td>
<td>Research</td>
</tr>
<tr>
<td>Medium</td>
<td>TM/T&amp;I</td>
<td>Combined</td>
</tr>
</tbody>
</table>

Having multiple stage-gate methods with different leading departments and different structures is not advocated in NPD literature. To enhance the NPD project’s probability of a desired outcome, a single and structured NPD process is necessary (Samra, Lynn, & Reilly, 2008). Preferably, this NPD process is conducted by a multi-disciplinary team (Kandemir et al., 2006). COMPANY X should not make the process to formal, since according to Samra et al. (2008), this will reduce the speed to market. An ideal combination will be a structured process with the ability to be flexible and adaptive to certain changes. In order to achieve this ideal combination, a stage-gate system which only formalizes high-level activities as proposed by Cooper (1990) is desirable.

4.1.2 NPD performance

In order to identify which functional requirements can be identified based on the performance of past COMPANY X product introductions, semi-structured interviews are conducted for the four most successful and five least successful products, as indicated in Table 3. This interview list of past product introductions is made in consultation with a senior manager at COMPANY X with knowledge about the total population of past product introductions at COMPANY X. The manuscript for the semi-structured interviews with COMPANY X employees can be found in Appendix 7. The interviewee has to confirm the level of successfulness of the product introduction and the underlying drivers for COMPANY X that caused that specific level. Moreover, during the interview
some important themes distilled from the design criteria of literature (see: Table 4 in Appendix 1) are discussed.

Table 3: Interview list of past product introductions

<table>
<thead>
<tr>
<th>Successful products</th>
<th>Associated employees</th>
<th>Appendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCT A</td>
<td>M. N.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>E. V.</td>
<td>9</td>
</tr>
<tr>
<td>PRODUCT B</td>
<td>M. S.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>T. S.</td>
<td>11</td>
</tr>
<tr>
<td>PRODUCT C</td>
<td>G. B.</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>G. C.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>M. S.</td>
<td>10</td>
</tr>
<tr>
<td>PRODUCT D</td>
<td>R. C.</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>D. G.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>P. W.</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Less successful products</th>
<th>Associated employees</th>
<th>Appendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCT E</td>
<td>P. W.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>D. G.</td>
<td>15</td>
</tr>
<tr>
<td>PRODUCT F</td>
<td>D. G.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>R. C.</td>
<td>14</td>
</tr>
<tr>
<td>PRODUCT G</td>
<td>D. J.</td>
<td>17</td>
</tr>
<tr>
<td>Product H</td>
<td>R. H.</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>J. E.</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>H. J.</td>
<td>20</td>
</tr>
<tr>
<td>PRODUCT I</td>
<td>G. C.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>M. S.</td>
<td>10</td>
</tr>
</tbody>
</table>

After conducting all the interviews it turned out that the investigated product introductions could be categorized into two broad categories. Firstly, five product introductions initiated based on market opportunities on a commodity market. From these five introductions, one introduction was indicated as successful after the interview sessions. Secondly, four product introductions initiated based on disruptive innovations leading to the creation of a specialties market. From these four introductions, two introductions were indicated as successful after the interview sessions. The categorization of the investigated past product introductions and the main drivers for the (non-) success are given in Table 5 in Appendix 21.

COMPANY X did introduce products on both the commodity market (by acting on market opportunities) and the specialties market (by acting on disruptive innovations). Both types of introductions did result in successful and unsuccessful product introductions. Therefore, the conclusion is that none of the two types led exclusively to a successful product introduction at COMPANY X. This finding is confirmed by Singh (2001) and Milmo (2003). Singh (2001) indicated that not only developing unique products for a specialties market, but also developing improvements and products focused specifically on replacing the incumbents on a commodity market are successful approaches in the polymer market. Milmo (2003) identifies that having a mixed portfolio of products on both commodity and specialties markets may be a specific strength. The technologically sound and cost-effective production of products for the commodity market provides the basis and knowledge to produce products for the specialties market at a favorable cost.
In the remainder of this section the performance of the two categories of product introductions is discussed.

Performance of product introductions based on market opportunities
Market opportunities on commodity markets form the basis of five of the investigated product introductions at COMPANY X. From these five, one was perceived as successful and four were perceived as unsuccessful. Two main drivers were underlying the unsuccessful product introductions based on market opportunities: a wrong estimation of the market and quality issues with the product. A wrong estimation of the market can be seen in three different forms. First, as was the case for the PRODUCT G, the market or market segment that will be served by the new product turned out to be too small to make an acceptable profit out of the new product. Second, as was the case for the PRODUCT E and PRODUCT I, the market that will be served by the new product is occupied by a few big players in an oligopolistic setting. Therefore, the market had high barriers to enter due to information costs, economics of scale, or patents (Ruffin, 2009). Third, as was also the case for the PRODUCT E and PRODUCT I, the market that will be served by the new product is already highly segmented with competitors supplying the market with a lot of different product variants. This makes it difficult to enter the market and to attract customers by supplying initially a single product variant. The other main driver that underlies the unsuccessful product introductions based on market opportunities are quality issues with the product. Quality issues arise when there are too less resources available for the development of the new product. This is confirmed by the stories about the PRODUCT E and PRODUCT F. Too less resources means: too less manpower, too less money, but most of all too less knowledge for the development of new products.

Two main drivers were underlying the successful product introductions based on market opportunities: co-development with a main customer on a certain market and the perceived risk of a corporate crisis of the competitors on a certain market. Both of these main drivers were identified in the PRODUCT B case. First, by co-developing with a main customer there was a guaranteed demand for the new product and therefore ground to invest in new product quality. With this higher product quality and the reference of the main customer, COMPANY X was ultimately able to sell its product to other customers as well. Second, when there is a high perceived risk of a corporate crisis of a competitor in the same industry, for example because of disappointing financial results or the closure of production facilities, this is a driver for other players in the same market to capture market share from that competitor. COMPANY X did this in the PRODUCT B case, where a competitor did have financial troubles and therefore their customers perceived a higher supplier risk.

Performance of product introductions based on disruptive innovations
Disruptive innovations leading to specialties markets are the basis of four of the investigated product introductions at COMPANY X. From these four, two were perceived as successful and two were perceived as unsuccessful. Two main drivers were underlying the unsuccessful product introductions based on disruptive innovations: quality issues with the new product or customers that were not willing to pay additional margins for the new product. First, as earlier mentioned, quality issues arise because of a lack of manpower, money, and knowledge. Second, when customers are not willing to pay additional margins for a technologically superior product features, the full success potential of the disruptive innovation is not reached. This happened in the PRODUCT C case. Although, the
product was technologically superior to the competition, COMPANY X did not succeed in asking an additional margin for it. They only retained their market share with this technologically better product.

Four main drivers were underlying the successful product introductions based on disruptive innovations: introducing technologically superior product features compared to the competing products, convince customers to pay for that features, be the first to the market with that features, and protect the used features. First, as was the case for the PRODUCT A and PRODUCT D, it is important to introduce new features. In both cases it turned out to be important to have knowledgeable employees dedicated to the project to speed up the development of new features. Those knowledgeable employees were attracted from other organizations with a specialized knowledge focus dedicated to that product area. Second, as was also the case for both the PRODUCT A and PRODUCT D, customers need to be convinced to pay additional margins for the newly developed features. In both cases customers were convinced to pay higher prices, because the use of COMPANY X products led to overall cost reductions which were higher than the additional price charged by COMPANY X. The PRODUCT A case shows that the customers were more easily convinced when the sales approach was a combined effort of the TM and sales department, focusing on the specific product knowledge of the TM employees in terms of cost effectiveness. Third, as was also the case for both the PRODUCT A and PRODUCT D, COMPANY X was the first to market with a certain new feature. By being the first, they raised a lot of attention for the product and locked-in customers by making them familiar with their product in a situation in which there are no other options to substitute the product. After the emergence of other options, a number of customers will choose its usual product over competing alternatives as a result of the cognitive lock-in effect which is similar to a familiarity effect or habituation (Harrison, Beatty, Reynolds, & Noble, 2012). Fourth, in case of the PRODUCT A, COMPANY X developed the new features in-house and protected them by patents. This makes their features unique and even further locks-in the customers once they use the product, since they are not able to acquire the same features anywhere else. In the case of the PRODUCT D, COMPANY X could not protect the technology for the new feature, because it was not developed in-house but bought from a supplier as an additive.

4.2 Design criteria
Based on the analysis of the NPD context, process, and performance at COMPANY X, design criteria can be given to engineer a successful product introduction. These design criteria are aggregated in Table 6 in Appendix 22.
5 Design

In this chapter, the design to proactively steer the engineering of successful products introductions via a high-quality NPD process with an emphasis on counteracting the commoditized markets on which COMPANY X is mainly operating is given section 5.1. In section 5.2 this design will be described step by step.

5.1 Overview of the design

In Table 7 in Appendix 23 the aggregated design criteria from literature (Arabic numbering) and the design criteria from practice (Greek numbering) can be found. Design criteria from literature and practice which overlap almost fully are integrated into a single design criterion with a double numbering. The phases in which the aggregated design criteria are grouped, follow logically out of the content of the design criteria and are graphically depicted in Figure 13 in Appendix 24, where the numbers in between brackets above certain steps relate to the associated design criteria from Table 7 in Appendix 23. A more detailed overview of the ideation and development phases of the design is given in Figure 14 in Appendix 25. This detailed overview is used to clarify the description of the design in section 5.2.

5.2 Description of the design

Some of the steps in the design are clustered into a specific phase. This is indicated by the colour scheme and the accolades at the right side of the design in Figure 13 in Appendix 24. In the remainder of this chapter the design is described according to the following steps or phases: engineering a NPS by counteracting commoditization, ideation phase, development phase, selling the product, and continuous innovation phase.

5.2.1 Engineering a NPS by counteracting commoditization

COMPANY X is mainly operating in commoditized markets. These kinds of markets are characterized by unsustainable competitive advantages, constantly breached industry boundaries, and inconstant customer loyalty (D'Aveni, 1994; Williams, 1992). Competition in these commoditized markets is primarily on the basis of price. In the long run it is very difficult to build a sustainable business on low margins and low customer loyalty (Hax, 2005). Therefore, in order to engineer successful new products, COMPANY X needs to counteract commoditization.

5.2.2 Ideation phase

The engineering of a new product starts in the ideation phase. This phase is graphically depicted as a stage-gate process in Figure 14 in appendix 25 based on an article by Cooper et al. (2002). During the ideation phase an ideation event is shaped into a business case after a screen of the idea, the scoping of the idea, and a second screen after the scoping stage. An ideation event is the discovery of an idea for a new product. Any employee at COMPANY X can experience an ideation event, but most likely the employees from the TM department, which have specific responsibilities for translating market needs into the development of new applications and products, are proactively capturing and handling ideas for a new product to the idea screen (section 5.2.2.1).

According to design criterion III the fundamental research activities of the T&I department at COMPANY X should be shaped to support the ideation phase. To enhance the fit between T&I developments and the ideation phase there should be more direction and focus to the fundamental
research activities of T&I. This could be achieved by introducing the concept of a stage-gate process for research activities (Cooper et al., 2002). As displayed in the upper half of Figure 14 in appendix 25, the process for these T&I developments should typically include multiple screens, a technical assessment, and a detailed investigation. After the detailed investigation, the results of T&I developments can most-likely support the ideation phase during the second screen before the generation of a business case, but sometimes the result of a T&I development is extensive enough to be directly transformed into a business case. The exact phase where a T&I development process should enter the conceptual model is decided upon during Gate 3 of the T&I development process.

