

MASTER

Customer involvement methods for radical products

developing a framework to select appropriate customer involvement methods in each stage of the NPD process for B2B companies

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Eindhoven, February 2015

Customer involvement methods for radical products: developing a framework to select appropriate customer involvement methods in each stage of the NPD process for B2B companies

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in Innovation Management**

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Preface

This report marks the end of my education at Eindhoven University of Technology. Both the bachelor Innovation Sciences and the master Innovation Management provided me with insights into the beautiful world of innovations. Especially, developing innovations in a way that they fulfil needs in the market caught my interest. Fortunately, I got the opportunity to conduct my graduation research on this topic. Beyond the interesting education last six years, I enjoyed my student time as an active member of study association Intermate. I got the opportunity to participate in several committees and to organize a variety of activities, such as an introduction week, lustrum week, study trips, and a college tour. This helps to develop myself personally at different areas and it was the start of new, close friendships.

This final graduation project was not possible without the help of some people to whom I want to express my gratitude.

First, I would like to thank my supervisors of the university. I would like to thank Jeroen Schepers for the guidance during the whole process, from defining a challenging research question to this report finally. He always motivated me to achieve the best possible result. In addition, I would like to thank Myriam Clodt for helping me with the qualitative research method and to give attention to some additional points that could be improved.

Second, I would like to thank Gaston and Ernst for their opportunity to graduate within the company about a topic I am really interested in. Furthermore, I would like to thank Gaston for guiding me during the whole process. His critical but supportive attitude stimulates me to think always one step further. In addition, I would like to thank Ernst for his positive feedback. Moreover, I would like to thank the employees of the marketing department to give me the opportunity to experience the daily activities and for sharing their experiences about working in an international company. Finally, I would like to thank all the employees who participated in the interviews and for their enthusiasm relating to my research topic. This really gave me some extra support to finish this report as well as possible.

Third, I would like to thank my parents and sisters for their support during my education. Furthermore, I would like to thank my friends with whom I did many nice activities next to studying. Finally, I would like to thank Jef who reads this report again and again and helps me when I did not know how to continue. But more importantly, he supported me from begin till end during all my ups and downs for which I am very grateful.

Last, I would wish everyone much pleasure while reading this report.

Stephanie Meertens

Eindhoven, February 2014

Management summary

Introduction

To achieve superior NPD performance, it is important to involve customers in the new product development (NPD) process (Hsieh & Chen, 2005). When companies understand their customers and the market, they can fit the developed product with the customers' needs in early stages of the NPD process which improves the NPD performance. Customer involvement is any interaction between customers and the design process (Kaulio, 1998). Different methods exist to collect information from customers. Those customer involvement methods can support and improve the NPD process in several ways. Studies have indicated that customer involvement methods support the process differently in early stages than in later stage of the NPD process (Veryzer, 1998a; O'Connor, 1998). Because the contribution of customer involvement methods differs between methods and phases of the NPD process, it is important to take goals of customer involvement methods into account when selecting the most appropriate method. Current research studied most customer involvement methods as on isolated subject and did not investigate to which NPD goals the methods contribute.

This research is conducted within a large complex equipment manufacturer (CEM). The employees of the CEM experience problems in selecting the most appropriate customer involvement method. In addition, they experience the process of customer involvement as unstructured because no guidelines exist to help them in making good, underpinned decisions. The unstructured approach results in acquired information that is conflicting, incomplete or incorrect which results in longer development times or higher development costs. This problem is also mentioned in research of Karkkainen and Elfvingren (2002). In addition, research has proved that customer involvement methods are developed for specific stage of the NPD process (Nijssen & Lieshout, 1995). As the CEM is mainly active in a business to business (B2B) market and develops radical products, the scope of this research will be on customer involvement methods for radical NPD process in a B2B environment.

Research can give more insights into appropriate customer involvement methods for the development of radical products and how those customer involvement methods contribute to the NPD process. This thesis contributes to gaining these insights by answering the following research question:

Which methods of customer involvement should the CEM apply in each stage of the new product development process for radical products to acquire information about customers, market and business?

Methodology

To answer the formulated research question, a literature study and a case study were conducted. The literature study gave insights into goals of each NPD stage, available customer involvement methods for radical NPD process and the information that each customer involvement method can collect. Based on the collected information of the literature study, a framework was proposed that presents available customer involvement methods during the NPD process of radical products. In addition, an overview was developed which specifies the collected information per customer involvement method.

Subsequently, the case study approach was conducted to acquire information about customer involvement methods in an empirical setting. Four radical projects within the CEM were selected to analyse the applied customer involvement methods. Data was collected by conducting semi-structured interviews with involved employees and by analysing company documents. The collected data was analysed by applying content analysis.

Literature study

In the NPD process, five stages can be recognized, namely scoping, build business case, development, testing & validation, and launch stage. In each stage, information is collected by companies to ensure the goals of each NPD stage are reached (Cooper, 2001). Companies can involve customers to collect that information. Previous studies have established a framework to give an overview of the different customer involvement methods available during the stages of the NPD process. Lagrosen (2005) proposed a framework that presents available customer involvement methods for a B2B market. Janssen and Dankbaar (2008) related customer involvement methods to different types of radical products and phases in the NPD process. The established framework was validated by multiple case studies in the B2C market. Besides that studies constructed frameworks to present the different customer involvement methods in different stages of the NPD process, other studies have investigated customer involvement methods. These studies explained the application of methods, the consequences and the results. However, the literature study indicated that a lack existed about what kind of information the customer involvement methods collect, how the methods contribute to the NPD goals and in which stages they can be applied.

Based on the detailed investigation of ten customer involvement methods that are available in the NPD process for radical products in a B2B market, a framework is established. This framework presents the available customer involvement methods in the different stages of the NPD process and is displayed in Figure 1. In addition, it is specified which information can be collected for each customer involvement method.

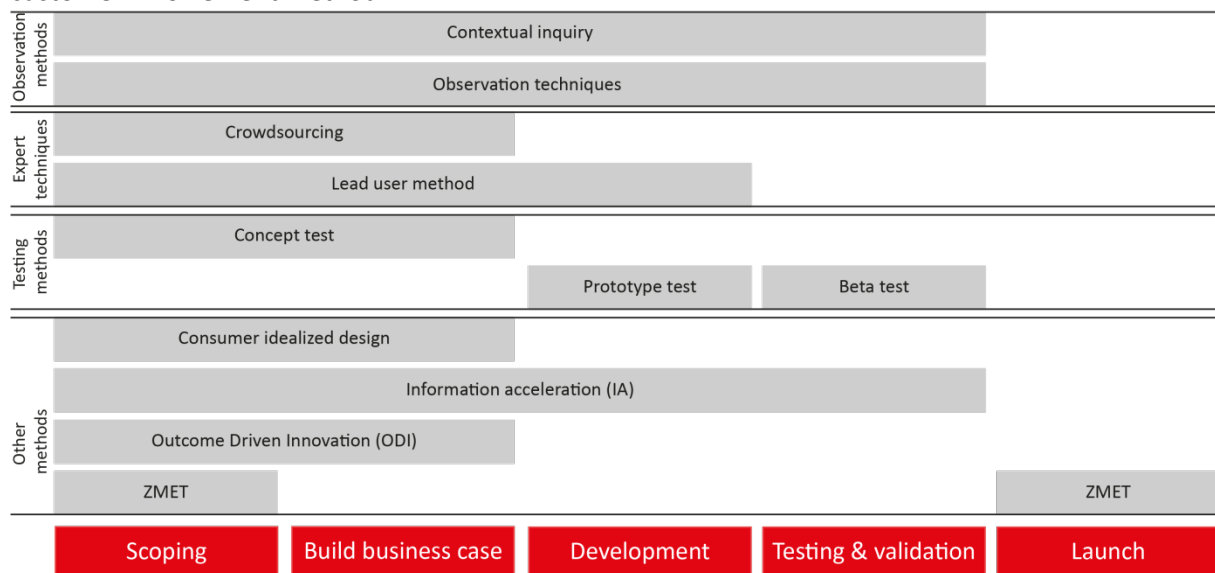


Figure 1. Framework relating customer involvement methods to stages of the NPD process

Case study results and evaluation

By analysing the results of the four studied projects, several methods to involve customers applied by the CEM are detected. In addition, the information that the employees would like to gather with the methods are identified. Furthermore, the perceived experiences of the employees about the application of the methods are analysed.

Besides the analysis of each case separately, the cases are analysed cross-case to identify similarities and differences between the four projects. The cross-case analysis shows that almost all methods were conducted once by the CEM, besides the structured and unstructured customer visits. When a method is applied in multiple projects, differences existed in the structure and organisation of the method. Some problems exist with the execution of the customer involvement methods, such as customer selection, interpretation of the results, and collecting important details.

Based on the case descriptions and the cross-case analysis, an overview is created with all the applied customer involvement methods by the CEM and their corresponding stage in the NPD

process. This overview is compared to the literature framework to distinguish similarities and differences. Four methods are present in both frameworks, namely concept test, validation test, usability test and beta test. The other methods applied by the CEM are not mentioned in the literature study. Subsequently, the applied methods by the CEM are evaluated on eight dimensions to detect points for improvement. This indicates that the method event is less useful than the other methods. Other points of improvement are among others, the customer selection and structuredness. Finally, the methods that are presented in the literature framework are evaluated whether they are useful for the CEM to apply. Based on this analysis, lead users, consumer idealized design and IA are useful methods for the CEM in the scoping and build business case stages. In the development, and testing and validation stages, lead users and IA are useful to apply.

Conclusion and discussion

Based on the evaluation of the case study results and the literature study, a framework is designed that presents available customer involvement methods in each stage of the NPD process for the CEM. This framework is displayed in Figure 2. For each stage of the NPD process, it is specified which information is collected by each customer involvement method. This can help the responsible employees to choose the most appropriate customer involvement methods in a project. Moreover, the framework answers the research question which customer involvement methods the CEM can apply in each stage of the NPD process to acquire knowledge about customers and market.

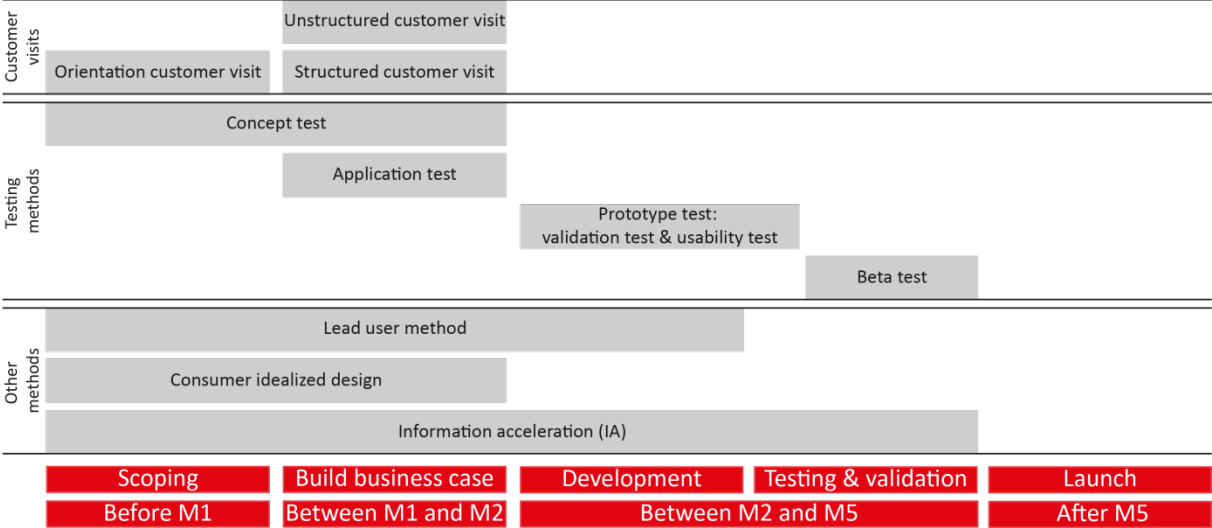


Figure 2. Design of appropriate customer involvement methods for the CEM

For the CEM, it is important to appoint a process owner of customer involvement who is in the lead of involving customers. The process owners should be embedded in the functional organization of the CEM instead of in the project organization. In addition, customer selection is very important to ensure the acquired results are representative for the target market. This should also be taken into account when the collected information is analysed.