5.2.2.1 Idea screen
The idea screen of a new product idea of a TM employee should be performed by a small, cross-functional group of mid-level managers (Cooper et al., 2002). At COMPANY X, this group should at least include a TM manager and a BM. According to design criterion 15, an identification of (potential) customer needs, wants, and preferences could support the cross-functional group of mid-level managers to make a first, rough separation between high potential and low potential new product ideas. For the high potential new product ideas, the cross-functional group of mid-level managers at COMPANY X should keep in mind that according to design criterion IV, COMPANY X should focus on introducing new products on both commodity and specialties markets, but preferably with the potential to counteract commoditization. Counteracting commoditization by introducing a new product on a commodity market is achieved by acting on market opportunities such as involve a customer in the NPD process or replace a competitor. New product ideas that have those potentials should be promoted to the scoping stage for market opportunities (5.2.2.2). Counteracting commoditization by introducing a new product on a specialties market is achieved by designing disruptive innovations. New product ideas that have that potential should be promoted to the scoping stage for disruptive innovations (5.2.2.3). Both scoping stages should be conducted by small cross-functional teams with two or three members (Cooper et al., 2002). At COMPANY X, these small cross-functional teams should include representative from the TM, T&I and sales departments. Since, together these departments combine both extensive market and technology knowledge.

5.2.2.2 Market opportunity trajectory
The market opportunity trajectory is aimed at scoping new product ideas that have the potential to act on opportunities that arise on a commodity market. These opportunities are divided into replace competitor and involve customers.

A new product idea could have the potential to replace a competitor on a commodity market. In that case, according to design criterion 3, the cross-functional team conducting the market opportunity trajectory should proactively search for possibilities to replace a competitor by developing the new product. This can be achieved if the new product has better resources capable of meeting market needs than the direct competitors in that market. The resource position can be identified by surveying the competitive environment of the new product beyond traditional product market boundaries by also including indirect competitors and potential competitors by using the first stage of the Bergen & Peteraf (2002) framework (design criterion 1), followed by an ordering of this competitive environment based on resource equivalence by using the second stage of the Bergen & Peteraf (2002) framework (design criterion 2). A specific case, in which COMPANY X’s new product will have better resources capable of meeting market needs than direct competitors, is when a
direct competitor shows a high change of corporate crisis. A corporate crisis of a direct competitor can be predicted by a model of Cortés et al. (2007). They developed a Z-score model which sums together a number of financial ratios. Based on the outcome of the model, a competitor can be categorized in terms of financial health. As stated by design criterion 4/X, COMPANY X should act on a corporate crisis of a direct competitor by developing the new product which replaces the product of the direct competitor associated with a corporate crisis. COMPANY X should communicate to the direct competitor’s customers the possible danger of lost sales due to stock-outs caused by the corporate crisis of the direct competitor and convince the direct competitor’s customers that the switching costs to choose for their new product are low (Primo, Dooley, & Rungtusanatham, 2007).

A new product idea could have the potential to be co-developed with (potential) customers on a commodity market. In that case, according to design criterion IX, the cross-functional team conducting the market opportunity trajectory should proactively search for possibilities to cooperate with large and innovative (potential) customers in developing the new product. This is called the lead user method (Cooper et al., 2002). It turned out that involving customers with strong past ties will lead to a significantly better new product performance than involving customers with few or no past ties. Moreover, the more diverse the set of lead users, the more innovative the result of the NPD will be (Bonner & Walker, 2004). Therefore, COMPANY X should involve a diverse set of well-known customers into their NPD to enhance the changes of NPS. From past COMPANY X NPD projects it turned out that this co-development should preferably include the possibility of prototype testing of the new product at the machines of the customer and guaranteed, but non-exclusive, sales to the customers involved in the NPD project. Preferably, the involved customers are leading in the market for the new product. This enhance chances that other potential customers on that market will also switch to COMPANY X’s new product, because they follow the movements of the market leaders in order to keep up with competition.

As can be seen in Figure 13 in Appendix 24, a new product idea can also act on both types of opportunities on a commodity market. The involvement of customers in the development of a new product can be a tool to replace competitors on the commodity market and vice versa.

5.2.2.3 Disruptive innovation trajectory
The disruptive innovation trajectory is aimed at scoping new product ideas that have the potential to be a starting point to engineer disruptive innovations for a specialties market. A disruptive innovation is engineered based on a latent need. Latent needs are those features that the consumers would value but have never experienced or would never think to ask for (Turock, 1998).

According to design criteria 5 and 6 the cross-functional team conducting the disruptive innovation trajectory should define the latent need their new product idea is solving and identify potential disruptive innovations following from their new product idea. A latent need can be identified by a strong emphasis on a combination of customer analysis methods. A combination of the umbrella method, emphatic design, and conjoint analysis have the best potential to uncover these needs (Reinhardt & Gurtner, 2011). By using the umbrella method (Noori et al., 1999), the cross-functional team should develop different future environmental scenarios and their associated customer needs and requirements. It is important to have a clear understanding about how environmental parameters need to change so that a specific environmental scenario emerges. By monitoring these
environmental parameters, the cross-functional team will know which scenario will emerge and which product features will be valued most by customers. During the emphatic design method (Leonard & Rayport, 1997), the cross-functional team should observe customers, non-customers and customers’ customers in their natural environments. For example by company visits. Afterwards the cross-functional team discusses about their observations and analyzes the data to identify whether the new product idea will bring a solution to the observed problems. During the conjoint analysis (Green et al., 2001) customers have to value product features based on pairwise comparison between an existing product and the new product idea. Afterwards, the cross-functional team can calculate the relevance of each feature. This method is useful for detecting future product features that customers will prefer, but also product features that are yet present, but not valued by customers. The result of this combination of methods will be a formulation of a problem or opportunity that needs to be addressed by a disruptive innovation. Kostoff et al. (2004) developed a bipartite model based on a combination of a literature study and the involvement of experts from inside and outside the organization, that the cross-functional team may follow to transform these problems and opportunities into one or more candidate disruptive innovations.

According to design criteria 8, 9, 10, 11, and 12, the cross-functional team should evaluate the candidate disruptive innovations to identify the disruptive innovation with the greatest potential. The evaluation can be conducted by following a combination of five methods. First, there need to be a clear indication of a ‘gap’ or overshoot in product requirements of the commodity product and the candidate disruptive innovation should score better on these requirements (Ganguly et al., 2010; Hang et al., 2011). Second, there should be a clear indication that the commodity product is mature, since those products will most likely not be further improved and are vulnerable for attack by a candidate disruptive innovation (Ganguly et al., 2010). Third, there should be a clear indication that the commodity market has a sufficient rate of technology adoption. A high rate of technology adoption in the commodity market is an indication that those customers will ultimately adapt to the candidate disruptive innovation (Ganguly et al., 2010). Fourth, the cross-functional team should make an assessment of the utilities between a candidate disruptive innovation and the commodity product. The utility level of the potential disruptive innovation should provide the targeted customers higher levels of utilities than the commodity product (Ganguly et al., 2010). Fifth, the cross-functional team should identify the existence of other favorable drivers that could influence the pace or faith of a candidate disruptive innovation (Hang et al., 2011).

After the identification of the candidate disruptive innovation with the greatest potential, this disruptive innovation should be worked out. According to design criterion 7, this can be done by constructing a roadmap. This roadmap should focus on the necessary research, development, capability, and requirement in order to work out the disruptive innovation (Kostoff et al., 2004).

5.2.2.4 Initial internal check

The scoping phase of the new product ideas is concluded with a second screen (see: Figure 14 in Appendix 25). During the second screen, which is also performed by at least a TM manager and a BM, the new product ideas are assessed on criteria based on the trajectory they did follow. New product ideas for the specialties market should be assessed with an emphasis on the potential of the new product to serve a latent need and create a specialties market. New product ideas for the commodity market should be assessed with an emphasis on the potential of the new product to be
developed in cooperation with a customer on the commodity market and/or the potential of the new product to sustainably replace a competitor on the commodity market due to a better resource position. Following design criterion 17, the new product ideas that pass the second screen should be transformed into a sound business case (see: Figure 14 in Appendix 25). COMPANY X should set this as a mandatory task prior to moving into the development phase (Cooper & Kleinschmidt, 2007).

According to design criteria V, VI, and VII, the cross-functional team responsible for the new product idea should at least include three important checkpoints into the business case. These checkpoints stem from past experiences at COMPANY X. First, there need to be a clear indication that the targeted market or market segment is not too small to make an acceptable profit. Second, in the case that a targeted market is taken by a few very big players, there need an in-depth action plan to target this oligopolistic market. COMPANY X’s SBU top management need to be convinced that they can breach the high entry barriers of the oligopoly market, for example by delivering a product with new or better features. Third, there need to be a clear indication that the targeted market is not too highly segmented to enter with only one product variant. Beside these three important checkpoints, the business case should always contain a detailed technical assessment, perhaps the input from T&I developments can be supportive for this assessment, and a financial and business analysis (Cooper & Kleinschmidt, 2007).

The business case is accepted or rejected into the development phase after the initial internal check. This is a very crucial point in the development of the new product idea. Cooper & Kleinschmidt (2007) stated that a central role of senior management in the new product project review process will lead to more successful total new product effort. Therefore, the team making the decision whether to promote a business case into the development phase should consist of members from the SBU top management at COMPANY X. According to design criterion 16, the SBU top management should promote the business cases which represent high potential new product ideas which fit into the defined areas of strategic focus. An efficient way to perform this step is with project portfolio management. COMPANY X’s SBU top management could use the portfolio management method by MacMilan & McGrath (2002) which combines strategic and portfolio map methods. In order to use this method, COMPANY X should categorize the total portfolio in terms of types of new products (commodities and specialties) and should divide each of those two categories based on their radicalness (launches and options). Because of the functional division at COMPANY X, there should consist project portfolios for HDPE, LDPE, and PP. These three portfolios should periodically be monitored by COMPANY X’s SBU top management as a single project portfolio. According to MacMilan & McGrath (2002) the most important decision to make is how many resources in terms of money, manpower, and knowledge to put into each category of the new product portfolio. Each new business case is assigned to one of the categories of the project portfolio. The SBU top management should consider whether there are resources left in that category to promote the business case to the development phase. This in order to make sure that sufficient money, manpower, and knowledge could be attached to the development phase of that new product (design criterion VIII). In case that there are resources left in the project portfolio and the business case is representing a high potential new product idea, the business case is promoted to the development phase by the SBU top management. In case that there are no resources left in the project portfolio, but the business case is representing a high potential new product idea, the
business case is promoted to the development phase by the SBU top management and another NPD project within the same category with less potential is killed. According to design criterion XII this methodology can be used to prioritize new product ideas with chances of being the first to market with a certain feature. Independent of the amount of free resources left in the project portfolio, business cases that do not represent a high-potential new product idea should not be promoted to the development phase.

5.2.3 Development phase

After that a business case is accepted into the project portfolio by COMPANY X’s SBU top management during the initial internal check, the development starts for that NPD project. Before the actual development (section 5.2.3.2) can start, a NPD team need to be set up to execute the NPD project (section 5.2.3.1).

5.2.3.1 Set up the team

The development phase should be conducted by a team. Three guidelines to set up a NPD team can be identified from design criterion 18/II. First, the team should include a strong champion (Kandemir et al., 2006). This strong champion should be an employee who has a strong responsibility feeling related to the NPD project and is capable of motivating the other team members to fulfill certain important tasks (Fisscher & de Weerd-Nederhof, 2000). A champion does not necessarily have to be formally appointed as responsible for the NPD project by COMPANY X and it does not matter from which functional department or which hierarchical level the champion comes. Second, the team should be multidisciplinary (Di Benedetto, 1999). At COMPANY X that means that at least representatives of the functional departments that have a direct relationship with the new product to develop, such as the BU, TM, T&I, and sales departments should be incorporated into the team. According to Troy, Hirunyawipada & Paswan (2008), this integration between departments should not be extended further than the team level and the integration is most successful for teams sharing knowledge with an emphasis on customer information. Third, the team should be able to dedicate their focus to the NPD project (Kandemir et al., 2006). This necessary focus can be achieved by appointing one or a few days per week that are dedicated to the NPD project. During one of these days, a weekly NPD team meeting for information sharing and roadmapping should be scheduled.