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1 Introduction

This report describes the results of the master thesis graduation project conducted for the TU/e at a large complex equipment manufacturer (CEM). The company prefers to remain anonymous and will therefore be called the CEM in the remainder of this report. This chapter first describes some background information about the theoretical and empirical context. Second, the company's problem is discussed which results in the research question. Third, the scope of this report is explained which defines the research. Fourth, the relevance of this study for the company and for research is stated. Finally, a description is given on how the remainder of this thesis is structured.

1.1 Background information

Involving customers in the new product development (NPD) process is a prerequisite for achieving superior NPD performance (Hsieh & Chen, 2005). If a firm understands the customer's expectations and needs, they are able to change the product in early stages of the NPD process which improves the NPD performance.

Customer involvement is any interaction between customers and the design process (Kaulio, 1998). Synonyms of customer involvement are customer co-creation, customer interaction and customer collaboration. A related concept to customer involvement is the Voice of the Customer (VOC). This is a complete set of customer wants and needs, expressed in the customer's own language, organized into a hierarchy and prioritized (Griffin & Hauser, 1993). Customer involvement methods are the tools to identify the VOC.

Different customer involvement methods exist such as interviewing methods, observational methods, testing methods and lead user method (Nijssen & Lieshout, 1995; Janssen & Dankbaar, 2008). Most methods have been well researched but only as an isolated subject and disconnected from other methods. For instance, in the lead user method companies can learn from lead users about the problems, needs and solutions that users face (Schreier & Prügl, 2008). Studies have researched the application of lead users in different fields such as technology firms (von Hippel, Thomke, & Sonnack, 1999), medical technology firms (Lettl, 2007) and kite surfing (Franke, von Hippel, & Schreier, 2006). In addition, the antecedents and consequences of lead users were researched (Schreier & Prügl, 2008).

Companies incorporate customer involvement methods in the NPD process because they can contribute to a better product outcome (Bharadwaj, Nevin, & Wallman, 2012; Gruner & Homburg, 2000). Probably, companies have a certain goal they want to achieve by applying customer involvement methods. Prior studies have indicated different benefits, goals or outcomes of customer involvement. For instance, Roser, DeFillippi, and Samson (2013) examined that business-to-business (B2B) companies co-create with customers to solve problems. According to Alam (2002), the main reason to involve customers in the NPD process is to develop differentiated and superior products. Biemans (1991) identified three reasons to involve potential users in product development, namely to achieve a better fit with customer needs, to shorten the cycle time and to accelerate market acceptance.

Thus, customer involvement methods can support and improve the NPD process in several ways. Studies indicated that customer involvement methods support the process differently in early stages than in later stages of the NPD process (Veryzer, 1998a; O'Connor, 1998). Because the contribution of customer involvement methods differs between methods and phases of the NPD process, it is important to take the goal of customer involvement into account when selecting the most appropriate method.

The study of Janssen and Dankbaar (2008) already investigated a part of this subject. In this study, they related customer involvement methods to different stages of the NPD process for three kinds of radical products which resulted in a framework for selecting appropriate customer involvement methods in two stages of the NPD process depending on the product's radicalness. Other frameworks were constructed by Kaulio (1998) and Lagrosen (2005). Kaulio reviewed seven methods which can be applied in different stages of the NPD process, whereas Lagrosen related

several methods to different levels of relationships between customer and company. None of these studies have investigated the possible contributions of the different customer involvement methods to the different stages of the NPD process. This master thesis aims to investigate how customer involvement methods contribute to NPD goals in the different stages.

1.2 Empirical context

The CEM is an international company with headquarters located in the Netherlands. The company develops innovative solutions for professional environments. The customers of the CEM are mainly business customers; thus, the CEM operates in a B2B market.

New product development process within the CEM

To develop new products, the CEM applies a centralized NPD process. The company has a matrix organization which means that in the NPD process employees of different functional departments are organized in project teams. This ensures that knowledge and skills of different departments are integrated from the start of the projects. In the beginning, the departments strategic planning and research and development (R&D) are mainly involved. Over the course of the process, marketing and manufacturing and logistics participate more and more while the involvement of strategic planning and R&D reduces.

The CEM structures the NPD process as a Stage-Gate process. The stages are project definition, concept, development, engineering, market confrontation and problem analysis. Each stage has one or more gates, called milestones within the CEM, where decisions are made about the continuation of the project. The structure of a typical Stage-Gate process is shown in Figure 1.1.

In each phase of the process, customers are involved. The type of involvement differs between the phases, ranging from receiving feedback to testing the product. For instance, the department R&D observes and questions customers by an in-house developed method which is an adapted approach of contextual inquiry. This method is applied in the concept phase to identify problems and needs. In the same phase, strategic planning and marketing wants to detect market demands and potential markets or customers. Examples of methods to achieve these goals are Outcome-Driven Innovation and interviews with lead users.

Although customer involvement methods are known by the employees of the CEM, in most stages practices or interviewing techniques are applied instead of formal customer involvement methods. In the remainder of this thesis, practices and interviewing techniques are also included in the definition of customer involvement methods to increase the readability of this report.

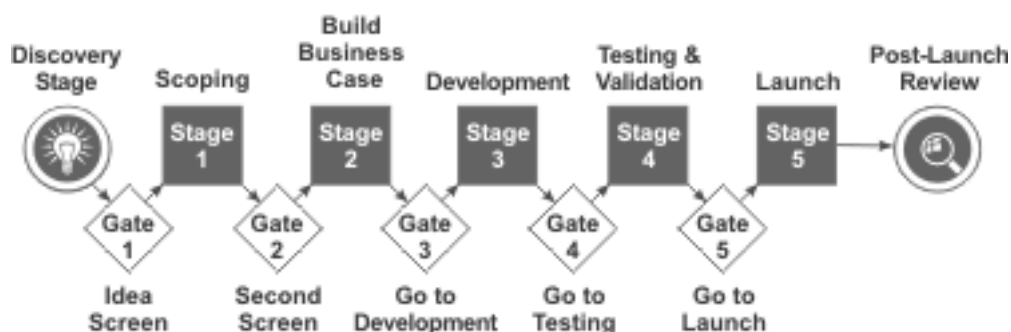


Figure 1.1. Overview of a typical Stage-Gate process (Cooper, 2001)

1.3 Problem description

As indicated above, different methods of customer involvement are known and applied by the employees of the CEM. However, during explorative interviews with employees of different departments several problems were identified regarding involving customers in the NPD process. In discussions with the supervisors, a decision was made to address one of these problems during this project. This selected problem is illustrated below.

Employees of the CEM recognize that different situations require different customer involvement methods. However, a framework to guide the employees in selecting the most appropriate method does not exist within the company. This means that employees choose a customer involvement method based on their feeling. It would be better to base this choice on a clear understanding of the alternatives and the consequences of applying a certain method. The employees experience the process of involving customers as unstructured because there are no guidelines to help them in making a good decision on which customer involvement method is useful. The unstructured approach of involving customer results in acquired information that is conflicting, incomplete or incorrect which results in longer development times and/or higher development costs.

The problem of the CEM is not an unknown problem. Karkkainen and Elfvengren (2002) analysed problems in the NPD process of five high-tech companies. One of the indicated main problems was that companies experienced the customer need assessment as unstructured. They did not describe how to solve this problem but investigated the problems associated with an unstructured customer need assessment. Nijssen and Lieshout (1995) concluded that customer involvement methods are developed for specific stages of the NPD process. However, based on their empirical research it could be concluded that companies seem to apply customer involvement methods to identify and solve other problems than the methods were intended to.

The CEM's employees are aware that the appropriateness of methods is determined by the stage of the NPD process. However, they do not exactly know which method is appropriate in which stage. The CEM wants to involve customers in the NPD process for several purposes. For instance, in the early stages of the NPD process (concept stage) the CEM would like to apply a method to check whether their technical solution solves a customer problem. In later stages, the CEM is interested in a method that identifies the number of potential customers and detects possible errors in beta products.

To solve the confusion about appropriate customer involvement methods and the risk of wrong prioritisation in product specifications and development, the CEM would like to gain knowledge about which customer involvement methods are suitable in each stage of the NPD process and the reasons to apply a particular method in a stage.

Based on the problem description, the following problem statement can be formulated.

Within the CEM there is no common view about which customer involvement methods should be applied to acquire information about customers, market and business in each stage of the new product development process for radical products.

1.4 Research question

The problem statement can be rewritten to a research question for the master thesis. This leads to the following question:

Which methods of customer involvement should the CEM apply in each stage of the new product development process for radical products to acquire information about customers, market and business?

In order to find an answer to the research question several sub-questions are formulated. Some of these sub-questions are literature specific while others are case specific.

Literature specific sub-questions

1. What is the purpose of each stage in the NPD process and what kind of information should be collected each stage?
2. To which NPD outcomes have customer involvement already been related?
3. Which customer involvement methods are available for the NPD process of radical products?
4. In which stages of the NPD process can those methods be applied?

5. What are the contributions or goals of those methods in each stage of the NPD process?

The answers of the literature specific sub-questions will result in a framework which presents the available customer involvement methods in each stage of the NPD process for radical products. In addition, the methods are related to the identified goals of the NPD process.

Case specific sub-questions

6. Which NPD goals are important in the NPD process of the CEM?
7. Which formal customer involvement methods and less formal practices are applied in each stage of the NPD process and what was the expected goal of those methods?
8. What are the experienced benefits of the applied customer involvement methods?
9. What are the similarities and differences between the applied customer involvement methods within the CEM and the framework based on the literature?
10. What should the CEM change based on these similarities and differences?

The answers of the case specific sub-questions will result in a tailored framework for the CEM that can guide employees to select appropriate customer involvement methods in the NPD process of radical products. The framework presents available customer involvement methods for each stage and how they contribute to the NPD process. In addition, this framework will answer the research question of this master thesis report.

1.5 Scope

The research question and sub-questions are answered in relation to new-to-the-world products and new product lines. These product categories are both new to the market, and score medium or high on product newness (Booz, Allen, & Hamilton, 1982). Within the CEM, new product lines are called new-to-the-firm products, but they have the same characteristics as products in the category new product lines. In the following of this master thesis, products developed by the CEM belonging to new-to-the-world or new product lines are referred to as radical products.

The CEM has sufficient knowledge about the use of customer involvement methods for incremental products. In addition, they have agreement on the steps to follow when involving customers in the NPD process of incremental products. On the other hand, employees have mixed opinions about the most appropriate customer involvement methods for the development of radical products. Veryzer (1998b) confirmed that incremental and radical products should be differently approached. Currently, the CEM is heavily investing in new markets in which they are not active. The products resulting from these investments belong to radical innovations because they are new-to-the-world or new product lines. Taking all these considerations into account, it is decided to focus this research on radical products.

1.6 Relevance

For the CEM, this research is important because they want to gain better insights into appropriate customer involvement methods for identifying customer's needs, determining potential customers and assessing the market potential. Customer needs are important in the development of new products because satisfying (latent) needs can lead to a better unique selling point (Narver, Slater, & MacLachlan, 2004). Next to this, the involved business unit is shifting their focus to a new market with big opportunities. This shift requires large investments in a market in which the CEM is not as familiar as current markets. A good understanding of the customer needs ensures the right investment decisions can be made.

The involvement of consumers differs from the involvement of business customers on several aspects (Hanna, Ayers, Ridnour, & Gordon, 1995). Until now, most research on customer involvement methods has been conducted in a business-to-consumer (B2C) instead of a B2B context. Therefore, this research contributes to prior research by focusing on the B2B context. In addition, the frameworks developed in earlier research did not relate customer involvement methods to goals of

the NPD process. Different customer involvement methods in the same stage of the NPD process can contribute in various ways to a better outcome of the NPD process. So, besides the fact that this master thesis is conducted in a B2B setting, it also contributes to research by relating the customer involvement methods to the stage of NPD process and goals of the NPD process.

1.7 Document structure

The structure of this master thesis report is visualized in Figure 1.2. In chapter 2, the methodology to find an answer on the research question and its associated sub-questions is illustrated. In addition, the chapter 3 gives an overview of the current literature about customer involvement and answers the literature specific sub-questions. Based on those findings, the literature framework is constructed in chapter 4.

Chapter 5 presents the results of the case study and answers some of the case specific sub-questions. Those findings are evaluated in chapter 6 to provide insights into which customer involvement methods the CEM can use. Based on those insights, a framework for the CEM is designed in chapter 7. The final chapter of this master thesis, chapter 8, summarizes the main findings of this report, presents recommendations and discusses some limitations.