5.2.3.2 Development

After the set-up of a NPD team to perform the NPD process, the development can be started. According to design criteria 19 and I, to enhance the development’s probability of a desired outcome, a single and structured development phase by means of a stage-gate process which only formalizes high-level activities, should be used by COMPANY X. This process should include a sharp, early product definition, strong go/kill points and a constant focus on quality. Despite the need for a structured development phase, COMPANY X should not make the process too formal, since according to Samra et al. (2008) this will reduce the speed to market. An ideal combination will be a structured process with the ability to be flexible and adaptive to certain changes. The proposed development phase for COMPANY X is depicted in Figure 14 in Appendix 25 and is based on findings from Cooper (1990) and Cooper et al. (2002).

After the introduction of a NPD project of a certain type into the development phase, the actual development of the product by the cross-functional NPD team can take off during Stage 1. After
Stage 1, the SBU top management acts as a gatekeeping team for Gate 2 and decides whether to promote the NPD project to Stage 2. Also, during that check the SBU top management should investigate whether the development resulted in any unique features to legally protect from use by competitors (design criterion XIII). By protecting certain features, COMPANY X might lock-in customer with the new product, since they will not be able to acquire the same features anywhere else. During Stage 2, the newly developed product will be tested and validated. According to design criterion 20, this testing & validation stage should consist of in-house testing and pilot production. The in-house testing of a new product ensures that all the major shortcomings are identified and resolved before those shortcomings can negatively affect COMPANY X’s reputation on the market. The pilot production of a product should be performed together with one or more of the potential customers; most preferably, these customers are involved in a co-development process with COMPANY X. The pilot production of the new product is used to perform the final checks at the machines of the customers to optimize the end product. Moreover, when the pilot production is performed together with an influential customer, a successfully finished pilot production period can be used as a reference to attract other customers on the same market as well.

After Stage 2, the SBU top management acts as a gatekeeping team and decides whether to launch the new product commercially on the market. During the launch, the actual selling of the new product (section 5.2.4) starts, but also from that moment on, the continuous innovation (5.2.5) of the newly introduced product will take off.

5.2.4 Selling the product
The launch stage in Figure 14 in Appendix 25 marks the back-end of the development phase and during this stage the actual selling of the new product starts. There are some important aspects of selling that hold for all new products and there are some additional aspects which only hold for new products that can be defined as disruptive innovations which create a specialties market.

For all new products, COMPANY X should use strong advertising and promotion activities during the launch phase (design criterion 21). This is because inadequate marketing has been identified as a major cause of new product failure (Kandemir et al., 2006). Also, for all new products, the sales activities should be conducted as a combined effort of representatives from the TM and sales departments at COMPANY X (design criterion 22/XI). For practicality reasons, these TM and sales representatives could be the same persons as the representatives from those departments in the cross-functional NPD team responsible for the development of the new product. According to Biemans, Brenchic & Malshe (2009) this combined effort still encompass distinct TM and sales functions, but also an integrated interface in which both departments appreciate the added value of the other function. At COMPANY X the added value of this integrated interface lies in the extensive technical knowledge of the TM representatives that they can add in the sales meetings with potential customers. By knowing the technological features of the COMPANY X product and the processing of the product, they may convince potential customers to pay additional costs for the product by calculating an overall cost reduction by using the new product due to capacity or quality improvements of that customer’s production process.

Specifically for new products that emerged from the disruptive innovation trajectory and are creating a specialties market, COMPANY X should focus its combined sales effort to innovators and
early adopters by communicating the relative advantages of the new product compared to other products (design criteria 13 and 14). Relative advantages can be communicated by the use of opinion leaders or reference sites. This will lead to the creation of a specialties market by building market awareness and educating prospective customers (Sandberg, 2002).

5.2.5 Continuous innovation phase
In the markets on which COMPANY X operates it is usually not enough to launch and maintain a single successful new product. Customers demand a high variety of fairly priced, but high quality and even increasingly customized products. Therefore, according to design criterion 23, COMPANY X should combine operational effectiveness and strategic flexibility in the continuous innovation phase which starts right after the first launch of a new product (see: Figure 14 in Appendix 25). As indicated by design criterion 24, COMPANY X should use self-organized cross-functional teams (which include at least employees from BU, TM, T&I, and sales) responsible for managing the strategic development and operational effectiveness of a COMPANY X product. These self-organizing teams should work in customer-driven work cycles to deliver value to customers during each iteration (Denning, 2010). It seems practical to maintain the cross-functional NPD team as the team responsible for the continuous innovation.

5.2.5.1 Operational effectiveness
Operational effectiveness is the capability to enable the satisfaction of today’s customers, and requires excellent exploitation activities such as a top class service level (Boer & Gertsen, 2003). One of the most important factors for the team to steer this satisfaction is the service level of COMPANY X. Findings by Falk, Hammerschmidt & Scheppers (2009) lead to the conclusion that the team responsible for the continuous innovation should ensure to be able to deliver a certain minimum level of functional-utilitarian service attributes, such as adequate support for problems with the quality of the product type. But, they should also be able to deliver more sophisticated hedonic service attributes to those customers with a lot of past experience with COMPANY X and/or the product. Examples of this hedonic service attributes could be an additional consultant type of advice from COMPANY X about how to use the product to enhance efficient operations at customers.

5.2.5.2 Strategic flexibility
Strategic flexibility is the ability to develop new configurations of products, processes, and technologies that enable the satisfaction of tomorrow’s customers (Boer & Gertsen, 2003). Denning (2011) gave four important practices that the team should follow to enable this development of new configurations. First, the team’s goal should become to delight and engage customers by continuously generating more value for customers. This can be achieved by targeting the core market or primary customers with a focus on features that those customers really need (Denning, 2011). Second, the cross-functional team should be coordinated via the ‘dynamic linking’ concept. This means that the work is done in short cycles with a goal set by COMPANY X’s polymers SBU top management based on what is known about what might delight the customer, decisions about how to work should be carried out are in hands of the team and the progress of the team should be measured by direct customer feedback at the end of each cycle (Denning, 2011). Third, the cross-functional team should set two values in particular: radical transparency and continuous self-improvement. Fourth, the communication mode with and from the team should be based on conversation and not on command. This means that communications with COMPANY X’s polymers
SBU top management and customers should no longer consist of unresponsive one-way messages and this could be reached by knowing each other’s story and conducting authentic conversations (Denning, 2011). By putting these four important practices together for a team responsible for the continuous innovation of a certain COMPANY X product, all the prerequisites for the successful development of new configurations are met. As can be seen in Figure 13 in Appendix 24, the developed configurations for new products are transformed into a business case and feed into the initial internal check.
6 Conclusions and recommendations

This last chapter starts with a discussion and conclusion of the whole research, followed by limitations and further research, and some findings for science and practice. Last, recommendations for COMPANY X will be given.

6.1 Discussion and conclusions

The main research question to be answered in this research was: How can COMPANY X proactively counteract commoditization by means of a high-quality NPD process? To answer this question, three research questions were defined in section 1.4. Together, these research questions led to a design which entails the answer to the main research question.

The first research question was related to the identification of design criteria from literature about the two subjects related to this research: counteracting commoditization and a high-quality NPD process. According to D’Aveni (2010) counteracting commoditization should be divided into two sub-subjects: acting on market opportunities and creating disruptive innovations. This brings the total set of subjects to be explored to three. The design criteria from literature were identified via an exploration of a vast body of literature related to those three subjects. The exploration delivers functional requirements related to the most important aspects of the subjects. These most important aspects per subject stem from a brief scan of available literature related to that subject via a general overview article and not from a thorough analysis.

The design criteria of market opportunities are identified based on functional requirements about identifying market opportunities and anticipating on a corporate crisis of a competitor. These design criteria can be found in Table 4 in Appendix 1. They propose to survey the competitive environment via a framework from Bergen & Peteraf (2002) to indicate market opportunities for a new product on the commodity market based on the resource position of organizations. Moreover, a special category of market opportunities turned out to stem from a corporate crisis associated with a competitor. This type of market opportunities can be identified by a competitor analysis based on the indebtedness and profitability of a competitor (Cortés et al., 2007; Siomkos et al., 2010).

The design criteria of disruptive innovations are identified based on functional requirements about identifying disruptive innovations, evaluating disruptive innovations, and creating the market for disruptive innovations. These design criteria can be found in Table 4 in Appendix 1. They propose to first define a latent need by a combination of customer analysis methods (Reinhardt & Gurtner, 2011) followed by the conducting of a literature study and the consulting of experts to identify potential disruptive innovations relating to the latent need (Kostoff et al. 2004). Once the potential disruptive innovations are defined, the disruptive innovation with the highest probability of success can be discovered by multiple evaluation methods as proposed by Ganguly et al. (2010) and Hang et al. (2011). After the development of the disruptive innovation with the highest probability of success, the relative advantages of the new product should be communicated to innovators and early adopters by the use of opinion leaders or reference sites (Sandberg, 2002).

The design criteria of a high-quality NPD process to enhance NPS are identified based on functional requirements about installing a high-quality NPD process, making launch decisions, and conducting continuous innovation. These design criteria can be found in Table 4 in Appendix 1. They propose
multiple recommendations and the most important are: let a cross-functional team conduct the complete NPD process form ideation to launch (Cooper & Kleinschmidt, 2007; Di Benedetto, 1999; Kandemir et al., 2006), use a stage-gate process to structure the NPD process (Cooper, 1990; Cooper & Kleinschmidt, 2007), and define areas of strategic NPD focus by means of project portfolio management (Cooper & Kleinschmidt, 2007; MacMilan & McGrath, 2002).

The second research question was related to the identification of design criteria from practice in two categories: the NPD context and process at COMPANY X and the NPD performance COMPANY X. The design criteria from practice were identified via a combination of desk research and semi-structured interviews to explore the NPD context and process at COMPANY X and via semi-structured interviews to explore the NPD performance at COMPANY X.

The first set of design criteria from practice were identified based on the NPD context and process at COMPANY X and can be found in Table 6 in Appendix 22. It turned out that COMPANY X should use a single stage-gate process for the NPD conducted by a multi-disciplinary team (Kandemir et al., 2006; Samra et al., 2008). Currently, COMPANY X has different leading departments for three distinctive stage-gate process. Also, the use of an additional stage-gate process for T&I developments can enhance the fit between T&I and the NPD process at COMPANY X, which currently lacks (Cooper & Kleinschmidt, 2007).

The second set of design criteria from practice were identified based on the NPD performance at COMPANY X and can be found in Table 6 in Appendix 22. By investigating a set of past product introductions it turned out that it is important for COMPANY X to focus on introducing products on both the commodity and the specialities market (Milmo, 2003; Singh 2001). A deeper investigation of factors which determine the performance in the past led to five important preconditions for NPD at COMPANY X. First, there should be ensured that the targeted market is not too small, too highly segmented, or taken by a few big competitors in oligopolistic setting. Second, sufficient money, manpower, and knowledge should be available to add to the NPD process. Third, there should be proactively searched for possibilities to co-develop with large customers in a certain market. This search could be aimed at potential customers who perceive a supplier risk due to a corporate crisis associated with a competitor. Fourth, customers should be convinced to pay additional margins for the new product via a combined sales approach by TM and sales aimed at the overall (cost) advantages for customers by using the new product. Fifth, SBU top management should prioritize the development of those new products with chances of being the first to market with a new feature. This new feature should be legally protected from use by the competitors.

The third research question was related to the construction of a design to engineer successful new product introductions which counteract commoditization. This question is answered by combining the design criteria from literature and practice, acquired via research question one and two, into a final set of design criteria for the design. This set of design criteria can be found in Table 7 in Appendix 23 and is used to develop the design in Figure 13 in Appendix 24.

The design starts with the ideation phase. During this phase, two streams of new product ideas should be investigated and scoped: ideas based on market opportunities on the commodity market (with a strong emphasis on replacing competitors, and combined development with customers), and ideas based on disruptive innovations which create a specialties market (with an emphasis on latent
needs). Those new product ideas are further shaped and rated by means of one or more screens and the targeted support of T&I developments. The new product ideas that pass all screens are transformed into business cases. The ideation phase ends with an initial internal check. During this check by COMPANY X’s polymers SBU top management, the business cases are controlled for their viability based on COMPANY X’s past knowledge about successful introductions and theoretical guidelines. Moreover, this is the point in time at which the SBU top management has to decide to which kind of NPD project the idea belongs and whether there are sufficient resources left for that kind of projects in the project portfolio of NPD projects. After approval at the initial internal check and before the development phase for the NPD project starts, a cross-functional NPD team needs to be constructed to carry out the NPD project. This team should at least include representatives from the BU, TM, sales, and T&I departments at COMPANY X. During the development phase and the follow-up continuous innovation phase, the cross-functional team should remain together and dedicated to the new product that follows out of the NPD project. After the release of the new product, the selling of the product should be conducted as a combined effort from TM and sales in a combined sales team.

The conclusion is that it is possible to proactively steer the engineering of successful products by focusing on counteracting commoditization by means of a high-quality NPD process. A focus on counteracting commoditization can be achieved by focusing on introducing new products on both the commodity and specialties market. New products for the commodity market should act on market opportunities, such as replacing a competitor and/or co-developing with potential customers. New products for the specialties market should solve a latent need by creating a disruptive innovation. A high-quality NPD process is characterized by NPD projects following a stage-gate process conducted by a cross functional NPD team. The NPD projects should be part of a project portfolio which is monitored by COMPANY X’s top management.

6.2 Limitations and further research
This research had to be conducted within restricted time, therefore the first limitation is that it was not possible to include all the factors relating to the three subjects of the design criteria from literature into the research. Only those factors that were identified in a general overview article about that subject were explored for functional requirements to transform into design criteria. The second limitation related to the restricted time available for this research, is that a selection of past product introductions to investigate for design criteria from COMPANY X practice had to be made. By only including those introductions that were indicated as either the most or the least successful, a number of past introductions was not included in the research. The third limitation is the fact that the final design is not implemented nor tested at COMPANY X, because the implementation of the result was not a part of this research. The design is a combination of elements grounded in theory and elements grounded in COMPANY X’s practice, but the newly developed design is not scientifically tested in its combined form.

Therefore, the first direction for further research will be to test the design after implementation at COMPANY X. The hypothesized result will be a higher number of successful new product introductions. A second direction for further research will be to test the design in other organizations that operate in highly commoditized markets to identify whether the design is generally applicable outside of the polymer market.
6.3 Theoretical and managerial implications
A specific theoretical implication of this research is the identification of design criteria to counteract commoditization. These design criteria indicate that counteracting commoditization is not only achieved by escaping the commoditized market with a disruptive innovation which creates a specialty market. But, counteracting commoditization can also be achieved by acting upon specific opportunities that arise on commodity markets. These opportunities result in sustainable market share growth which counteracts the negative effects of commoditization.

A managerial implication of this research is that looking to the markets on which an organization is active from a theoretical point of view and looking to the NPS drivers of past product introductions from a practical point of view, may lead to design criteria for an approach to enlarge the level of NPS of an organization. The approach based on the resolved design criteria should then be implemented at the organization.

6.4 Recommendations for COMPANY X
The design presented in chapter 5 provides an outline for an approach to enlarge the level of NPS at COMPANY X by proactively engineering new products that counteract commoditization. Implementing this design at COMPANY X will impose some changes for the organization. The recommendations for COMPANY X are built around the most important changes, and include: another structure of the NPD process, a focus on possibilities to counter commoditization in the ideation phase of the NPD process, a project portfolio approach for the NPD projects, another sales approach and a focus on continuous innovation in the back-end of the NPD process.

The first recommendation is that COMPANY X should restructure the core of their NPD process. At this moment, the core of COMPANY X’s NPD process is formed by a collection of three distinctive and detailed stage-gate processes, each of these processes has different leading departments and serves NPD projects with different levels of radicalness. The design proposes a single stage-gate process with a high abstractness level for all COMPANY X’s NPD projects. None of the functional departments is exclusively leading the stage-gate process, since the process is conducted by a cross-functional team consisting of representatives from at least BU, TM, sales, and T&I. Due to the high abstractness level of the proposed stage-gate process, it can handle projects with different levels of radicalness, since the cross-functional team can easily extend or reduce the number of tasks per step and/or steps to take. One exception to this recommended single stage-gate process is made for the research intensive, highly radical ‘blue sky’ or ‘new platform’ projects. These fundamental research projects are still carried out with T&I as the single leading department, but are coupled to the ideation phase of the newly proposed NPD process via two additional stages (as shown in Figure 14 in Appendix 25). This means that T&I can maintain its own stage-gate process for ‘blue sky’ and ‘new platform’ projects but should redesign the back-end of this process in order to make it fit more easily with the newly developed NPD process.

The second recommendation is that COMPANY X should focus its new product idea scoping efforts in the fuzzy front-end of the NPD process exclusively on new product ideas with possibilities to result in NPD projects that counter commoditization. It follows out of the design that these possibilities exist in three areas: co-development with customers, replace competitors, and latent needs. COMPANY X employees should be learned to search for possible NPD projects within those areas. They should do...
this by focusing on signs of competitor corporate crisis and immediately communicating these signs to the customers of this competitor in order to win this customer’s attention to become their new supplier with a new product. Moreover, involve these and other customers into the development phase will lead to a better NPD performance. Finally, motivating COMPANY X employees to scan the market actively for latent needs will lead to an increased change of developing disruptive innovations. Scanning the market for latent needs can be done by using a combination of specific methods, described in section 5.2.2.3.

The third recommendation is that COMPANY X’s SBU top management should embrace project portfolio management as a macro management method for all the NPD projects at COMPANY X. Currently there seems to be a lack of overview of the available resources in terms of money, people, and knowledge for the NPD projects and the radicalness factor associated with different NPD projects. These issues can be resolved by implementing project portfolio management. First, the COMPANY X’s polymers SBU top management should map the desired number of resources per category. Whenever a new product idea results into a business case for a NPD project, the should top management should only initiate the NPD project when there are enough resources left in the portfolio for that specific category of NPD projects.

The fourth recommendation is that COMPANY X should restructure its sales approach. Based on some successful product introductions in the past, the selling of a new product should preferably be a combined effort of the TM and sales departments. By this combined effort, COMPANY X creates a consultancy setting in which especially the TM representative can bring in its technological knowledge about the product and processing of the product, to persuade the potential customer in terms of an overall cost reduction or increased quality of their production process by using the new product.

The last recommendation is that COMPANY X should remain the cross-functional team that worked on the development phase of the NPD process intact in the continuous innovation phase after the launch of the new product. During this continuous innovation phase, the cross-functional team should be made responsible for the service and development activities surrounding the new product. The development activities should be discussed and monitored during regular meetings and may include segmenting or updating the product in order to attract more potential customers.
7 References


# Appendix 1

Table 4: Design criteria from literature

<table>
<thead>
<tr>
<th>Design criteria market opportunities</th>
<th>Explanation</th>
<th>Source*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Survey the competitive environment beyond traditional market boundaries by using the first stage of the Bergen &amp; Peteraf (2002) framework to get a dynamic outlook on how the competitive environment is changing.</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>Use the second stage of the Bergen &amp; Peteraf (2002) framework to order the competitive environment in terms of threats and opportunities based on resource equivalence.</td>
<td>a</td>
</tr>
<tr>
<td>3</td>
<td>Act on a market opportunity by NPD effort in a certain market when the Bergen &amp; Peteraf (2002) framework indicates a better position in resources capable of meeting market needs than the direct competitors in that market.</td>
<td>a</td>
</tr>
<tr>
<td>4</td>
<td>Act on a market opportunity by NPD effort in a certain market when a competitor analysis based on the indebtedness and profitability of a competitor shows a high change of corporate crisis at that competitor.</td>
<td>b,c</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design criteria disruptive innovations</th>
<th>Explanation</th>
<th>Source*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Define a problem or latent need via an analysis of current and potential customers by a combination of the umbrella method, emphatic design and conjoint analysis.</td>
<td>d,e</td>
</tr>
<tr>
<td>6</td>
<td>Conduct a combination of a literature study and expert consults to identify and prioritize potential disruptive innovations relating to the defined problem or latent need.</td>
<td>d</td>
</tr>
<tr>
<td>7</td>
<td>Construct a roadmap with a focus on research, development, capability, and requirement in order to work out the disruptive innovation with the greatest potential.</td>
<td>d</td>
</tr>
<tr>
<td>8</td>
<td>Analyse the ‘gap’ in requirements left by a commodity product to identify the potential of a certain disruptive innovation.</td>
<td>f,g</td>
</tr>
<tr>
<td>9</td>
<td>Measure the maturity level of a commodity product to identify the potential of a certain disruptive innovation.</td>
<td>f,g</td>
</tr>
<tr>
<td>10</td>
<td>Measure the rate of technology adoption of the mainstream market to identify the potential of a certain disruptive innovation.</td>
<td>f,g</td>
</tr>
<tr>
<td>11</td>
<td>Make an assessment of the utilities between a certain disruptive innovation and a commodity product to identify the potential of a certain disruptive innovation.</td>
<td>f,g</td>
</tr>
<tr>
<td>12</td>
<td>Make an assessment of the other favourable drivers that could influence the pace or faith of a certain disruptive innovation to identify the potential of a certain disruptive innovation.</td>
<td>g</td>
</tr>
<tr>
<td>13</td>
<td>Communicate the relative advantages of the disruptive innovation compared to other products by the use of opinion leaders or reference sites.</td>
<td>h</td>
</tr>
<tr>
<td>14</td>
<td>Aim the communication of the relative advantages of the disruptive innovation to innovators and early adopters.</td>
<td>h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Criteria high-quality NPD process</th>
<th>Explanation</th>
<th>Source*</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Identify (potential) customer needs, wants, and preferences to back the development process by providing accurate information about changing needs.</td>
<td>i,</td>
</tr>
<tr>
<td>16</td>
<td>Define areas of strategic focus with a long-term view by means of project portfolio management, leading to a clear goals/objectives for the total new product introduction effort, which are clearly communicated.</td>
<td>j</td>
</tr>
<tr>
<td>17</td>
<td>Focus on up-front homework, resulting in a sound business case, before the development process starts.</td>
<td>j</td>
</tr>
<tr>
<td>18</td>
<td>Create a dedicated, multidisciplinary team with a strong champion to perform the development process.</td>
<td>i,j,k</td>
</tr>
<tr>
<td>19</td>
<td>Engineer a development phase which includes a sharp, early product definition, strong go/kill points, a constant focus on quality, which is complete, but flexible. This can be done by means of a stage-gate approach.</td>
<td>j,l</td>
</tr>
<tr>
<td>20</td>
<td>Include an extensive testing phase during the development process consisting of in-house testing and pilot production.</td>
<td>i,</td>
</tr>
<tr>
<td>21</td>
<td>Use strong advertising and promotion activities during the launch phase.</td>
<td>i</td>
</tr>
<tr>
<td>22</td>
<td>Use a cross-functional team during the launch phase</td>
<td>k</td>
</tr>
<tr>
<td>23</td>
<td>Let the launch phase feed into a continuous innovation phase which combines operational effectiveness and strategic flexibility.</td>
<td>m</td>
</tr>
<tr>
<td>24</td>
<td>Use a self-organized cross-functional team during the continuous innovation phase.</td>
<td>n,o</td>
</tr>
</tbody>
</table>

Appendix 2

Date: 

Name: 

Position: 

1. Can you explain the duties related to your current position?

2. Can you explain the NPD process at COMPANY X. How is it structured?
   a. Which methods/procedures are in use?
   b. Is there a distinction between sustainable/disruptive innovations?