In the subsequent chapters, it is not explained how information was collected or conclusions were drawn because that is clarified in detail in chapter 2. The figure below will be used as guide to indicate in which phase of the report the readers are.

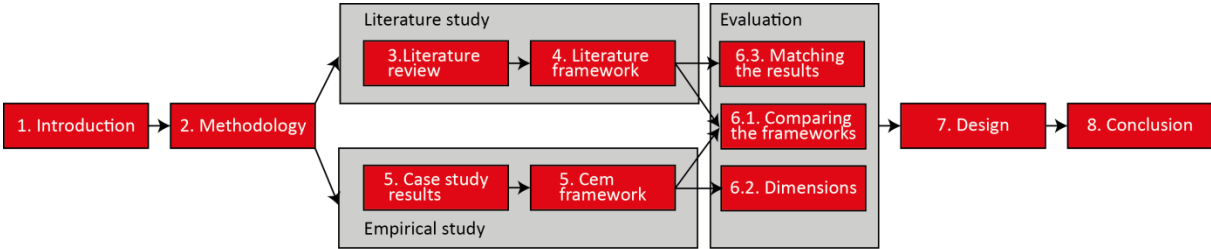


Figure 1.2. Overview of the research phases and the corresponding chapters

2 Methodology

The problem statement, formulated in the previous chapter, can be categorized as a business problem. The research question is open-ended and can probably not be solved by one unique solution. Therefore, this research is a business problem solving project (van Aken, Berends, & van de Bij, 2007). The goal of this kind of projects is to develop a solution for a field project based on a design-oriented and theory-informed methodology. This research is explorative because little theory exists about the relationship between customer involvement methods and NPD goals in a radical B2B environment. This study gives insights into some relationships but does not describe, explain or test them.

To solve the CEM's problem and to find an answer to the research question the case study method was applied. A case study research studies contemporary events in-depth and within its real life context, relies on multiple sources of evidence, and benefits from the prior development of theoretical propositions to guide the data collection and the analysis (Yin, 2009). Because a case study is theory based and design-oriented, it is an appropriate research method for the business problem of the CEM. The research design of a case study has five components; a research question, its propositions, its units of analysis, the logic linking the data to the propositions, and the criteria for interpreting the findings (Yin, 2009). The research question, and the corresponding problem description, is discussed in the previous chapter. The second component, the propositions, will be derived from the literature review. The last three components are related to the empirical study and are therefore discussed in this section.

First, the research design for the literature review is discussed and then the research design for the empirical study is explained. Subsequently, the quality of this research is evaluated in paragraph 2.3.

2.1 Literature review

A literature study was conducted to investigate the current state of research with respect to the research subject. The literature study focused on current research about customer involvement methods, the NPD process and purposes of the NPD process. In the literature study the literature specific sub-questions, question 1 till 5 about customer involvement methods for radical products, were answered.

The answers on those sub-questions resulted in a framework that provided guidance for the empirical study. The framework displays the customer involvement methods that are appropriate in each phase of the NPD process. In addition, the goals which are influenced by the customer involvement methods in each stage are presented.

2.1.1 Search method and selection criterion

The literature search used two strategies; the keyword strategy and the snowballing technique (van Aken et al., 2007). First, the keyword strategy was applied. Some keywords and combinations of keywords were used in the search engines of ABI/Inform, ScienceDirect and Google Scholar. In addition, the search engines of specific quality journals were used such as the Journal of Product Innovation Management.

Besides searching on key words in search engines, another strategy was applied to search interesting literature namely the snowballing technique. While reading the selected articles from the first search strategy, attention was paid to the articles cited in the literature. The articles that seemed interesting or related to the sub-questions were searched and the abstract was read to judge the usefulness. When the article seemed relevant, the whole article was read and also the references of those articles were checked for interesting citations.

Prior to the literature search, some selection criteria had been set to ensure the articles had a sufficient quality and were related to the research question. While searching for literature and reading the articles, these criteria were checked. When an article did not meet one of the criteria, a decision was made about the relevance of this criterion in the specific situation.

The criteria were divided into quality- and content-related requirements. To ensure the quality of the articles was sufficient, the 5-year journal impact factors were checked. Articles should have an impact factor at Web of Science to be included in the literature study. In addition, the numbers of citations were checked using Google Scholar. Some exceptions were made because specific customer involvement methods are often discussed in journals without an impact factor. Because this information was required to complete this research, those articles were still included.

Content-related requirements were set to guarantee the articles in the literature review were relevant to the research topic. First, the articles should be published after 2000 to ensure the information provided was recent and still applicable. Second, the sector in which the study was investigated should be high-tech or industrial to be able to translate the results to the case study which was performed after the literature study. Third, the scope of the articles should preferably be B2B, product-related and about radical innovations. Most articles in the literature study met those requirements. However, some articles were published before 2000. In those cases, a decision was made to include or exclude the article. When such an article was included, it was taken into account that the information may be outdated.

2.2 Empirical study

In the empirical study, the case specific sub-questions 6 till 8 about applied customer involvement methods by the CEM were answered. These sub-questions already gave direction to the data collection process. To ensure the collected data was related to the research question, some components were determined before the actual data collection started. These components were the unit of analysis, the data that needed to be collected, and the method for data analysis. This is discussed in the following paragraphs.

2.2.1 Unit of analysis and case selection

Related to the research question, the unit of analysis and the cases were defined. The unit of analysis in this study was the radical NPD process. Therefore, projects that dealt with the radical NPD process were chosen to be studied as cases. These cases had to meet two criteria to be included in the analysis. First, the NPD projects should be radical. Incremental projects were excluded from this analysis because they were outside the scope of this research, as explained in section 1.5. Second, the projects should have been recently finished or were in progress. This ensured that the information required for the analysis was easier to collect and more reliable than information collected from projects finished earlier.

Four projects met these criteria and were analysed which made this study a multiple-case study. These four projects are included in the analysis to identify the applied customer involvement methods in past projects. The four projects are called project Alpha, Gamma, Delta and Epsilon in this report. More details about the selected projects can be found in appendix G where the projects are described.

The analysis of multiple cases ensured a deep understanding of the applied customer involvement methods within the CEM was gained in comparison with a single case study. For example, it would be possible that a single case did not involve customers in all the stages of the NPD process or that several cases applied different customer involvement methods. This made the multiple-case study a good research method.

Project Gamma had almost passed the whole NPD process, whereas the projects Alpha, Delta and Epsilon were approaching the development phase of the NPD process. For the latter projects, data was gathered on the activities that occurred in the first stages of the NPD process and the intentions for future stages. These projects were still important in the analysis because they could provide much information about the current practices applied in the NPD process and the reasons that customers were involved. Furthermore, in the first stages of the NPD process the product specifications are determined which largely define the product and require a good understanding of the customers.

2.2.2 Data collection

According to Yin (2009), a good case study uses as many sources as possible to detect the same facts, called triangulation. In this case study, different sources were used to support the same and different facts. So, some of the data collected was triangulated but some sources were only used to support one finding. Triangulated data increases the construct validity, and the findings are likely to be more accurate and convincing (Yin, 2009). The data was collected by analysing documents and conducting semi-structured interviews.

Documentation

Internal documents of the CEM were studied in preparation for the interviews and for validation of the interview results. In preparation for the interviews, documents were studied to identify the goals of each stage in the NPD process. This was found in documents explaining the CEM's NPD processes and milestones checklist documents. With this information, the kinds of answers that could be expected during the interviews were known beforehand.

After the interviews, customer visit reports were analysed to validate the results of the interviews. This consisted of a check which practices or methods were applied and for which questions answers were found by applying those practices or methods. An overview of the consulted company documents can be found in appendix A.

Interviews

Semi-structured interviews were conducted with employees of the departments strategic planning, marketing and R&D. The goals of these interviews were to identify the goals of each NPD stage, the customer involvement methods that the CEM had applied in past projects, and to measure the experienced benefits and disadvantages of the applied methods. The selected persons were employees, who were responsible for involving customers in the NPD process, applied the customer involvement methods or gained benefits of involving customers.

Semi-structured interviews were chosen as a data collection method because they can be focused on the research question and provide insightful explanations (Tellis, 1997). In addition, semi-structured interviews allow for asking for clarification when ambiguous or unclear answers were given. However, when clear and detailed answers were given, not all the questions had to be asked. Semi-structured interviews have also some limitations, such as potentially poorly formulated questions, insufficient skills of the interviewer and social desirability bias (Tellis, 1997).

To reduce those limitations and to guide the semi-structured interviews, an interview guide was constructed. This guide was used in conducting the semi-structured interviews with the invited employees. The questions were as much as possible based on or originated from prior research. A test interview was conducted to ensure the questions were understandable and delivered the answers needed for the research project. In addition, some background information about the structure of the NPD project was provided which gave better insights into appropriate people to invite for participating in the interview. Based on the test interview, some questions were changed, added or removed. The interview guide can be found in appendix B.

Managers and specialists involved in the four selected projects were invited for an interview. The aim was to interview three or four people from different departments per project. In addition, two employees were invited because they had extensive experience with customer involvement within the company. These people could provide new or additional insights into the experiences with customer involvement methods. In total, seventeen people were interviewed with interview durations ranging from 16 till 60 minutes. This difference in duration existed because not all employees could answer all questions and some employees were only involved during a small part of the project. In appendix C, details of the interviews are specified per project.

2.2.3 Data analysis

The data retrieved from the interviews was recorded and transcribed for the data analysis. Interviews conducted in English were translated to Dutch to enable a thorough data analysis. Content

analysis was conducted to structure the collected data and to be able to draw conclusions. This is a procedure for the categorization of verbal data by coding and classifying data (Blumberg, Cooper, & Schindler, 2011). All fragments about the same theme or idea were marked with the same code label. To ensure consistency in the coding process, every time a fragment was coded, it was compared to all previous fragments with the same code. A coding frame was constructed to guide the coding process. The coding frame is a list of all the constructed codes and can be found in appendix D.

The codes in the coding frame were constructed following the template approach (van Aken et al., 2007). The template approach relies on existing codes. Those existing codes were related to the research question, sub-questions, and based on literature. In addition, some codes were constructed based on the company context such as the stages of the NPD process. Because many codes were created, some family groups were defined which is also illustrated in the coding frame (see appendix D).

The data analysis was conducted on two levels as explained by Eisenhardt (1989). First, all the projects were separately analysed in the within-case analysis. This ensured that the unique patterns for each project were known before generalization. Second, there was sought for cross-case patterns between the four projects. Categories were formulated for which similarities and differences were found between the projects. The results of the within-case and cross-case analyses are reported in chapter 5.

2.3 Research quality

This paragraph explains the quality of this research by explaining four criteria, namely construct validity, internal validity, external validity and reliability. First, the three types of validity are discussed. Subsequently, the reliability of this research is explained.

2.3.1 Validity

Construct validity is the extent to which a measuring instrument measures what it is intended to measure (van Aken et al., 2007). Several strategies were followed to ensure construct validity in this study. First, multiple sources of evidence were used to guarantee triangulation (Yin, 2009). Most of the data was collected by the semi-structured interviews. In addition, documents were consulted to check the statements of the interview respondents and to acquire additional information. Second, the interview protocol was based on existing questions from studies with the same research subject as this study. This guaranteed that the interview protocol covered all the required information to answer the sub-questions. For the same reason, the company and university supervisors checked the interview protocol. By following those three strategies, it was ensured that the right concepts were studied and a good interview protocol was established.

Internal validity is the extent to which conclusions about causal relationships are justified and complete (van Aken et al., 2007). In this study, little attention was paid to causal relationships. Therefore, the internal validity of this research is not relevant.

External validity is the extent to which the results can be generalized to other organizations. This study was a case study conducted within one company. The designed solution was specific developed for the CEM and adapted to their preferences in the NPD process. Therefore, the design is not directly applicable in other organizations. However, the insights into which customer involvement methods can contribute to which NPD goals are also valid for other organizations. Those organizations should operate in a B2B market, just like the CEM, and should develop radical high tech products to apply the same solution as proposed for the CEM.

2.3.2 Reliability

Reliability is the extent to which the results of a study are independent of the study characteristics and can be replicated in other studies (Yin, 2009). Four potential sources of bias exist, namely the researcher, the instrument, the respondent and the situation.

First, research results are more reliable when they are independent of the person who has conducted the study. To reduce this risk, the interview protocol was developed to structure the interviews. In addition, multiple people rated the customer involvement methods on the dimensions to increase the reliability of this evaluation part.