3. What is the role of TM in the NPD process?

4. What is the role of T&I in the NPD process?
Appendix 3

**Meeting with:** T. S.  
**Position:** Manager  
**Date and time:** 16-09-2012 at 10.00

The purpose of the meeting with T. S. was to get a better view on the NPD process at COMPANY X. It was a semi-structured interview, following the manuscript given in Appendix 1.

T. S. explains the difference between two types of NPD projects: the market pull projects and the technology push projects. The first type of NPD projects is almost fully conducted by the TM department who is representing the ‘voice of the customer’ and T&I will, for example only provide information about the necessary additives. The second type of NPD projects is almost fully conducted by T&I and after that they have developed a new technology, TM will be involved to help with finding applications and customers for the newly developed technology. These types of NPD projects have their own separate stage-gate models. This also means that a project team working on a NPD project is not always multidisciplinary and may change over time when other functions needs to be included in the process.

Also, according to mister S., the gatekeeping team does not have the same composition for each gate. During the early gates 1 and 2 it may be a smaller, more lightweight, team and at gate 3 it is the heavyweight value team (VT) that takes the decision to continue or stop development of the new product.

Mister S. states that there is no specific approach for a disruptive innovation. This is because the disruptiveness factor of a new product can only been seen after the introduction on the market and not on beforehand.
Appendix 4

**Meeting with:** G. C.  
**Position:** Senior manager  
**Date and time:** 19-09-2012 at 13.00

The purpose of the meeting with G. C. was to get a better view on the NPD process at COMPANY X. It was a semi-structured interview, following the manuscript given in Appendix 1.

First, mister C. explained his background. He studied chemical technology in university and worked for Shell and DSM, before he started at COMPANY X. His positions had always a strong emphasis on technology and developing new products. Personally, mister C. is heavily interested in pure innovation and this is reflected in the way he manages his TM department. Pure innovation is explained as introducing new products on new markets (see: Figure 12).

![Figure 12: New product matrix](image)

According to mister C., at COMPANY X 90 percent of new product introductions are commodities: existing products that are introduced to existing markets. The strategy for 2005 until 2010 was to introduce more new products to existing markets. Bringing existing products to new markets is known as segmentation. The pure innovation concept of mister C. is in the quadrant of new products released on new markets.

The foamed film project is given as an example of pure innovation, conducted by E. V., within the LD/LLDPM BU. This innovative project is aimed at using foam for the production of films for the production of films for packaging. By the use of this low-density foam for the production of films, a huge cost reduction may be possible. But, this material requires a different production process and therefore it needs to be developed in close cooperation with film producers. G. C. is struggling with the question how to play this game of disruptive innovation, and more specifically: how to protect the intellectual property of this innovation.

When asked to describe the methods and procedures for NPD, G. C. answered that he does not believe in these flow schemes. He sees them as innovation killers.
The role of TM and technology & innovation (T&I) in the NPD process is quite distinct. TM has direct contact with the market and the customers, during visits and exhibitions. They translate customer needs and market trends into proposals for new products. T&I have rarely or never direct contact with the COMPANY X customers and is performing fundamental R&D. Their outcomes are more likely to be disruptive, since they are not based on existing market structures. Together, T&I and TM are responsible for delivering ideas and concepts that form the input for multidisciplinary meetings about aligning the portfolio of new products.
Appendix 5

Meeting with:  J. B.
Position:  Manager
Date and time:  02-10-2012 at 10.15

The purpose of the meeting with J. B. was to get a better view on the NPD process at COMPANY X. It was a semi-structured interview, following the manuscript given in Appendix 1.

Miss B. introduced herself by stating that she works for COMPANY X for six years now. First as a TM engineer responsible for extrusive coating, and currently as manager of the technical application centre (TAC) PE.

She explained that TM is focusing on the market. They compare the position of the current COMPANY X product portfolio with that of the competitors, and take a look at market movements. They do this by contacting customer, end-users, and machine manufacturers. Most of the ideas for new products originate from TM.

TAC is responsible for the coordination within the organization of the new product ideas that TM suppose. After an approval during a value team meeting, they involve production, logistics, and site management into the project.
Appendix 6

Meeting with: P. B.
Position: Manager
Date and time: 27-09-2012 at 08.45

The purpose of the meeting with P. B. was to get a better view on the NPD process at COMPANY X. It was a semi-structured interview, following the manuscript given in Appendix 1.

P. B. started as a process technology manager at the Geleen site and is currently responsible for the global process excellence process at the T&I department of COMPANY X.

Mister B. explains that T&I have multiple research centers all across the world. The locations of this research centers are based on historical reasons, but also they tend to be close to sites, close to customers or close to scientific resources. Within the resources centers the T&I researchers are working on NPD projects.

According to mister B. the overall NPD process is as follows. On a very high level, the BU’s are determining the strategy of the business. The can steer the technology roadmap towards more disruptive innovations. But, when they want disruptive breakthrough innovations they need to enlarge the budgets for T&I. Since, the BU’s are traditionally incrementally and locally oriented, there is not much of a long term vision. A long term vision should encompass the identification of gaps in the market. Based on this gaps, the researchers of T&I should get directions to conduct projects. Mister B. adds that most of the time T&I is seen as the department responsible for innovation, but T&I can only deliver if there is a clear strategy on which areas to provide innovations.

At this moment the T&I department is going through a major change related to NPD. For all the projects T&I is conducting they are using a stage-gate process. This process is digitalized in a software tool called Accolade. Accolade is a tool that steers the T&I organization into using the same standardized methods for the stage-gate approach globally. Moreover, it provides a dashboard where you can easily check the progress of all the projects of different types. Accolade is used in Geleen, Bergen op Zoom en Saudi-Arabia and will be expanded to other research centers globally.
Appendix 7

Date:
Name:
Position:

Introduction about the product

Determining NPS

- Most important driver

Goal of the product

Theme A: NPD team

- Dedicated
- Multidisciplinary
- Strong champion

Theme B: Organizational support

- Long-term strategic focus with clear goals

Theme C: NPD process

- **General**: Go/kill points, focus on quality, roadmap
- **Testing**: In-house/prototype/pilot production testing
- **Up-front homework**: problem definition, expert consults, customer analysis
- **Disruptiveness**: analyzing the gap, measure maturity level, technology adaption rate, assessment of utilities

Theme D: Market scan

- Surveying beyond traditional market boundaries
- Monitoring competitors’ movement and likelihood of attack
- Identify market opportunities (corporate failure competitors)

Theme E: Marketing

- Communicating the relative advantages by opinion leaders or reference sites
- Aim at innovators and early adopters
Appendix 8

Meeting with: M. N.
Position: Manager
Date and time: 26-11-2012 at 14.00

The purpose of the meeting with M. N. was to discuss the reasons for the success of the PRODUCT A grade.

Introduction about the product
The PRODUCT A is a foam grade. Foam is used for the production of a wide array of product types: from packaging to medicals, and from tapes to caps and closures. This specific COMPANY X foam grade has a lower density and a higher quality, leading to cost reductions, processing improvements and an improved product quality for foam producers.

Determining NPS/Goal of the product
The PRODUCT A grade is a premium grade, sold for high prices compared to competitor’s foam grades. Due to the premium quality of the grade and the fact that the COMPANY X team is contacting both purchase as well as operations representatives from the potential customers, it can sell this grade against high prices because they show the overall cost benefits for the potential customers. These overall cost benefits are reached by advantages that arise because of the technical superiority of the COMPANY X grade compared to competitor’s grades.

Theme A: NPD team/Theme B: Organizational support
In terms of NPD, the COMPANY X foam grade product category is continuously evolving. This evolution is mainly into niche-applications which require some special grade properties, since there is a lot of margin to make in those special low-volume market segments. The ultimate goal is to have a broad range of multiproduct foam grades that serve the whole market with specialized grades. According to mister N. one of the most important things to keep in mind during this segmentation is to give products (even if they are technically the same) a different name if you target them at a different market segment. This allows for price differentiation between the products based on the level of service that is associated with the products.

Beside this continuous development, there are also six weekly FOAM@COMPANY X meetings with participants from T&I, TM, BM and Sales to make sure that each actor within the organization is equal minded about the strategic direction of the foam grade product category.

Theme C: NPD process

Theme D: Market scan
Mister N. stresses the importance of having a well-defined market snapshot which encompasses competitors, customers and potential customers. Competitor’s customers are also potential customers.
Theme E: Marketing
For the PRODUCT A grade, COMPANY X makes use of the consultant sales concept. This means that COMPANY X not only sells a product, but also resolves production problems and enhances production quality with their product. Therefore it is important to make a link between purchase and technique when targeting potential customers. After the sale, COMPANY X tries to lock-in the customers by the use of patents. This means that a customer can only acquire the production improvements by using COMPANY X material. Moreover, by delivering a very extensive service package, COMPANY X locks-in the customers as well.

Mister N. wants to cooperate with machine manufactures in the future to use that as a reference that the COMPANY X foam grades are the best choice for those specific machines for the production of foam products.
Appendix 9

**Meeting with:** E. V.  
**Position:** Engineer  
**Date and time:** 26-11-2012 at 13.00

The purpose of the meeting with E. V. was to discuss the reasons for the success of the PRODUCT A grade.

**Introduction about the product**
The PRODUCT A is a foam grade. Foam is used for the production of a wide array of product types: from packaging to medicals, and from tapes to caps and closures. This specific COMPANY X foam grade has a lower density and a higher quality, leading to cost reductions, processing improvements and an improved product quality for foam producers.

**Determining NPS/Goal of the product**
At this moment, COMPANY X is the largest player on the LDPE foam market, with a 48 per cent market share. However, COMPANY X’s foam grades are also the highest priced products on the market. The reason that they can ask these high prices is because they escape the commodity trap by delivering a technologically superior product which locks-in customers, once they buy it. The technological advantages of the PRODUCT A grade are communicated via a joint meeting with the customer’s and COMPANY X’s purchasing and operational representatives. After showing the operational representative that the COMPANY X grade will deliver process improvement (e.g. less web break) and an improved quality of the end product (e.g. finer cell structure, less corrugation and an improved resilience), he will be convinced to use the COMPANY X grade. The purchasing representative, however, will most likely be reticent to use the COMPANY X grade, because of the higher price compared to competitors. In order to convince the purchasing representative, a total cost of ownership model shows an overall cost reduction by using the technologically superior COMPANY X grade compared to less quality competitor’s grades. This type of selling is sometimes referred to as: consultant sales.

**Theme A: NPD team**
The COMPANY X foam grades are developed by a dedicated team, consisting of employees from TM, sales, and T&I. Mister van de Ven indicated that M. N. may be the strong champion of this NPD team striving for continuous development of the foam grades.

**Theme B: Organizational support**
For the COMPANY X foam grades, there is quite a lot of organizational support. Each 6 weeks there is a so-called FOAM@COMPANY X meeting which includes people from different functional departments. During these meeting the long-term strategy is determined. With a focus on development and patenting issues.

**Theme C: NPD process**
The NPD process for the COMPANY X foam grades had a clear focus on quality and consists of a clear roadmap which improved products to release in the upcoming years.
Theme D: Market scan/ Theme E: Marketing
Potential customers for the 2202 UMS grade are always contacted by a sales and a TM representative from COMPANY X. Because of the superior technology of the products, COMPANY X aims their sales effort at high quality foam producers. Before the contacting of a potential customer, the COMPANY X team needs to know the business of the customer to persuade the customer, via the total cost of ownership model, that the superior technical performance of the grade leads to a cost reduction for the customer.
Appendix 10

Meeting with: M. S.
Position: Senior manager
Date and time: 11-12-2012 at 09.30

The purpose of the meeting with M. S. was to discuss the successfulness of the PRODUCT B and PRODUCT C grades and the unsuccessfulness of the PRODUCT I grade.

Introduction about the product (PRODUCT B)
The ICP4907S grade is used for the production of big containers (with a volume up to 1000 liters) which are used for the transportation of dangerous substances. Before this type of grade can be sold, approval by the United Nations is necessary. This approval can only be acquired after several tests.

Determining NPS/Goal of the product (PRODUCT B)
The ICP4907S grade was introduced in 2007 in a two year exclusivity deal with guaranteed sales together with the largest player on the container market: Schütz. Before that time, COMPANY X was not participating on this market. They were asked to do so because the exclusive supplier of Schütz, LyondellBasell, was facing a financial crisis and therefore Schütz considered the possibilities for a second supplier to diminish the supplier risk.

Theme A: NPD Team (PRODUCT B)

Theme B: Organizational support/Theme C: NPD Process (PRODUCT B)
According to mister S., the organization supported the ICP4907S project by investing in factory assets in order to produce the grades by dosing the hexane volume. These new factory settings were operational in November 2009.

Theme D: Market scan/Theme E: Marketing (PRODUCT B)
Before producing this product, COMPANY X was mainly active in the HDPE blow molding segment for bottles. This was only one half of the HDPE blow molding market and also the least profitable half. Therefore, COMPANY X was investing in product quality after entering in the HDPE blow molding segment for containers. After entering the market by a two year exclusivity agreement with Schütz, COMPANY X was able to attract a lot of other customers by the good references they got by cooperating with Schütz.

Introduction about the product (PRODUCT C)
The PRODUCT C grade is typically used for the production of milk bottles.

Determining NPS/Goal of the product (PRODUCT C)
Under pressure of the English milk bottle market, which was claiming negative effects of HDPE bottles on smell and health, COMPANY X started with evolving its milk bottle grade by adding a new additive to the product. This resulted in a product which was multiply recyclable and had low smell.
features. With this new product, COMPANY X was able to maintain its market share, but it never was able to get a higher margin for the new product features.

**Theme A: NPD team/Theme B: NPD process (PRODUCT C)**  
Milk bottle producer Blowplast wanted to participate in trials with the newly added additive and thereby COMPANY X was able to deliver a technically superior product.

**Theme C: Organizational support (PRODUCT C)**  
The organization shifted the production of the B6246LS grade to KSA, where it replaced a lower margin product. By this shift there was created more capacity in Europe to produce other products.

**Theme D: Market scan/Theme E: Marketing (PRODUCT C)**  
-  

**Introduction about the product (PRODUCT I)**  
The PRODUCT I grade is typically used for the production of cartridges. Cartridges are e.g. the housing used for silicone sealant dispensers.

**Determining NPS/Goal of the product (PRODUCT I)**  
The M80060CC was developed in an attempt to deliver more products for the injection molding market. In 2007, COMPANY X terminated the project because the margins were too low compared to the rest of the injection molding market.

**Theme A: NPD team/Theme B: Organizational support/Theme C: NPD process (PRODUCT I)**  
-  

**Theme D: Market scan/Theme E: Marketing**  
According to mister S., the development was started after a potential customer scan at Fisbach, among others. After the development, it turned out that COMPANY X was never able to enter the market by delivering at Fisbach. This was because Eneos, who is big in still water applications, was using the cartridge market to dump its waste material which they could not sold for a premium price. This important market characteristic was only resolved after the development of the PRODUCT I grade.
Meeting with: T. S.
Position: Manager
Date and time: 26-11-2012 at 11.00

The purpose of the meeting with T. S. was to discuss the reasons for the success of the ICP4907S grade.

Introduction about the product
The ICP4907S grade is used for the production of big containers (with a volume up to 1000 liters) which are used for the transportation of dangerous substances. Before this type of grade can be sold, approval by the United Nations is necessary. This approval can only be acquired after several tests.

Determining NPS/Goal of the product
In 2007, the firm LyondellBasell had a leading position in supplying grades for the production of these big containers for dangerous fluids. They were the supplier of Schütz, the largest producer of those containers. Due to financial troubles at LyondellBasell, Schütz started thinking about reducing their supplier risk by attracting a second supplier for the necessary grades and contacted COMPANY X. At the same time, COMPANY X was looking for new ways to exploit their LD3 factory and they decided to produce the ICP4907S grade in this factory.

At this moment, COMPANY X supplies 50 per cent of Schütz’s demand. This is mainly because they delivered the grade for a better price than LyondellBasell. All COMPANY X’s competitors produce this kind of product and at this moment Schütz is searching for a third supplier, this behavior will most likely reduce the margins on the ICP4907S in the future.

Theme A: NPD team/Theme C: NPD process
T. S. was not involved in the actual development of this product. According to him, Ron Reijntjens knows more about this subject.

Theme B: Organizational support
Based on the ICP4907S grade, a whole portfolio of ICP grades was developed for a wide array of applications. These grades for special applications, such as pharmaceutical PCG grades, are sold against higher margins than the initial grade.

Theme D: Market scan
Mister S. states that COMPANY X is proactively approaching potential customers with a single-supplier relationship to make them aware of the supplier risks that are involved with such a relationship. The ultimate goal is to introduce COMPANY X as a second supplier and try to grow bigger than the initial single-supplier in terms of volume.

Theme E: Marketing
T. S. concludes this interview with the following learning point: cooperation with customers in developing a product works. This guarantees a certain level of sales and thereby makes the
development of a new product a sound investment. Based on this initial developed product, a whole portfolio of products may be developed.
Appendix 12

Meeting with: G. B.
Position: Engineer
Date and time: 26-11-2012 at 15.00

The purpose of the meeting with G. B. was to discuss the reasons for the success of the PRODUCT C grade.

Introduction about the product
The PRODUCT C grade is typically used for the production of milk bottles.

Determining NPS/Goal of the product
COMPANY X was aiming at escaping a commodity market and creating a higher margin by producing a grade with superior recycling and organoleptic properties for milk bottles. Technically, the PRODUCT C grade was superior to competitor’s milk bottle grades. Nevertheless, the product was not a great financial success. Milk bottle producers did not value the new properties of the grade and therefore were not willing to pay additionally for it. Perhaps it was too early for milk bottle producers to embrace the sustainability concept. COMPANY X maintained or even slowly increased its market share in the milk bottle grade market, but they never received the higher margin where they were aiming at.

Theme A: NPD team/Theme C: NPD process
The development of the B6246LS grade was a combined TM and T&I project. According to mister B., G. C. knows more about it.

Theme B: Organizational support/Theme D: Market scan

Theme E: Marketing
Marketing activities for this product consisted mainly of: presentations, conferences, PR, and also the visiting of (potential) customers. Mister B. states that the customers are not always visited by both Sales and TM representatives.

Other
By the end of the interview, mister B. shared his opinion about enlarging NPS in the future. This can be done by having a more effective business intelligence which monitors the competitive environment more closely in order to identify opportunities to capture market share. At this moment, it are often the (potential) customers who indicate when one of COMPANY X’s competitors is having troubles.
Appendix 13

Meeting with:  G. C.
Position: Senior manager
Date and time: 05-12-2012 at 14.00

The purpose of the meeting with G. C. was to discuss the reasons for the success of the PRODUCT C grade and the non-success of the M80060CC grade.

Introduction about the product (PRODUCT C)
The PRODUCT C grade is typically used for the production of milk bottles.

Determining NPS/Goal of the product (PRODUCT C)
About six years ago, there was a discussion, started at T&I, about a possible additive to the milk bottle grade. It turned out that this additive would lead to a more stable product which is a perfect property for recycling. Moreover, this product also had better organoleptic properties, which means that it does not release any taste or smell into the milk. Finally, due to the improved stiffness of the product, milk bottles could be produced with less material, making them lighter and also more effective to produce.

At that moment, the milk bottle market was positioning itself with a sustainable image. This sustainable movement was also embraced by Nempack which was the largest producer of milk bottles. COMPANY X saw this movements on the market and believed that the unique properties of their milk bottle grade would perfectly fit those movements and therefore could potentially raise additional margins compared to the competitors’ products.

Relating to the success of this grade mister C. states that COMPANY X has maintained or even raised its market share in the milk bottle market. The customers accept the product, are highly satisfied with the product but they are not paying the additional margin that COMPANY X was striving for with this technologically superior milk bottle grade.

Theme A: NPD team/Theme C: NPD process (PRODUCT C)

Theme B: Organizational support (PRODUCT C)
Within the organization there was the opinion that milk bottles were becoming a commodity market, with a lot of price based competition and low margins. Therefore, this market was no longer strategic for COMPANY X and the production of the PRODUCT C grade was shifted to KSA. No effort was put into promoting the unique properties of this product to escape the commodity trap.

Theme D: Market scan/Theme E: Marketing (PRODUCT C)
Mister C. stated that the product was marketed and sold as a commodity product, COMPANY X did not emphasize enough on the unique properties of the product. This was despite the fact that none of the competitors had these unique properties.
Introduction about the product (PRODUCT I)
The PRODUCT I grade is typically used for the production of cartridges. Cartridges are e.g. the housing used for silicone sealant dispensers.

Determining NPS/Goal of the product (PRODUCT I)
This product was launched from a factory which was victim of different intern strategic interests. Without any knowledge of the market, COMPANY X chooses to produce a me-too product for the cartridges market, but it turned out that the customer demands were too fragmented to serve with only one grade. The product was technologically fine, but there was no trend or support in the cartridge market.

Theme A: NPD team/Theme C: NPD process (PRODUCT I)

Theme B: Organizational support (PRODUCT I)
The organizational support for developing this product stemmed from the fact that COMPANY X was looking for products to produce in a factory that has to be filled with a new product portfolio. Therefore there was sufficient organizational support to the development of this grade. However, at this moment there is no support at all and this product is not produces anymore.

Theme D: Market scan/Theme E: Marketing (PRODUCT I)
Mister C. stated that COMPANY X was entering in a commodity market with a me-too product. In this market, 1 or 2 big competitors were serving the existing customers with a diversified portfolio of cartridge grades. COMPANY X was not able to deliver this broad portfolio, nor did it bring additional value to the value chain by delivering a technologically better product.
Appendix 14

**Meeting with:**  R. C.
**Position:**  Engineer
**Date and time:**  11-12-2012 at 11.00

The purpose of the meeting with R. C. was to discuss the successfulness of the PRODUCT D grades and the unsuccessfulness of the PP CPC 35C grade.

**Introduction about the product (PRODUCT D)**
The PRODUCT D grades are transparent polymers which are used for food trays and buckets.

**Determining NPS/Goal of the product (PRODUCT D)**
COMPANY X was the first to include an innovative additive to their random copolymers. This additive, bought from a supplier, made the product highly transparent and gave the product a better flow behavior. The new product was an immediate success with high sales volumes offered at a higher price than other products. But, since competitors have started using the same additive, COMPANY X could not maintain the high price for the no longer unique features. Starting from this year, the prices are decreasing.

**Theme A: NPD team/Theme C: NPD process (PRODUCT D)**
COMPANY X was quick in adapting a new technology from an additive supplier into its new products, because they had the specific knowledge about the additive from newly attracted employees. These employees were former employees from the additive supplier.

**Theme B: Organizational support (PRODUCT D)**

**Theme D: Market scan/Theme E: Marketing (PRODUCT D)**
At first, COMPANY X promoted the PRODUCT D with an emphasis on the high transparency features, but after the entry of many competitors which were using the same additive they focused more on the flow behavior of the product. This flow behavior allows customers to produce faster at lower temperatures.