Second, research results should be independent of the instruments used (van Aken et al., 2007). Reliability can be increased by using multiple research instruments. As explained above, besides semi-structured interviews, documents were consulted to complement the collected data.

Third, the results should be independent of the respondents in the study. Therefore, employees of all involved departments in the projects were represented to ensure different perspectives were gathered. In addition, several employees per project were interviewed to enable verifying the statements.

Fourth, the results can be influenced by the different circumstances the study has been conducted. To prevent this bias, the interviews were conducted at different moments in time.

Furthermore, to increase the reliability and to ensure the study can be repeated, all the documents and transcriptions were documented.

The next chapter describes the most important results of the literature review and answers the literature specific sub-questions. Those results were obtained by following the procedure explained in this chapter.

3 Literature review

This chapter discusses current literature about the NPD process, goals of the NPD process and customer involvement methods. The goal of this literature review is to identify research gaps to which this research project can contribute. In addition, the knowledge acquired from this literature review will guide the data collection, evaluation and design.

First, the stages of the NPD process are defined in paragraph 3.1. Then, the goals of these stages are explained in paragraph 3.2. Subsequently, previous efforts to link customer involvement methods to NPD stages are discussed in paragraph 3.3. Fourth, the consequences of the difference in product newness and market type for customer involvement are clarified in paragraph 3.4. Next, available customer involvement methods for radical products and B2B are selected in paragraph 3.5. The selected methods are further explained in paragraph 3.6. Finally, this chapter is concluded with identifying research gaps in the existing literature in paragraph 3.7.

3.1 The NPD process and its stages

This section explains some important definitions and concepts which are related to the research question and sub questions. First, an illustration is provided on the NPD process. Second, the stages which are typical in the NPD process are discussed.

3.1.1 New product development process

Most companies have a clear and defined new product development process to guide products from idea to launch (Cooper & Edgett, 2012). The NPD process contains all the activities undertaken to transform a market opportunity into a product available for sale (Kristnan & Ulrich, 2001). Many companies structure the NPD process as Stage-Gate or other phased-review processes. A Stage-Gate process is a blueprint for managing the NPD process to increase effectiveness and efficiency (Cooper, 2001). This process contains stages and gates. In each stage, activities are undertaken, required information is collected, data is integrated and analysed, and finally described in deliverables. Each stage is finished by a gate where a go or kill decision is made about further investments in the project (Cooper, 2008). This ensures that throughout the NPD process, the amount of risks and uncertainty is reduced (Crawford & Di Benedetto, 2011).

3.1.2 Stages of the new product development process

NPD processes which are structured as Stage-Gate usually have six stages namely discovery, scoping, build business case, development, testing and validation, and launch as can be seen in Figure 1.1 (Cooper, 2001). The basis of every NPD process is the same but the details of each activity can differ (Song & Montoya-Weiss, 1998). For example, Crawford and Di Benedetto (2011) identified five stages in the NPD process; opportunity identification and selection, concept generation, concept/project evaluation, development, and launch. Overall, the activities undertaken in this NPD process are the same as in the Stage-Gate process described by Cooper (2001). However, some activities are executed earlier or later and are more or less emphasized. Therefore, in the next paragraphs and chapters the defined stages are scoping, build business case, development, testing and validation, and launch. The discovery stage is not taken into account in this literature review because the activities in this stage are very preliminary. In addition, most companies have a separate process to study the market and to search for opportunities which is stated by Cooper, Edgett, and Kleinschmidt (2002).

3.1.3 Summary

This section explained the NPD process and its stages. As illustrated, different formats exist to structure the NPD process. In the remainder of this report, the stages scoping, build business case, development, testing and validation, and launch will be used.

3.2 Goals of the NPD process

In Stage-Gate processes, each stage is designed to reduce project uncertainties and risks by gathering information (Cooper, 2008). Consequently, the information that is required in each stage determines the purpose of each stage in the NPD process. This section shortly explains the goals and the required information for the five identified stages.

3.2.1 Scoping

When it is decided to invest in an idea, it is important to determine the product's technical and marketplace value (Cooper, 2001). This is achieved by conducting preliminary market and technical assessments. The purpose of the preliminary market assessment is to determine whether the proposed product has promising forecasts (Cooper & Kleinschmidt, 1996). Therefore, companies collect information about customer needs, market segments and competitive situation to determine market size, market potential and likely market acceptance. The goal of the preliminary technical assessment is to identify the technical possibilities and risks (Cooper & Kleinschmidt, 1996).

Furthermore, a preliminary business and financial assessment should be conducted in the scoping stage (Cooper, 2001). In the business assessment, the company states the strategic and competitive motivation and compares it to the business' core competences. In the preliminary financial analysis, the company estimates sales, costs, required investments and payback time. Khurana and Rosenthal (1998) agreed that those four assessments should be conducted in the first stages of the NPD process. Furthermore, they stated that the following issues should be conducted in the first stage, namely identifying core requirements, testing the product concept, specifying the required resources and identifying the key risks and challenges.

3.2.2 Build business case

The build business case stage is the final stage before the actual development or design starts, and therefore, the stage before heavily investing in the product (Cooper, 1990). Therefore, the product must be clearly defined in this stage (Cooper, 1990; Khurana & Rosenthal, 1998). The four assessments of the scoping stage are continued to clearly define the product (Cooper & Kleinschmidt, 1996). In this more detailed investigation, a concept test, a competitive analysis and a market study are conducted. By conducting concept tests, customer's reactions to a new product concept, important product attributes and potential market size can be determined (Ozer, 1999). Furthermore, a competitive analysis and a market study should be conducted to determine the customer's needs and wants (Cooper, 1990). This detailed investigation results in a business case for the project which is the end result of this stage. The business case includes the product definition, the project justification and a detailed project plan (Cooper, 2001).

3.2.3 Development

In the development stage, the actual product is designed and developed. The end result of this stage is a product or prototype that is partially tested by customers (Cooper, 2001). This prototype or product should meet the customer requirements. This can be checked by customer input, customer feedback and customer tests. Besides developing and testing the product, some other activities are conducted in the development stage according to Cooper (2001). First, the marketing plan is written and completed. The marketing plan describes the marketing communications, pricing, sales and distribution channels, and customer service. Second, the intellectual property and regulatory issues of new technologies should be arranged. Third, the supply or production process should be defined and designed. In addition, the business and financial analysis should be updated with new available information. Finally, a plan for the next stage should be developed that guide the testing and validation activities (Cooper, 2001).

3.2.4 Testing and validation

In this stage, the main activity is to test and validate the project. The project and product should be validated on several fronts, such as production and marketing (Cooper, 2001). According to Bhuiyan (2011), the goal of customer tests is to ensure that the product meets performance requirements and design specifications. In the gate evaluation of this stage, heavy emphasis is put on the financial analysis (Cooper, 2001). Therefore, underpinned estimations about costs, sales volumes, prices and profit margins should be made. For the next stage, the market launch, an elaborated marketing plan should be complete. In this stage, the marketing plan is tested and finalized (Cooper, 2001).

3.2.5 Market launch

The market launch is the final stage in which the market launch plan and the operation plan are executed (Cooper, 1990). The marketing plan describes the product's entry to the market and specifies the marketing objectives, strategies and programs (Cooper, 2001). The marketing plan is constructed in parallel with the product development as discussed in the previous paragraphs. During the market launch stage, the plan is measured, controlled and adjusted when necessary.

3.2.6 Summary

This paragraph gave an answer on the first sub-question. Per stage of the NPD process important goals that should be achieved are described. The most important goals per stage are listed in appendix E in Table E.1.

3.3 Relating customer involvement methods to other dimensions

This section discusses prior research on frameworks that compare different methods of customer involvement. In addition, it is reasoned why different stages of the NPD process require different customer involvement methods.

3.3.1 Existing frameworks of customer involvement methods

Prior studies have established a framework to give an overview of the different customer involvement methods available during the stages of the NPD process. One of the first studies was conducted by Kaulio (1998) who reviewed seven different methods on two dimensions; phase of the NPD process and the depth of customer involvement. The reviewed methods had all a form of interaction between the users and the designers. The review resulted in a framework presenting that different customer involvement methods support the NPD process differently in various phases (see Figure 3.1). This framework was created by a review of key literature on the seven methods and applicable in both B2B and B2C. Surprisingly, the framework is not tested in subsequent studies to validate the results of Kaulio's study.

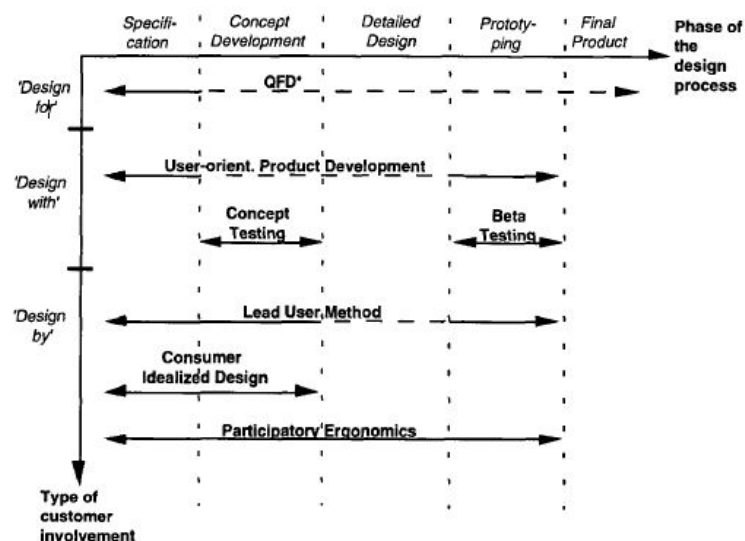


Figure 3.1. Framework of Kaulio (1998)

Lagrosen (2005) investigated the role of customer involvement in NPD from a relationship marketing perspective with the framework of Kaulio (1998) as a starting point. In-depth interviews with representatives of three large B2B companies were conducted to relate the applied customer involvement methods to stages of the NPD process. In addition, the relationship between the company and the customer was determined, ranging from no integration to frequent information exchange between company and customer. The relations were categorized to three levels of relationships and were connected to phases of the NPD process and the corresponding customer involvement methods. The end result of this research is a proposed framework for customer involvement methods in different levels of relationships as presented in Figure 3.2. However, they did not test if the framework corresponds to the real practice of customer involvement. In addition, it was not mentioned whether the companies developed incremental or radical products.

Level of relationship	Longitudinal customer involvement	Lateral customer involvement	Suitable methods
Transactional	Only in the early phases	Design for the customer	Surveys, focus group interviews, observation
Facilitative	In the early phases, in the testing phase and occasionally in the other phases	Design with the customer	QFD, Delphi method, conjoint analysis, prototype testing, beta testing, team customer visits
Integrative	In all phases	Design by the customer	Integrated product development teams including representatives of both the supplier and the customer

Figure 3.2. Proposed framework of Lagrosen (2005)

Janssen and Dankbaar (2008) were the first who related customer involvement methods to different types of radical products and phases in the NPD process. Three types of radical products were distinguished based on the level of customer needs (manifest versus latent) and technology (existing versus new), namely technologically really new, breakthrough and trend-break really new. For these three types of radical products the appropriate customer involvement methods were determined in two stages of the NPD process; discovery (scoping and build business case) and incubation (development) phases. For the six situations that arose, the requirements a customer involvement method should meet were determined. In addition, the methods were also evaluated on those requirements to define the method's characteristics. To determine the appropriateness of the methods for each situation, the number of fits between the requirements of the situation and the characteristics of the method were calculated. Based on the number of fits, appropriate customer involvement methods for radical innovations were identified and presented in a framework (see Figure 3.3). This framework was validated by multiple case studies in the B2C market.

The previous mentioned studies took the whole NPD process into account. In contrast, van Kleef, van Trijp, and Luning (2005) focused on customer involvement methods for the opportunity identification (scoping) stage. They identified ten methods that were commonly applied in this stage. Those methods were evaluated on several aspects to develop a categorization scheme which can guide companies' processes for selecting an appropriate customer involvement method. Based on the constructed categorization scheme, van Kleef and colleagues recommended that some methods are more useful for incremental products and other methods for radical products. This is visualized in Figure 3.4. The research of van Kleef et al. (2005) was totally focused on customer involvement methods for the B2C market.