**Introduction about the product (PRODUCT F)**
The PRODUCT F grade is a transparent grade with a higher impact than other transparent polymers. This makes it applicable as material for the production of paint or ice cream containers who should be capable of handling a high impact.

**Determining NPS/Goal of the product (PRODUCT F)**
The product was not very successful. COMPANY X had to use a higher price for this grade than for other, non-transparent grades with the same impact properties, because it was expensive to produce a transparent product. Besides that, the competitors were already making this kind of product and their products had a better performance. This two reasons made it no easy to convince customers in this market.
Appendix 15

Meeting with: D. G.
Position: Engineer
Date and time: 18-12-2012 at 09.30

The purpose of the meeting with D. G. was to discuss the successfulness of the PRODUCT D grades and the unsuccessfulness of the PRODUCT E and PRODUCT F grade.

Introduction about the product (PRODUCT D)
The PRODUCT D grades are transparent polymers which are used for food trays and buckets.

Determining NPS/Goal of the product (PRODUCT D)
According to mister G. the success of this grade was due to one important characteristic: COMPANY X was the first to market to introduce a random copolymer with high transparency properties at low production temperatures. This has advantages for producers in terms of cost savings and reducing energy waste. COMPANY X could bring this product at high speed to the market because they had the relevant knowledge internally and they could keep the development within one department. This resulted in the fastest growing product in the PP market.

At this time, the success of the product turned out to be sustainable due to the continuous development and segmentation efforts at COMPANY X. This year they added another three new products to their QR product portfolio.

Theme A: NPD team/Theme C: NPD process (PRODUCT D)
The NPD team consisted only of employees from the TM department. This enhanced the effectiveness of communication and the speed of the development process dramatically. The associated TM employees had a strong knowledge base with regard to the product category.

Theme B: Organizational support (PRODUCT D)
There is an ongoing organization support to segment and further develop the product category.

Theme D: Market scan/Theme E: Marketing (PRODUCT D)
The strategy was to make full use of the fact that COMPANY X was the first to market with this type of product. Therefore, they launched a combined plan with the TM and SALES departments as actors to intensively promote the product to raise their market share in the period that the product was without competitors. They even started sales in regions outside the base market that would not have been attractive normally.

Together with the combined sales plan, a communication plan was launched. For one of the first times, COMPANY X was promoting the new product with a new brand name. They even contacted a marketing agency to support them with the communication campaign.

Introduction about the product (PRODUCT E)
The PRODUCT E grade is used for the production of flexible foils. These foils can be used for the production of pouches.
**Determining NPS/Goal of the product (PRODUCT E)**
With this new product, COMPANY X has not any position on the foil market. This is because the product does not have any unique properties and, even worse, does not comply with the quality standards of the competitors on that market.

**Theme A: NPD team/Theme C: NPD process (PRODUCT E)**
For this product category, COMPANY X did not have any knowledge internally.

**Theme B: Organizational support (PRODUCT E)**
-

**Theme D: Market scan/Theme E: Marketing (PRODUCT E)**
COMPANY X is seen as a financial healthy organization. COMPANY X though they could profit from competitors’ customers who perceived a supplier risk, because of the financial troubles of competitors in the foil market. Their whole sales strategy was aimed at enlarging the fear of potential customers.

**Introduction about the product (PRODUCT F)**
The PRODUCT F grade is a transparent grade with a higher impact than other transparent polymers. This makes it applicable as material for the production of paint or ice cream containers who should be capable of handling a high impact.

**Determining NPS/Goal of the product (PRODUCT F)**
The CPC35C grade is a niche product, which means that it has no high sales volumes. Nevertheless, the value proposition is working and the product is sold at premium prices. Those prices are high because of high production costs, but the product is also sold with a relatively high margin.

According to mister G., the product is a technical success and also the value proposition of the product is working. However, there is not sufficient belief in the product and therefore also no further development.

**Theme A: NPD team/Theme C: NPD process/Theme D: Market scan/Theme E: Marketing (PRODUCT F)**
-

**Theme B: Organizational support (PRODUCT F)**
Mister G. does perceive this product to be strategically to COMPANY X. But there is no organizational support to further develop the product and this is necessary to get a better margin for this premium product.
Appendix 16

Meeting with:  P. W.
Position:  Engineer
Date and time:  06-12-2012 at 09.00

The purpose of the meeting with P. W. was to discuss the success of the PRODUCT D grades and the non-success of the PRODUCT E grade.

Introduction about the product (PRODUCT D)
The PRODUCT D grades are transparent polymers which are used for food trays and buckets.

Determining NPS/Goal of the product (PRODUCT D)
COMPANY X acquired two employees from an organization which produces additives for PP production. Because of their former experiences they know that there was an additive in development that could make a highly transparent polymer, against a lower than average cost price. Moreover, the additive also makes it possible to produce the product quicker and therefore to better utilize the capacity. COMPANY X decided to be the first to include this additive in their PP products and the products with enhanced transparency features were quickly accepted in the market. COMPANY X even reached a market share of 10-15% in this market. Shortly after the introduction, COMPANY X was able to get a relatively high margin for this lower cost transparent polymer, because even with a high margin it was cheaper than products with the same transparency level that did not use the additive. However, because COMPANY X buys this additive from a supplier, competitors were also able to do so and yet the market is becoming commoditized again.

Theme A: NPD team/Theme C: NPD process (PRODUCT D)
The NPD for the PRODUCT D grades was purely TM driven. T&I’s expertise was not used, since the TM employees came up with the additive themselves based on former experiences.

Theme B: Organizational support (PRODUCT D)
The organization supported this PRODUCT D project because COMPANY X was embracing a new strategy of producing higher margin grades in Europe. Transparent grades have higher margins than non-transparent PP grades and therefore in 2007 a factory was refurbished to make the production of transparent PP grades possible. In order to fill that factory a whole range of PRODUCT D products was developed.

Theme D: Market scan/Theme E: Marketing (PRODUCT D)
The QR grades are marketed as a full product range. According to mister W., this disperses the market into small segments that are served with PRODUCT D variants that are not that different at all. But, perhaps this is the only way to serve the whole potential of the market.

Introduction about the product (PRODUCT E)
The PRODUCT E grade is used for the production of flexible foils. These foils can be used for the production of pouches.
Determining NPS/Goal of the product (PRODUCT E)
As a result of the strategic course set out in 2007, COMPANY X was aiming at producing higher margin grades in Europe. Because of the large foil market segment, it seems a good opportunity to sell high volumes of new products. COMPANY X released their PRODUCT E grade in 2010, but it underestimated the technical properties and market knowledge of the foil industry and therefore the product never really became a success. COMPANY X only sold 3 kT and they forecasted to sell 40 kT.

Theme A: NPD team/Theme B: Organizational support/Theme C: NPD process (PRODUCT E)
According to mister W., COMPANY X’s foil grade had a too low weld ability and their product had the tendency to glue. This was because COMPANY X had too less knowledge, manpower, and money devoted to this project. There was no machine to test the grade internally and also T&I had no resources available for research on the properties of the foil grade.

Theme D: Market scan/Theme E: Marketing (PRODUCT E)
It turned out after product release that the foil market was a complex market where the two largest players had a market share of 40%. Both these organizations were supplying almost thirteen foil product variants and possess a superior technological knowledge about foil.

At this moment the product is approved and sold in Poland and Russia. There are the changes for COMPANY X, because there are no local supplier of foil grades in those C.tries and COMPANY X has a good sales network in place for those C.tries.
Appendix 17

Meeting with: D. J.
Position: Coordinator
Date and time: 28-11-2012 at 10.45

The purpose of the meeting with D. J. was to discuss the reasons for the non-success of the PRODUCT G grade.

Introduction about the product
The PRODUCT G grade is typically used in the fiber industry, i.a. for the production of diapers.

Determining NPS/Goal of the product
Originally, COMPANY X served the fiber industry with the 512P grade, which was imported from the Kingdom of Saudi-Arabia (KSA). Based on a market research performed in Italy, COMPANY X concluded that the PP 512P was too generic for many customers, since they preferred melt flow indexes between 511 and 519. Therefore, COMPANY X decided to introduce the PP 511A and the PRODUCT G in 2010. Both are also imported from KSA.

After the introduction of those two distinct grades, it turned out that most of the customers in the fiber industry preferred the PP 511A grade and associated melt flow index. For the PRODUCT G there were only two customers. The largest is Union from Italy, this organization produces P&G approved products. With this approval, COMPANY X can more easily sell the PP 511A grade to other potential customers. However, because the fiber market consists of a few very big producers, the competition is mainly price driven. Therefore, both the PP 511A and PRODUCT G are not very profitable. An additional disadvantage for the PRODUCT G grade is that there is almost no market for the grade and the largest customer for this product is complaining about the fact that the process ability of the material is worse than comparable material of the competitors.

Mister J. concluded the determination of the NPS with the remark that he doubts the correctness of the market research performed in Italy.

Theme A: NPD team/Theme C: NPD process

Theme B: Organizational support
At this moment the organizational support for the PRODUCT G grade is low. Despite the remarks about the bad process ability of the grade, COMPANY X is not willing to invest in development due to a too small customer base for this product.

Theme D: Market scan
Mister J. states that it is almost impossible to attract customers for the PRODUCT G grade. The only reason that the grade is still sold is the fact that a large customer (Union) still buys the product (and has a P&G approval). Otherwise, the PRODUCT G grade would probably not be sold anymore.
Theme E: Marketing
The most important factor in marketing these kind of fiber industry grades is that you deliver the product to customers who have approvals by the largest end-users like Kimberly Clark and P&G. This indicates to other potential customers that your material is approved by the largest fiber consumers and therefore safe to buy.
Appendix 18

Meeting with: R. H.
Position: Engineer
Date and time: 07-11-2012 at 10.00

The purpose of the meeting with R. H. was to get a better understanding about the potential success and the goals for the COMPANY X ® Vestolen A RELY 5924R and COMPANY X ® Product H grades, who are not sold commercially (on a large scale) yet. It was an unstructured interview.

Mister H. explains that the RELY grades are developed as specialization grades, by positioning these grades different compared to the existing grades. In order to reach a higher margin, the RELY grades, besides meeting the appropriate pressure properties, have a focus on sustainability. The grades reduce the carbon footprint of, and enhance the workability for the customers.

Parallel to the development of these RELY grades, COMPANY X is developing a new method to test the pressure properties of their products. This method allows COMPANY X to internally check the quality of their products, without having to wait for external quality checks. Moreover, with this new in-house method, COMPANY X will be able to better steer the quality of their products. This can be used as an unique selling point towards potential customers.

Relating to these grades’ success rate, mister H. states that the prospects are good. The first feedback from customers on the RELY 5924R grade is positive. Also, the product is technically well performing; the wall thickness and wall partition are fine. Besides that, COMPANY X has raised a lot of interest among potential customers. They even won an award for customer value enhancement for these new grades.
Appendix 19

Meeting with: J. E.
Position: Senior manager
Date and time: 05-11-2012 at 10.00

The purpose of the meeting with J. E. was to get a better understanding about the potential success of and the goals for the introduction of the COMPANY X ® Vestolen A RELY 5924R and COMPANY X ® Product H grades, who are not sold commercially (on a large scale) yet. It was an unstructured interview.

Mister E. explains that the RELY grades were introduced to the customers during the Vancouver 2010 exhibition. But, due to quality problems with the product, operational problems at the production site, and the long approval procedure for certification for the pipe industry it takes until January 2012 to launch the product commercially. At this moment COMPANY X is in the exploration phase with target customers.

One of the main causes for the long timespan from introduction to commercial launch was the certification procedure. The RELY 5922R grade is used for pipes with very well high pressure properties suitable for a large wall thickness. This large wall thickness makes the pipes made from the RELY 5922R grade suitable for the drilling of pipes in to the ground, instead of digging them. At this moment a German institute has a monopoly on the certification of these pipes. Therefore, COMPANY X is working on their own method to certificate these pipes, this method is quicker and more accurate than the existing one. Mister E. believes that the successful implementation of this quick test may boost sales for the RELY 5922R, because it shows the excellent quality of the pipes and the dedication of COMPANY X to the pipe industry.