Technologically really new	
<i>Discovery-phase</i>	<i>Incubation-phase</i>
Lateral thinking synectics	Category appraisal Conjoint analysis Information acceleration
Breakthrough	
<i>Discovery-phase</i>	<i>Incubation-phase</i>
Applied ethnography Crowd sourcing (develop) Toolkit for innovation Visioning/back casting	Applied ethnography Crowd sourcing (design) Lead-user method (need) Toolkit for innovation
Trend-break really new	
<i>Discovery-phase</i>	<i>Incubation-phase</i>
Applied ethnography Consumer idealised design Empathic design Innovation templates	Applied ethnography Probe and learning

Figure 3.3. Framework of Janssen and Dankbaar (2008)

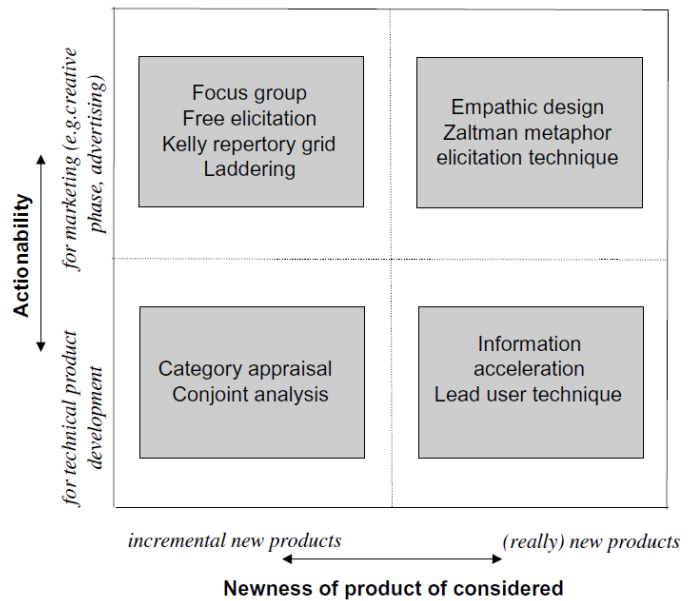


Figure 3.4. Categorization of customer involvement methods by van Kleef et al. (2005)

The discussed frameworks showed that methods can be applied in different stages of the NPD process. Other researches indicated that methods contribute differently to the NPD process as explained in the next paragraph.

3.3.2 Different stages require different customer involvement methods

Customer involvement methods can support and improve the NPD outcome in several ways. In fact, customer involvement methods are designed to deal with specific NPD problems and for specific stages (Nijssen & Lieshout, 1995). O'Connor (1998) also indicated that the stage of the NPD process determines which questions about the market should be answered. Consequently, these questions influence the nature of the tools or processes used to learn about the market in the NPD process. Veryzer (1998b) also emphasized that the focus on customers differs between the stages of the NPD process. For instance, in the development stage it is important to understand the market and to gain insights into the target users. In later stages, the customers' reactions are assessed and the product is tested. For those different stages and their corresponding goals, the customer focus changes which imply that other customer involvement methods are required (Veryzer, 1998b).

3.3.3 Summary

This section provided an answer on sub-question 2 about to which NPD outcomes customer involvement methods have already been related. All the discussed studies in paragraph 3.3.1 established a framework that presented appropriate customer involvement methods for particular stages of the NPD process and related the methods to a dimension (e.g. radicalness, relationship level, depth of customer involvement). However, those studies did not investigate how these customer involvement methods contribute to the goals of NPD stages discussed in section 3.2. As explained in paragraph 3.3.2, the different stages of the NPD process require various customer involvement methods to answer the stage specific questions. Presumably, the customer involvement methods will likewise contribute differently to the NPD goals in each stage.

3.4 Customer involvement for radical products and B2B companies

The research question distinguishes two dimensions on which customer involvement methods can differ, namely product newness and market type. Those dimensions are explained in this section.

3.4.1 Customer involvement for radical versus incremental products

Differences between the involvement of customers in radical and incremental NPD processes exist (van Kleef et al., 2005). First, customers only know what they have experienced (Ulwick, 2002). Consequently, customers cannot compare very new products to existing products and it is hard for them to imagine how they should be used (Veryzer, 1998b). Asking to customers what they want results in incremental products instead of the desired radical suggestions. Second, customers have the tendency to ask for missing features that competitors already deliver (Ulwick, 2002). This also results in incremental products rather than radical ones. So, if companies want to collect ideas from customers about radical products, they should try to avoid directly asking this to customers (Ulwick & Bettencourt, 2008). In other words, the customer involvement methods for radical products should not directly ask to customers what they want or need but the methods should derive it from other information sources. Therefore, not all customer involvement methods in the explained frameworks will be appropriate for the NPD process of radical products.

3.4.2 Customer involvement for B2B versus B2C markets

The other dimension contains the B2B and B2C market. In a B2B market, the customers are business customers who also have their customers. This means that B2B companies have to deal with the preferences of their own customers but also with the wishes of the end customer. In a B2C market, companies can directly involve the end customers. Research of Hanna et al. (1995) indicated that in B2B, customers served as the most important source for new product ideas. In B2C companies, customers are less involved and R&D departments deliver the new product ideas. Lagrosen (2005) emphasized that his research only included B2B companies because the processes of involving customers differs between B2B and B2C companies. Because the processes differ, it is likely that not all customer involvement methods are applicable in B2B context.

3.4.3 Summary

This section provided insights into the differences between customer involvement methods for radical and incremental products, and the differences between a B2B and B2C market. Those differences entail that not all customer involvement methods are appropriate in the same context.

3.5 Selection of customer involvement methods for further analysis

As explained above, not all customer involvement methods are applicable in the NPD process of radical products and for B2B markets. This also applies for the methods presented in the frameworks of section 3.3.1. Van Kleef et al. (2005) positioned the ten reviewed methods against the dimension product newness which gave insights into available methods for radical products. Furthermore, the methods in the framework of Janssen and Dankbaar (2008) are all appropriate for radical products. In contrast, Lagrosen (2005) did not divide the identified methods in groups of product newness. In the following paragraphs, all the mentioned methods are categorized according to their appropriateness for both radical products and B2B companies. In addition, the requirements discussed in the methodology (see section 2.1.1) were taken into account. An additional important requirement to select the customer involvement method was that it should collect market and customer information and that it should not ask customers to design a solution or product.

3.5.1 Customer involvement methods not appropriate for radical products

Van Kleef et al. (2005) identified methods that were appropriate for the development of incremental products. The methods that are more useful for incremental product development are category appraisal, conjoint analysis, free elicitation, focus group, Kelly repertory grid and laddering. These methods collect information about current needs that can be met by product improvements. Therefore, these methods are not included in the further analysis.

Some of the identified methods by Lagrosen (2005) are traditional market research techniques such as surveys, focus group interviews, observations and customer team visits. In those methods, customers are unable to compare the future products to products which are familiar to

them (Veryzer, 1998b). In addition, it is difficult for customers to imagine situations they have not experienced before (von Hippel, 1986). Consequently, traditional market research methods will rarely result in radical products but in products that already exist or product improvements. Therefore, they are excluded for further analysis.

Other methods identified by Lagrosen (2005) are Quality Function Deployment (QFD) and Delphi method. QFD is a method to implement the VOC through all the phases of the NPD process (Cristiano, Liker, & White, 2000). The appropriateness of QFD for the development of radical products is not proven. In addition, QFD is not a method to collect customer and market information but a tool to translate the acquired information into product features. Therefore, it is decided to exclude QFD for further analysis. In the Delphi method, experts answer questions in two or more rounds (Grisham, 2009). The forecast product's market share and no real customer or market information is collected. Therefore, it does not meet the requirements and is excluded from further analysis.

3.5.2 Methods proven to be appropriate for radical products

Janssen and Dankbaar (2008) indicated five customer involvement methods that are appropriate for radical products and meet the requirements. These methods are applied ethnography, empathic design, crowdsourcing, information acceleration (IA) and lead user method. Van Kleef et al. (2005) suggested four methods appropriate to apply in the development process of radical products. In addition, these methods meet the set requirements. These four methods are empathic design, IA, Zaltman metaphor elicitation technique (ZMET), and lead user method.

3.5.3 Methods with conflicting results in prior investigations

About the appropriateness of category appraisal and conjoint analysis as a customer involvement method for radical products, the studies of Janssen and Dankbaar (2008) and van Kleef et al. (2005) are contradictory. Janssen and Dankbaar stated that the methods can be applied in the development of technologically really new products. In contrast, van Kleef and colleagues assessed that those methods are more useful for incremental products. Furthermore, both methods do not meet all set requirements. Therefore, both methods are not further investigated as customer involvement methods. A more detailed explanation for this decision is provided in appendix F.

3.5.4 Preliminary investigation of the remaining methods

About the remaining six methods identified by Janssen and Dankbaar (2008), more knowledge was required to determine whether they will be included for further analysis or not. After a preliminary investigation, there was decided to include consumer idealized design. The other methods, innovation templates, lateral thinking, probe and learning, toolkits for innovation, and visioning, did not meet all the criteria and are excluded in further analysis. The exact reasoning for this can be found in appendix F.

3.5.5 Other methods included in the analysis

For some methods, it is not investigated in which circumstances they can be applied. A detailed investigation of the literature is conducted in section 3.6 to be able to conclude about the methods' appropriateness for radical products. The methods which belong to this category are concept test and prototype test. In addition, the methods contextual inquiry and Outcome-Driven Innovation (ODI) are both included in the further analysis because they are repeatedly discussed in literature but not presented in the discussed frameworks.

3.5.6 Summary

This chapter answered the third sub-question about which customer involvement methods are available for the development of radical products. In addition, ten methods are selected which meet all the set requirements for a detailed investigation. To structure the analysis in paragraph 3.6, the methods are divided into categories which are presented in Table 3.1. Applied ethnography and

empathic design were both included for further analysis but are joined in the method observation techniques as explained in the next paragraph.

Table 3.1. Overview of categories and selected customer involvement methods

Methods	
Observation methods	Contextual inquiry
	Observation techniques
Expert techniques	Crowd sourcing
	Lead user method
Testing methods	Concept testing
	Prototype testing
Other methods	Consumer idealized design
	Information acceleration (IA)
	Outcome-Driven Innovation (ODI)
	Zaltman metaphor elicitation technique (ZMET)

3.6 Description of customer involvement methods

This section discusses the ten selected customer involvement methods in more detail. For each method, a definition, information about in which stages the method can be applied, and what kind of information the method collect are discussed. The methods are discussed per group illustrated in Table 3.1.

3.6.1 Observation methods

Contextual inquiry

Contextual inquiry is an interviewing and observation method in the user's working environment. The researcher conducts one-on-one interviews with users in their workplace to discover how work is carried out (Beyer & Holtzblatt, 1999). Besides questions about the product usage, researchers ask users about procedures, preparations and so forth to detect unexpressed customer needs (Goffin, Varnes, van der Hoven, & Koners, 2012). In addition, the researcher observes the user while he/she uses the product in their own environment. Simultaneously, the researcher asks about the user's actions to understand their motivation and strategy. Discussion between the researcher and user can take place to create a shared interpretation of the work. Interruptions by the researcher stop the user's workflow which motivates the user to deeply think about their daily activities and about possible solutions (Beyer & Holtzblatt, 1995).

When the researcher has a deep understanding of the user's work and the problems they face, the gathered data can be analysed and a solution can be developed. Eventually, the prototype or product can be tested by putting it in a user's workplace and repeating the same steps as the problem identification (Beyer & Holtzblatt, 1999).

Contextual inquiry is applied to understand customers' needs, desires and working approaches (Beyer & Holtzblatt, 1999). In addition, it can be applied to define product requirements, to identify new product opportunities or to test prototypes and products (Beyer & Holtzblatt, 1995). According to those authors, contextual inquiry can be used in all stages of the NPD process depending on the goal of the usage. The application of contextual inquiry in the NPD process of radical products is not proved by empirical literature.

Observation techniques

In literature, multiple techniques that acquire customer information by observing the customer or end user are known. Examples of described methods are ethnographic studies (Rosenthal & Capper, 2006), applied ethnography (Sanders, 2002) and empathic design (Leonard & Rayport, 1997).

Because the differences between these methods are very subtle, they are assembled into one method called observation techniques in this literature review.

The main point of all these studies is to observe the customer in his/her own environment (Rosenthal & Capper, 2006; Sanders, 2002). Researchers spend time in the field with customers to observe the customer and their environment. This ensures researchers understand customers' lifestyle, problems and needs (Janssen, 2011).

Different kinds of information can be gathered by observation techniques (Sanders, 2002). First, an understanding on how people use current products can be acquired. Second, emerging and unmet customer needs can be identified. Final, important product attributes for customers can be identified. Leonard and Rayport (1997) agreed with those three contributions and added two others; observations give insights into the triggers of use and how the product interacts with user's environment. This information ensures really new products are developed instead of me-too products which the competitors also produce. Van Kleef et al. (2005) emphasized that the underlying motives for using a particular product can be detected. In other words, researchers gain insights into the benefits a customer wants to experience when using a product.

Rosenthal and Chapper (2006) proved with two cases that observation techniques can provide companies with different information for the NPD process. For instance, ideas for new product concepts, suggestions for changes to the product design, defined product specifications, specified target markets and product positioning.

Van Kleef et al. (2005) judged empathic design as an appropriate method to develop radical products. In addition, Janssen and Dankbaar (2008) proved that empathic design and applied ethnography can be applied for the development of radical products. Therefore, it is likely that observation technique is an appropriate method to involve customers in radical projects. The observation technique can be used during the whole NPD process. However, it is especially suitable for the early stages of the NPD process; namely scoping, build business case and development (Janssen & Dankbaar, 2008; Sanders, 2002). In addition, observations can be used in later stages when it is used to test the functionality or the appearance of new products in the development or the testing and validation stages (Leonard & Rayport, 1997).

3.6.2 Expert techniques

Crowdsourcing

Many definitions for crowdsourcing exist (Simula & Vuori, 2012). The most official definition describes crowdsourcing as "the act of a company taking a function once performed by employees and outsourcing it to an undefined network of people in the form of an open call" (Howe, 2006). The crowd can exist of internal employees, trusted partners or basically everyone (Simula & Vuori, 2012). In practice, crowdsourcing works as follows (Whitla, 2009); a specific task that is usually performed in-house is outsourced to a larger audience. People are invited to respond by a complete open call or by a call for selected departments, communities or partners. They have some time to work on the task and respond to the company. The company evaluates the quality of the tasks and might pay the respondents for their contribution.

Crowdsourcing can be applied for several purposes in different areas. In the product development, crowdsourcing obtains feedback on products and concepts from experts, potential and existing customers (Whitla, 2009). In addition, the crowd can provide ideas for new products but can also provide new products that are joined with the company's own products. Simula and Vuori (2012) argued that crowdsourcing can solve problems effectively, create new product ideas, and lower the development costs and time. These authors emphasized the benefits of crowdsourcing in the scoping stage of the NPD process. Janssen and Dankbaar (2008) agreed that crowdsourcing can be applied in the scoping and build business case stage to develop radical new products.

Lead user method

Lead users are users who have two characteristics (von Hippel, 1986). First, they recognize customer needs before the marketplace encounters them. Second, they can significantly benefit by obtaining a

solution to their needs. Incorporating lead users in a companies' NPD process is called lead user method. Companies can learn from lead users about problems, needs and solutions users face (Schreier & Prügl, 2008). Von Hippel (1986) described the steps to involve lead users in the NPD process.

One of the most striking aspects is that it could be beneficial to search for lead users in other industries than the company serves. In other words, lead users in markets or fields that face similar problems but in other forms can help companies to discover really new products (von Hippel et al., 1999). A case study by Lilien, Morrison, Searls, Sonnack, and von Hippel (2002) proved that involving lead users from outside the target market result in more radical products. In this case study, involving lead users resulted in higher forecasted market share and sales, newer customer needs, and higher product novelty. Lead users should collaborate with the NPD team to develop product ideas that are technologically feasible and meet customer needs (Janssen & Dankbaar, 2008).

The main goal of collaborating with lead users is to generate new product ideas or concepts (Schreier & Prügl, 2008). Another goal is to identify (future) latent customer needs (von Hippel, 1986). Dahlsten (2004) described the active involvement of women in the development of a new car. This product development was not radical but gives a good illustration of what information can be acquired by involving lead users. The women provided the team with information about the reasons of usage, an understanding of the target group, and feedback on the product concept. This case study proved that lead users can provide an understanding of the work processes, underlying motives of use and feedback on concepts and products.

The opinions about in which stages lead users can be involved vary between studies. According to Lettl (2007) involving lead users is applied in the scoping, build business case and development stage. However, the companies in the case studies also involved lead users in the testing and validation stage. Janssen and Dankbaar (2008) found that the lead user method is appropriate in the development stage for radical products. Whereas Lilien et al. (2002) argued that it should be used in the scoping stage of the NPD process.

3.6.3 Testing methods

Concept test

In a concept test, customers are asked to evaluate a product concept (Nijssen & Lieshout, 1995). Describing the product concept can in various ways such as by visualization or written documents. The concept should be presented as realistic as possible and in line with the proposed product (Kaulio, 1998). In a concept test, customers often evaluate alternative concepts including the new product concept and concepts of competition.

The goal of a concept test is to estimate how customers react on a new product concept compared to alternative concepts, to identify important product attributes, to determine potential market size, and to estimate purchase intentions (Ozer, 1999). Concept tests are usually conducted before a working prototype can be produced in the build business case stage (Kaulio, 1998). According to research of Nijssen and Lieshout (1995), concept tests are mainly used in the build business case and development stage. However, 25% of the companies also suggested to use the method in the scoping stage. The concept test is a method frequently used by companies, namely by 61 percent (Nijssen & Lieshout, 1995). Ozer (1999) mentioned different types of concept tests and their appropriateness for radical products. It appeared that not every type of concept test is useful in testing radical products, but expert opinions, scenario analysis and information acceleration can be used.

Prototype test

In a prototype test, customers evaluate a prototype of a new product. In most cases, the concept of the product is already defined. A prototype is a (physical) model of a product in development. According to Ozer (1999), three types of prototype test exist, namely alpha, beta and gamma tests. In alpha tests, the prototype is tested in a laboratory to check whether the product delivers the intended performance. In beta tests, customers use the product for a while in their own environment

and share their experiences with the company (Kaulio, 1998). In gamma tests, customers use the product for an extended time period and report to the company when they experience problems (Barczak, Griffin, & Kahn, 2009).

Multiple goals of prototype tests are identified by Ozer (1999). The overall goal is to detect and revise potential product problems before the product moves to later stages in the NPD process. To reach this overall goal, companies test prototypes to check whether the product meets the requirements and demands. In addition, they receive feedback about the prototype on other aspects. Furthermore, prototypes are tested to detect potential problems with a new product before it is mass produced. In addition, the product is compared with competitive products in the market and the marketing is tested. Finally, companies can assess how customer preferences and needs change after using the product (Ozer, 1999).

Mostly, prototype tests are conducted in the development stage (Lagrosen, 2005). In addition, it is advisable to build every stage something that can be showed to customers to receive early feedback (Cooper, 2014). This can be reached by rapid prototypes, working models or beta versions. Prototype tests can be applied in the NPD process of radical products, as long the prototype can be developed (Ozer, 1999).

3.6.4 Other methods

Consumer idealized design

Consumer idealized design allows customers to design their ideal product without concerning the product's feasibility (Ciccantelli & Magidson, 1993). Moreover, there is emphasized that they should only concern their desirability. Some constraints can be imposed such as technology constraints and legal restrictions. In consumer idealized design session, a facilitator is present who guide the session. Usually, a session has multiple iterations consisting of brainstorming, designing a plan and presenting the designed plans till all participants have agreement on the design (Ciccantelli & Magidson, 1993).

The goal of consumer idealized design is to generate new product concepts (Janssen, 2011). Furthermore, information about latent needs and customer's motivation to incorporate certain attributes or features can be collected during the sessions. Ciccantelli and Magidson (1993) explained that consumer idealized design should be occur in the early stages of the NPD process in parallel with brainstorms of the development team. The combination of both information sources can define the product concept. Applying consumer idealized design in the scoping stage was also proved by Janssen and Dankbaar (2008). In the same research, it was demonstrated that consumer idealized design can be applied in the NPD process of radical products.

Information acceleration (IA)

IA is applied to test concepts or products by using multimedia (van Kleef et al., 2005). Customers are placed in a virtual buying environment in which they are exposed to really new products (Urban, Weinberg, & Hauser, 1996). The virtual buying environment simulates information to the customer about showroom visits, advertising, consumer articles and word-of-mouth. Customers are encouraged to actively search for information before they make a purchase decision between the presented alternatives. The customer's intentions, perceptions and preferences are measured. This ensures actual customer behaviour is observed instead of intentions (Deszca, Munro, & Noori, 1999).

The goal of IA is to forecast sales of really new products by measuring actual customer behaviour rather than intentions (Urban et al., 1996). This can be achieved by combining IA with existing forecasting methods such as conjoint analysis and concept evaluation (Urban, Hauser, Qualls, Weinberg, Bohlmann, & Chicos, 1997).

According to Janssen and Dankbaar (2008), IA is applicable in the development stage of the NPD process of radical products. It provides information about product specifications and latent needs. According to van Kleef et al. (2005), IA can also be applied in the scoping stage to test concepts by obtaining customer feedback. The benefit of IA in comparison with other methods is that IA creates a more realistic view of marketing aspects (Urban & Hauser, 1993). Furthermore, the method can provide information about product characteristics and benefits. During and after the

development stage, IA can also be used to obtain accurate forecasts about purchase intentions and purchase probability (Urban & Hauser, 1993).

Outcome Driven Innovation (ODI)

In the method ODI, collected customer input is related to desired outcomes instead of solutions (Ulwick & Bettencourt, 2008). This is achieved by asking customers what they are trying to achieve in using a product rather than directly asking to their needs and wants (Ulwick, 2002). The interviews focus on features, steps that are undertaken in using a product, results that customers want to achieve in using products, and reasons why customers want the stated results. Based on the interview results, statements are formulated about the customers' desires. These are grouped under each process step and rated on importance and satisfaction by customers. Based on these ratings, decisions about new products and markets can be made.

The goal of ODI is to uncover customers' latent needs (Ulwick & Bettencourt, 2008). With the gathered information about customer needs and the jobs they want to get done, a company can set a direction (Ulwick, 2002). The data can be used to identify opportunity areas for product development, to segment markets, to conduct competitive analysis, to formulate concepts and product strategies, and to evaluate potential and alternative concepts. In the description of ODI's working, it is shown that ODI provides insights into the customer's work process, important product features and underlying motives of using a product. In existing literature, it is not explicitly stated in which stages ODI can be applied. In addition, literature has paid little attention to the appropriateness of ODI in the NPD process of radical product.

Zaltman Metaphor elicitation technique (ZMET)

In the method ZMET, participants are asked to collect images that express to them a meaning of a product or their feelings and associations with the product (Zaltman & Coulter, 1995). After a couple of days, the participants are interviewed by the researcher. The interview consists of several parts, including talking about the pictures and missing issues, a sorting task, and summarization of the images. Based on the interviews and images, the researcher constructs a consensus map which shows the relationships between the gathered information. The relationships present how one idea leads to another idea which is important in learning how concepts are related in the participants' mind.

The information collected with ZMET is useful in the NPD process to understand customer's perception of concepts, products, brands and companies. In addition, latent needs and new product ideas can be identified. Two studies assessed ZMET as an appropriate method to involve customers in the NPD process for radical products. Van Kleef et al. (2005) argued that ZMET is useful in the scoping stage to collect customer needs constructed as benefits and values. Zaltman and Coulter (1995) described ZMET as a method to improve advertising research which is important in the launch stage.

3.6.5 Summary

This chapter discussed ten customer involvement methods that are available for the development of radical products. For each method, it is described in which stages of the NPD process they can be applied and what kind of information they can collect which provide an answer on sub question 4 and 5. The discussion showed that customer involvement methods are available for all stages of the NPD process. However, most methods are used in the early stages and the development stage. Literature described some goals of the customer involvement methods or indicated what kind of information the methods collect. Those descriptions also demonstrated that customer involvement methods can contribute in various ways to the NPD process. Moreover, the contribution of a particular method can differ between stages. For instance, the method contextual inquiry identifies customer problems in the first stage but can be used to test the prototype in later stages of the NPD process.

3.7 Conclusion from literature review

The literature study discussed some relevant topics regarding customer involvement and the new product development process. First, the main activities and goals of each stage in the NPD process were identified. Subsequently, it was proved that over the course of the NPD process, different customer involvement methods should be applied to collect all the required information (Nijssen & Lieshout, 1995). In addition, it was clarified that methods in the same stage could contribute differently to the NPD process (O'Connor, 1998; Veryzer, 1998).

Second, some established frameworks of customer involvement methods were discussed. This discussion indicates that customer involvement methods are linked to several dimensions such as radicalness, relationship level and depth of customer involvement.