RELY 5922R grade material that fails the requirements for certification for a specific pressure property, may be sold as RELY 5924R grade material, since this grade requires a lower pressure property. Both the RELY 5922R and the RELY 5924R grade are part of the new RELY branding family, with their own logo and style. The RELY family is positioned as an innovative family of grades, which have great processing advantages due to the emphasis on sustainability. The biggest competitor in this market is Borealis.

Relating to these grades’ success rate, mister E. states that COMPANY X have not sold a high volume of it yet, but already received an award for these grades. The award was assigned to COMPANY X because of their unique positioning on the market with these new products and their cooperation with customers.
Appendix 20

**Meeting with:** H. J.  
**Position:** Engineer  
**Date and time:** 05-12-2012 at 15.15

The purpose of the meeting with H. J. was to discuss the successfulness of the Vestolen A RELY 5922 and Vestolen A RELY 5924 grades.

**Introduction about the product**  
The RELY 5922R and 5924R grades are used for large diameter pipes with very well high pressure properties suitable for large wall thicknesses. Additional point load and anti-scratch properties make the RELY 5922R grade suitable for the drilling of pipes into the ground, instead of digging them.

**Determining NPS/Goal of the product**  
The RELY grades are developed because there was a movement in the market towards pipes with increasing diameters. In order to produce these pipes, the melt flow index of the material has to be decreased by making longer molecules. COMPANY X was not the first one with this special grade for large diameter pipes, they were a follower. However, their grades were energetically better performing than those of the competitors. Better energetic performance will lead to a higher throughput or the possibility to lower the processing temperatures. Both may result in financial benefits for COMPANY X's customers.

According to the success level of the RELY grades, mister J. states that the RELY 5924R grade is successfully growing into the market. The RELY 5922R is facing severe technical issues at the moment. Only 20% of the produced batches are certificated for sale and this resulted in a limited supply of this products. Therefore, COMPANY X cannot yet contact all the potential customers.

**Theme A: NPD team/Theme B: Organizational support/Theme C: NPD process**

**Theme D: Market scan/Theme E: Marketing**  
Mister J. explains that COMPANY X is not getting a higher margin out of the better energetic features of their RELY products. They use the energetic features as additional features of their me-too product to attract customers from competitors by offering their product at market prices.
<table>
<thead>
<tr>
<th>NPS</th>
<th>Category</th>
<th>Product name</th>
<th>Main drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>Market opportunity</td>
<td>PRODUCT B</td>
<td>• Main competitor was giving alarming signals to its customers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Product was developed in cooperation with large customer</td>
</tr>
<tr>
<td></td>
<td>Disruptive innovation</td>
<td>PRODUCT A</td>
<td>• First to the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Technologically superior product features compared to the competing products</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Customers are convinced to pay additional margins for a technologically superior feature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRODUCT D</td>
<td>• First to the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Technologically superior product features compared to the competing products</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Customers are convinced to pay additional margins for a technologically superior feature</td>
</tr>
<tr>
<td>Non-successful</td>
<td>Market opportunity</td>
<td>PRODUCT G</td>
<td>• Wrong estimation of the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRODUCT E</td>
<td>• Quality issues with the product</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Wrong estimation of the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRODUCT F</td>
<td>• Quality issues with the product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRODUCT I</td>
<td>• Wrong estimation of the market</td>
</tr>
<tr>
<td></td>
<td>Disruptive innovation</td>
<td>PRODUCT H</td>
<td>• Quality issues with the product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRODUCT C</td>
<td>• Customers were not convinced to pay additional margins for a technologically superior feature</td>
</tr>
</tbody>
</table>
Appendix 22

Table 6: Design criteria from practice

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
<th>Source*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Use a single stage-gate approach for the development process.</td>
<td>a</td>
</tr>
<tr>
<td>II</td>
<td>Let the development process always be conducted by a multi-disciplinary team.</td>
<td>b</td>
</tr>
<tr>
<td>III</td>
<td>Use an additional stage-gate approach for T&amp;I projects in order to enhance the fit between research and the support of the ideation phase.</td>
<td>c</td>
</tr>
<tr>
<td>IV</td>
<td>Focus on introducing new products on both the commodity and the specialties markets.</td>
<td>d,e</td>
</tr>
<tr>
<td>V</td>
<td>Ensure that the targeted market (segment) is not too small to make an acceptable profit.</td>
<td>-</td>
</tr>
<tr>
<td>VI</td>
<td>Ensure that the targeted market (segment) is not too highly segmented.</td>
<td>-</td>
</tr>
<tr>
<td>VII</td>
<td>Ensure that the targeted market (segment) is not taken by a few big players in an oligopolistic setting.</td>
<td>-</td>
</tr>
<tr>
<td>VIII</td>
<td>Attach sufficient money, manpower, and knowledge to the development process.</td>
<td>-</td>
</tr>
<tr>
<td>IX</td>
<td>Search proactively for possibilities to cooperate with a large potential customer in a certain market (segment).</td>
<td>-</td>
</tr>
<tr>
<td>X</td>
<td>Search proactively for possibilities to profit from the perceived supplier risk from potential customers, caused by competitors' facing a corporate crisis.</td>
<td>-</td>
</tr>
<tr>
<td>XI</td>
<td>Convince customers to pay additional margins for a product by convincing them of the overall (cost) advantages by using the product in a combined TM/sales effort.</td>
<td>-</td>
</tr>
<tr>
<td>XII</td>
<td>Prioritize products with chances of being the first to market with a certain feature.</td>
<td>-</td>
</tr>
<tr>
<td>XIII</td>
<td>Search for possibilities to protect a certain feature from use by competitors.</td>
<td>-</td>
</tr>
</tbody>
</table>

*: a = Samra et al. (2008), b = Kandemir et al. (2006), c = Cooper et al. (2002), d = Singh (2010), e = Milmo (2003),
### Appendix 23

**Table 7: Aggregation of the design criteria per phase**

<table>
<thead>
<tr>
<th>Phase 1: Ideation phase</th>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>III</td>
<td>Use an additional stage-gate approach for T&amp;I projects in order to enhance the fit between research and the support of the ideation phase.</td>
</tr>
</tbody>
</table>

#### Phase 1a: Idea screen

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Identify (potential) customer needs, wants, and preferences to back the development process by providing accurate information about changing needs.</td>
</tr>
</tbody>
</table>

#### IV

Focus on introducing new products on both the commodity and the specialties markets.

#### Phase 1b: Market opportunities (commodity markets)

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Survey the competitive environment beyond traditional market boundaries by using the first stage of the Bergen &amp; Peteraf (2002) framework to get a dynamic outlook on how the competitive environment is changing.</td>
</tr>
<tr>
<td>2</td>
<td>Use the second stage of the Bergen &amp; Peteraf (2002) framework to order the competitive environment in terms of threats and opportunities based on resource equivalence.</td>
</tr>
<tr>
<td>3</td>
<td>Act on a market opportunity by NPD effort in a certain market when the Bergen &amp; Peteraf (2002) framework indicates a better position in resources capable of meeting market needs than the direct competitors in that market.</td>
</tr>
<tr>
<td>4/X</td>
<td>Act on a market opportunity by NPD effort in a certain market when a competitor analysis based on the indebtedness and profitability of a competitor shows a high change of corporate crisis at that competitor.</td>
</tr>
<tr>
<td>5</td>
<td>Search proactively for possibilities to cooperate with a large potential customer in a certain market (segment).</td>
</tr>
</tbody>
</table>

#### Phase 1c: Disruptive innovations (specialities markets)

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Define a problem or latent need via an analysis of current and potential customers by a combination of the umbrella method, emphatic design and conjoint analysis.</td>
</tr>
<tr>
<td>6</td>
<td>Conduct a combination of a literature study and expert consults to identify and prioritize potential disruptive innovations relating to the defined problem or latent need.</td>
</tr>
<tr>
<td>7</td>
<td>Construct a roadmap with a focus on research, development, capability, and requirement in order to work out the disruptive innovation with the greatest potential.</td>
</tr>
<tr>
<td>8</td>
<td>Analyse the ‘gap’ in requirements left by a commodity product to identify the potential of a certain disruptive innovation.</td>
</tr>
<tr>
<td>9</td>
<td>Measure the maturity level of a commodity product to identify the potential of a certain disruptive innovation.</td>
</tr>
<tr>
<td>10</td>
<td>Measure the rate of technology adoption of the mainstream market to identify the potential of a certain disruptive innovation.</td>
</tr>
<tr>
<td>11</td>
<td>Make an assessment of the utilities between a certain disruptive innovation and a commodity product to identify the potential of a certain disruptive innovation.</td>
</tr>
<tr>
<td>12</td>
<td>Make an assessment of the other favourable drivers that could influence the pace or faith of a certain disruptive innovation to identify the potential of a certain disruptive innovation.</td>
</tr>
</tbody>
</table>

#### Phase 1d: Initial internal check

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Define areas of strategic focus with a long-term view by means of project portfolio management, leading to clear goals/objectives for the total new product introduction effort, which are clearly communicated.</td>
</tr>
<tr>
<td>17</td>
<td>Focus on up-front homework, resulting in a sound business case, before the development process starts.</td>
</tr>
<tr>
<td>V</td>
<td>Ensure that the targeted market (segment) is not too small to make an acceptable profit.</td>
</tr>
<tr>
<td>VI</td>
<td>Ensure that the targeted market (segment) is not too highly segmented</td>
</tr>
<tr>
<td>VII</td>
<td>Ensure that the targeted market (segment) is not taken by a few big players in an oligopolistic setting.</td>
</tr>
<tr>
<td>VIII</td>
<td>Attach sufficient money, manpower, and knowledge to the development process.</td>
</tr>
<tr>
<td>XII</td>
<td>Prioritize products with chances of being the first to market with a certain feature.</td>
</tr>
</tbody>
</table>

### Phase 2: Development phase

#### Phase 2a: Set up the team

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18/II</td>
<td>Create a dedicated, multidisciplinary team with a strong champion to perform the development process.</td>
</tr>
</tbody>
</table>

#### Phase 2b: Development

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Engineer a development phase which includes a sharp, early product definition, strong go/no-go points, a constant focus on quality, which is complete, but flexible. This can be done by means of a stage-gate approach.</td>
</tr>
</tbody>
</table>
| 20 | Include an extensive testing phase during the development process consisting of in-house testing and pilot
production.

I Use a single stage-gate approach for the development process.

XIII Search for possibilities to protect a certain feature from use by competitors.

### Phase 3: Selling the product

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Communicate the relative advantages of the disruptive innovation compared to other products by the use of opinion leaders or reference sites.</td>
</tr>
<tr>
<td>14</td>
<td>Aim the communication of the relative advantages of the disruptive innovation to innovators and early adopters.</td>
</tr>
<tr>
<td>21</td>
<td>Use strong advertising and promotion activities during the launch phase.</td>
</tr>
<tr>
<td>22/XI</td>
<td>Convince customers to pay additional margins for a product by convincing them of the overall (cost) advantages by using the product in a combined TM/sales effort.</td>
</tr>
</tbody>
</table>

### Phase 4: Continuous Innovation phase

<table>
<thead>
<tr>
<th>#</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Let the launch phase feed into a continuous innovation phase which combines operational effectiveness and strategic flexibility.</td>
</tr>
<tr>
<td>24</td>
<td>Use a self-organized cross-functional team during the continuous innovation phase.</td>
</tr>
</tbody>
</table>
Appendix 24

Figure 13: Design to proactively steer the development of successful products
Figure 14: Overview of the ideation and development phase of the design