Third, customer involvement methods that seem available for the development of radical products and B2B were selected. The selected methods were further explained in detail. Most customer involvement methods have been discussed in literature. However, some in more details than others. For all methods, a description is provided, the actual usage is illustrated, the application in NPD stages is discussed, and the contribution to the NPD process is revealed.

Two research gaps are identified based on a detailed analysis of the current literature. First, the NPD process and customer involvement methods are both well researched. However, little efforts are made to connect these two research areas. As described in the previous sections, customer involvement methods can contribute to the NPD process enormously. Some studies described what kind of information customer involvement methods can collect. However, those studies did not translate those collected information into goals of the NPD process which were described by Cooper (2001).

Second, in the discussion of existing frameworks for customer involvement there is revealed that no framework is available for customer involvement methods in radical NPD process and a B2B market. Frameworks for one of the two conditions are available. Janssen and Dankbaar (2008) extensively researched which customer involvement methods are appropriate for three types of radical products in a B2C environment. In addition, Lagrosen (2005) identified customer involvement methods for B2B markets. However, a framework that both conditions meet is not constructed or described in current literature. As explained in section 3.4, differences exist between customer involvement methods for radical and incremental products. For radical products, it is more important to derive the customer needs without directly asking it. Furthermore, section 3.4 emphasized the differences between involving customers in a B2B and B2C market. In a B2B market, companies should take into account and collect the wishes and preferences from their own customers but also from the end customers. As explained in section 3.5, not all customer involvement methods are appropriate to derive the required information from customers in a B2B environment. Therefore, a framework that presents available customer involvement methods for radical products in a B2B market will contribute to research and will be beneficial for B2B companies.

In the next chapter, a framework is established which presents available customer involvement methods in different stages of the NPD process of radical products for B2B companies. In addition, the kinds of information the customer involvement methods can collect and to which NPD goals that information contribute is presented.

4 Constructing a framework

In this chapter, a framework for customer involvement is constructed based on the findings of the literature study. First, the available customer involvement methods for radical products are related to stages of the NPD process in which they can be incorporated in paragraph 4.1. For each method, there is shortly underpinned why a method is applicable in the specific stages. Second, the customer involvement methods are linked to goals of the NPD process or to information that is important in the NPD process in paragraph 4.2.

4.1 Relating stages to methods

Based on the literature study of existing literature about the selected customer involvement methods, a framework is proposed. It is assumed that all the methods can be applied in the NPD process of radical products because literature did not disclaim. In the construction of the framework, the existing frameworks of Lagrosen (2005), Janssen and Dankbaar (2008), and van Kleef et al. (2005) are taken into account. When it was not stated in current literature in which stages a method is applicable, the method is classified as wide as possible.

For some methods, section 3.6 describes clearly in which stages the methods can be applied. This applies to the following methods: contextual inquiry, observation techniques, crowdsourcing, lead user method, concept test, and ZMET. The remaining methods consumer idealized design, IA, ODI and prototype test are clarified more below.

For consumer idealized design, it is explained in in section 3.6.4 that the method should occur at the early stages in the NPD process. The application of consumer idealized design in the scoping stage was also proved by Janssen and Dankbaar (2008). In the build business case stage, it is important that the product concept is defined. As one of the most important goals of consumer idealized design is to generate new product concepts, this method is also applicable in the build business case stage.

As explained in the section 3.6.4, IA can be applied in the scoping and development stages. By applying IA, concepts can be validated by customers. In the build business case, the concept is still in development. As the description of IA explains, IA can help to define the concept by letting customers evaluate alternatives. Consequently, IA can also be applied in the build business case stage. Urban and Hauser (1993) stated that IA can also be applied after the development stage to obtain accurate forecasts about purchase intentions and purchase probability. Therefore, IA is presented in the framework in the scoping till testing and validation stages.

For the method ODI, it is not explicitly stated in which stages the method can be applied in section 3.6.4. The goal of ODI is to uncover customers' latent needs. This information can be used to formulate concepts and strategies. This information is required in the first two stages of the NPD process, namely scoping and build business case. Therefore, the method ODI is positioned in those two stages in the framework.

Prototype tests can be applied when a working prototype or product is produced. According to the goals described in section 3.6.3, this should occur in the development stage. In addition, during the testing and validation stage prototype test will be applied but as beta test (Ozer, 1999). Therefore, prototype test is positioned in the development stage and beta test in the testing and validation stage.

Based on this underpinning and the information in chapter 3, the framework is constructed which is displayed in Figure 4.1.

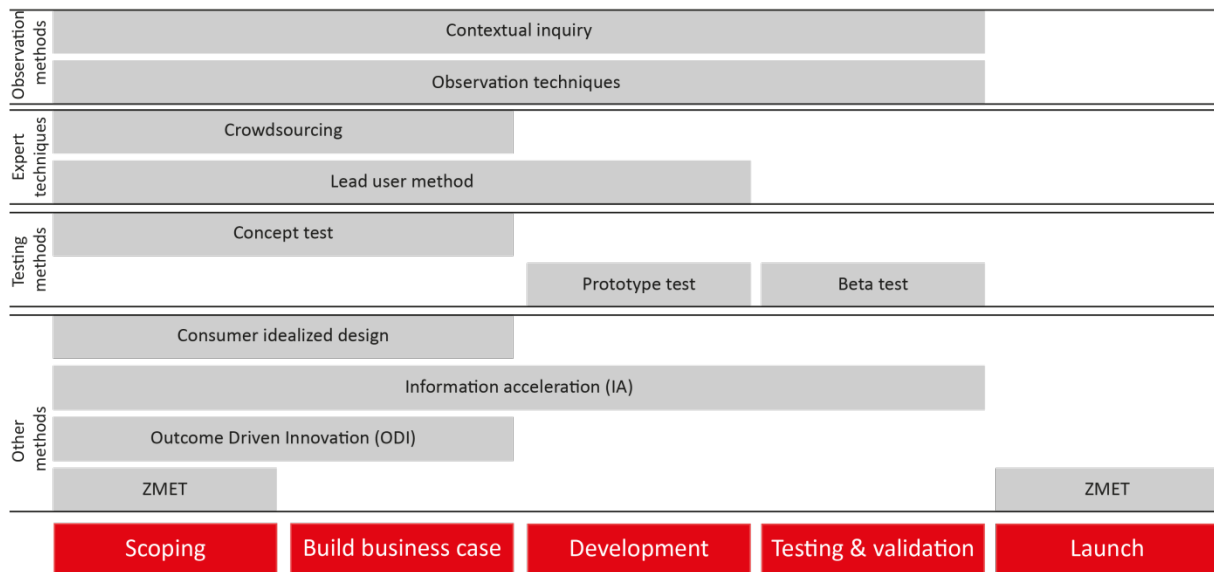


Figure 4.1. Framework relating customer involvement to stages of the NPD process

4.2 The contributions of the methods to NPD goals

The framework created in the previous section does not include what kind of information the methods collect or which NPD goals the methods help to fulfil. Therefore, a table is created which gives insights into what kind of information is collected. This table is constructed by analysing the current literature about customer involvement methods. Most literature about this subject describes what kind of information is collected or which goals can be achieved in general. It is often undefined in which stages of the NPD process the information is gathered. Therefore, it is decided to create one overview which relates the customer involvement methods to the kind of data they collect. In other words, the overview does not comment on appropriate stages for these methods or on when this information is required.

The goals of the NPD stages mentioned in section 3.2 are included in the established overview. Based on the clarification of these goals by Cooper (2001), some sub goals and required information are formulated. In Table 4.1 the NPD goals identified in section 3.2 are presented in the bold rows. The sub goals and required information are listed below those bold rows. The customer involvement methods contribute by collecting information for the sub goals and required information. In the process of relating methods to information, relationships were only marked when those were literally described in section 3.6. So, when a relationship could be detected by interpretation of the descriptions in section 3.6, the relationship was not marked.

Some goals identified in section 3.2 are excluded because they were not addressed in the customer involvement literature. The goals for which this applies are execute market launch plan and operation plan, finalize financial analysis, complete marketing plan, and build a business case with product definition, project justification and detailed project plan.

Table 4.1 shows all the identified customer involvement methods and the information they can collect. For example, the method contextual inquiry can identify opportunity areas, identify underlying motives of use, uncover customers' needs, and understand customers' work processes. These four types of information help to assess the market value of a product. In addition, the method can be applied to define the product clearly, develop prototype or final product design and to test the product, production and marketing with customers.

Table 4.1. Overview of the NPD goals that each method helps to achieve.

Available customer involvement methods	Contextual inquiry	Observation techniques	Crowdsourcing	Lead user method	Concept test	Prototype test	Consumer idealized design	IA	ODI	ZMET
Goal – information collected										
Deliver new product ideas	X	X	X	X			X			X
Assess financial and competitive situation										
Forecast sales								X		
Assess market value of product										
Define the target market		X		X			X		X	
Determine potential market size					X					
Evaluate alternative concepts					X			X	X	
Identify opportunity areas	X								X	
Identify underlying motives of product use	X	X		X			X		X	
Uncover customer’s (latent) needs	X	X		X			X	X	X	X
Understand customer’s work processes	X	X		X					X	
Assess technical and product performance objectives										
Receive feedback on product concept		X	X	X	X			X		
Define the product clearly										
Determine product’s requirements or specifications	X	X		X			X	X		
Formulate product concept				X	X		X		X	
Identify important product attributes		X		X	X		X	X	X	
Develop prototype or final product design										
Ensure product meets customer requirements	X			X		X				
Test prototype	X	X		X		X				
Test product, production, and marketing with customers										
Test product	X			X		X				
Compare product with competitive products						X		X		
Detect potential product problems	X			X		X				
Forecast purchase intentions and purchase probability				X				X		
Receive feedback on product	X	X		X		X		X		
Receive information on marketing aspects								X		
Measure, control and adjust the marketing plan										
Improve advertising research										X

4.3 Conclusion

This chapter constructed a framework which represents available customer involvement methods in the different stages of the NPD process for radical products in a B2B market. Furthermore, the type of information and the contribution to NPD goals are shown. Both are the result of the literature study. In the next chapter, the case study results are discussed to investigate whether the literature findings corresponds the actual performance of a B2B company.

5 Results of case study

This chapter presents the results of the case study. First, important goals in the NPD process of the CEM are discussed to find an answer on which NPD goals are important in the NPD process of the CEM (sub-question 6). Second, the applied customer involvement methods in each project and the employees experienced benefits are discussed to answer sub-questions 7 and 8. Third, the overall perceived utility of customer involvement in the four projects is explained.

5.1 The NPD process within the CEM: from idea to launch

In this paragraph, sub-question 6 is answered about important goals in each stage of the NPD process. First, the structure of the NPD process is explained in paragraph 5.1.1. Besides the goals, important information that is required towards reporting each milestone is discussed. The latter is added in this chapter because customers are often approached for the collection of that specific information. The information in this section is required to establish a design in chapter 7 that meets the needs of the CEM.

5.1.1 Stages in the NPD process

Projects within the CEM run from the 'before M1 milestone' till the M7 milestone which is the end of the project. The milestones can be seen as the gates which are usually at the end of each stage in the NPD process. At those milestones, decisions are made about the continuation of the project. The stages between the milestones do not have explicit names or descriptions but are denoted by, for instance, 'before M1 milestone' or 'we are working towards M2'.

As the stages of the NPD process in the CEM are not called like the stages discussed in chapter 3, an additional step is required to enable comparison of the constructed framework in chapter 4 and the results of the empirical analysis. Therefore, the next paragraph discusses all the CEM's milestones and the corresponding main activities, main goals and the required information. Subsequently, based on those descriptions, the CEM's NPD stages are transformed to the stages identified in the literature study.

5.1.2 Goals of the NPD process

As explained in the previous paragraph, this section discusses all stages and milestones. During the interviews, it appeared that not all the milestones are very strictly separated. Therefore, some milestones are merged into one stage. The information in those paragraphs is collected by the interview question 'What were the main goals of each phase in the NPD process?' and by consulting company documents that describe the NPD process.

Before the M1 milestone

In this first stage of the NPD process, very preliminary information is collected to define a project plan. This project plan contains information about product, market and customer requirements. However, it is still on the level of a concept whether they have something that can work and fulfil a need in the market. In addition, target dates are estimated for the M2 and the M5 milestones.

The goals between the M1 and M2 milestones

At the M2 milestone, the product functionality should be clear and established. There should be known what kind of product they are going to develop, what the value is and who the customers are. In other words, target market, competition, product features and functionalities, expected costs, estimated amount of sales and expected revenues should all be specified. Based on the information about features and functionalities, the R&D department writes a Product Specification Document (PSD) that describes all the specifications of the product. In addition, an underpinned plan for the subsequent stages should be written. In this plan, one of the topics is how the risks will be reduced to ensure a well-developed product exists at the M5 milestone.

One of the employees remarked that the type of information required for the M2 milestones is the same as before the M1 milestone but a difference exists in the accuracy of the information. Towards the M2 milestone everything should be sharpened into a proposal, while in the M1 milestone it is more at the concept level.

The goals between the M2 and M5 milestones

Between the M2 and M5 milestone the separation between the milestones is less strict than before. The CEM has guidelines for the separate milestones between M3, M4 and M5. In practice, the process passes from the M2 milestone to the M5 milestone. In general, very soon after the M2 milestone, the hardware should be finished which means that no problems will be caused by the hardware. In addition, the industrialization is started. Between M2 and M5, a whole validation path occurs to ensure the quality is sufficient at the M5 milestone, the beta test is part of that trajectory. Officially, the beta test is the M4 milestone. For the marketing department, it is important to formulate launch strategy. In addition, the roll out and the allocation plan should be clear before the M5 milestone. The M5 milestone means that the product can be launched to the market.

After the M5 milestones

When the M5 milestone is passed, the product can be launched to the market. This starts with a limited amount of products available for customers and results in worldwide availability of the product. After the M5 milestone, the development of the product is mostly finished. However, some other aspects remain important before the project is completed. For instance, the profitability should be assessed and the documentation should be finalized.

5.1.3 Translating CEM's milestones into general NPD stages.

The most important goals per stage are summarized in Table E.2 in appendix E. This summary answers sub-question 6 'Which NPD goals are important in the NPD process of the CEM?' A comparison of the NPD goals per stage between the CEM and literature enables it to translate the stages of the CEM to general NPD stages (see appendix E). The information that each stage is collected by the CEM is subdivided to the literature stages. When this was finished for every goal in each stage, a decision was made about which literature stage had the most similarities with the stages of the CEM. The result of the translation is presented in Table 5.1. The goals of the scoping and build business case are clearly recognized in the goals pursued by the CEM before the M1 milestone, and between M1 and M2. The development, and testing and validation stages are both recognized in the CEM's NPD process between M2 and M5.

Table 5.1. Translating the CEM's NPD stages into general descriptions of NPD stages

Literature	CEM
Scoping	Before M1
Build business case	Between M1 and M2
Development	Between M2 and M5
Testing and validation	Between M2 and M5
Launch	After M5

5.2 Results within-case analysis: applied customer involvement methods

In the case study, four projects are analysed. This section highlights the most important information about the customer involvement methods and the experienced benefits of the employees. To increase the readability of this section, the descriptions of the projects are presented in appendix G and the procedures of the applied customer involvement methods are given in appendix H. The goals of the applied customer involvement methods are listed in section 5.3.2. All this information is collected during the semi-structured interviews and the analysis of documents. Because

confidentially to the employees was ensured, the departments of employees are not mentioned while this sometimes was taking in mind during the analysis.

All the customer involvement methods applied by the CEM are conducted at the customer's place; any exceptions are mentioned by the particular methods.

5.2.1 Project Alpha

The different points at which customers were and will be involved in project Alpha are illustrated in Figure 5.1 and are discussed in the next paragraphs. Alpha is currently between the M1 and M2 milestones.

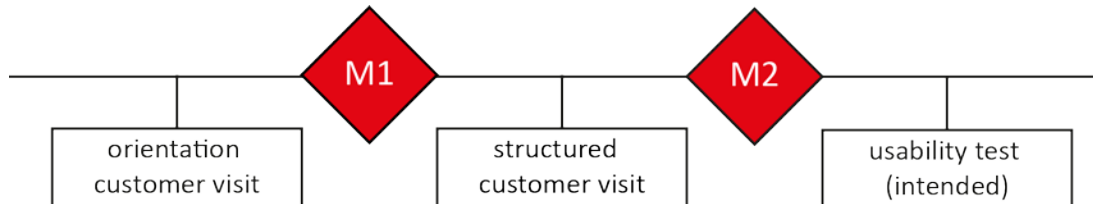


Figure 5.1. Applied methods of customer involvement in project Alpha

Orientation customer visits

At the beginning of project Alpha, some customers were involved. Customers were visited and interviewed. At this point in the project, the customer interviews were quite unstructured. The team started visiting a very broad range of customers from all kind of market segments to understand where the considered product should be best targeted. The collected information helped the team to target the product and to set a direction for the M1 milestone.

Structured customer visits

When there was a clear picture of the desired direction the project should go, a more structured approach was formulated. In addition, the customer visits were more and more focused on the target customer. Until now, around 25 visits have been conducted following the approach described in appendix H. A big part of the visits was composed of the structured interview. However, the involved employees emphasized that a lot of additional valuable information was collected from informal discussions on the job.

These structured customer visits were experienced as very useful by the involved employees. Based on the received customer feedback, some requirements were changed. One of the involved employees remarked that it is important to take the selection of customer into consideration when evaluating the results of the customer visits. The customers were selected by the own sales organization which might induce not all desired customer segments were included.

While the focus of these visits was on the target customers, they tried to keep in contact with the customers surround the target customers to monitor whether opportunities exist in that position as well.

Usability test (intended)

There are plans to do a kind of usability test, once they have a working machine. This will be probably after the M2 milestone. Then, customers will be invited to visit the CEM side to give some user feedback on the product. The focus of this test will be more on the usability of the product and what customers like and what they do not like. Therefore, this will be more about validating the product than collecting customer information or concept validation. In addition, only small changes can be made in the design at that point in the process.

5.2.2 Project Gamma

In Figure 5.2, an overview is presented of all the customer involvement methods that occurred in project Gamma. These methods are discussed in the following paragraphs. Project Gamma is currently approaching the M5 milestone.

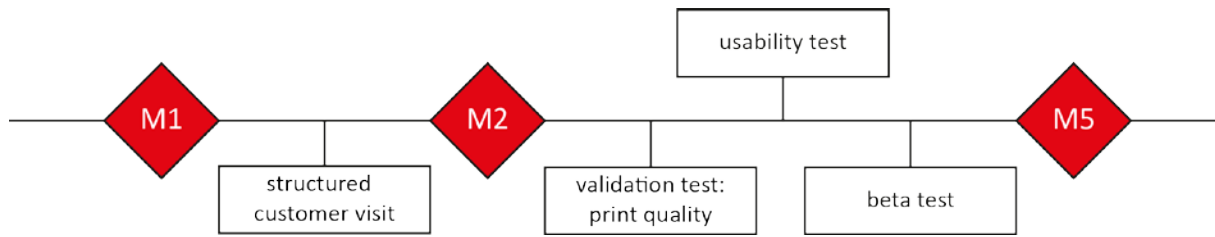


Figure 5.2. Applied customer involvement methods in project Gamma

Structured customer visits

Between the M1 and the M2 milestones, about 40 customer visits were conducted. As preparation for those visits, all the involved employees participated in a training to learn what kind of questions they should ask and what kind of questions they should avoid, how they should prepare a customer visit, and to what aspects they should pay attention. Furthermore, a booklet was created as guidance for the visits. Each customer visit was done by pairs with representatives of different departments to ensure different perspectives were gained. During the tour through the company, the employees could validate the information acquired with the interviews. The precise implementation of those customer visits is illustrated in appendix H.

Originally, the goal was to get a good story about which products are we going to develop, why do we develop it, who are our competitors? The involved employees had diverse experiences with the end results of the customer visits. One of the employees assessed the results as not sufficiently detailed to completely answer those questions. He explained that the visits were conducted by too many different people which resulted in much global information but no specified information. In addition, the visited customers did not always represent the target market which made it hard to generalize the findings. In contrast, another employee was very satisfied with the approach of the customer visits. He assessed the results as sufficiently thorough for this stage of the process.

Validation test: quality

In an early stage of this project, it was decided that a quality validation should be part of the process because the quality was significantly improved in comparison with the predecessor product. Therefore, four customers participated in the validation procedure as described in appendix H. These customer contacts were conducted between the M2 and M3 milestones.

The employee in the lead of this customer involvement method was satisfied with the collected information. He commented that the usefulness of feedback depends on the type of customer and the type of applications the customers is used to implement. However, he acknowledged that you should always take this in mind when analysing the results. Furthermore, he advised to repeat those validation visits in future, not only for quality but also for other aspects of the product.

Usability test

The next step in the validation trajectory was to test the usability of the product. Earlier in the project, parts of the product were tested on usability, but in this test the whole machine was tested. So, this was the first real customer confrontation for the whole product which took place between milestones M3 and M4. The procedure of this usability test is explained in appendix H. Six customers were invited to participate in the usability test.

The focus and the purpose of the usability test were *“Can the customer use the product like he expected to use it? Did we match our product properly with his expectations?”* Based on the received feedback and the video images, some issues in the design were detected that have to be solved. Some of the issues have been estimated beforehand and were confirmed during the usability tests, others were new to the team. In addition, no big or unsolvable problems were detected.

However, not all those issues have been solved because there is always the trade-off between speed-to-the-market and product quality.

The usability test discovered some issues which were not expected, so the involved employees were satisfied with this test. One of the employees mentioned that the timing could be earlier in the process. But he reflected on his own statement that a developed product that is ready for this kind of test is a prerequisite, otherwise it will not be beneficial.

Beta test

The final involvement of customers before the product launch was the beta test. A beta test is the final check where a product is installed at the customer's place. This customer can use the product for six weeks and return all his feedback. The goal of a beta test is to check if the product is usable in the customer's working environment and in his workflow. In addition, possible blocking parts can be identified.

A big disadvantage of the beta test is that little opportunities exist to change the product. At the moment of the beta test, the product is almost finished to enter the market. Changes in the product design will delay the product launch and increase development costs. Since you can learn a lot from beta tests, they are still part of the process.

Because the beta test is currently running, no specific information about the results of the beta test can be presented. One issue that is already noticed is that it is hard to interpret the results of a beta test. This is caused by the fact that the number of customers is limited; a problem for one customer does not mean all customers will experience that as a problem. To avoid these interpretation difficulties, it is important to select customers that are representative for the target market and have a workflow that fits with the product.

Another aspect that is already considered as a lesson learned is that some means should be provided to get the customer's opinion. For instance, by using cameras to observe the customer or by giving the customer a diary in which he/she can mark experiences, errors or ideas for improvement. In the currently running beta test, this was not offered. This caused that little information was acquired about how the customer really interacted with the product.

5.2.3 Project Delta

Project Delta is currently between the M1 and M2 milestones. In this project, customers were involved at different moments in the NPD process. A global overview is displayed in Figure 5.3. Some employees made interesting remarks with regard to the research topic of this thesis, these comments are discussed at the end of this chapter in the section other notable results.

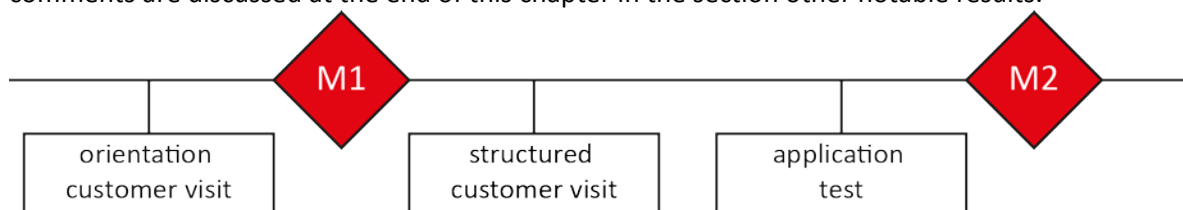


Figure 5.3. Applied methods of customer involvement in project Delta.

Orientation customer visits

In project Delta, the first contacts with customers were two orientation visits. At that moment, the project was approaching the M1 milestone. These visits had a more open type of interview and a tour through the shop. These visits were meant to get a feeling of how the interviews could work, how useful it was to show things and how much they should tell in preparation for the more structured interviews. These goals were achieved according the involved employees because they were able to define the approach for the structured customer visits.

Structured customer visits

In project Delta, around 30 structured customer visits in different continents were done. In these visits, a structured interview approach was followed. The procedure of these structured interviews is explained in appendix H. This procedure was defined after the orientation interviews and is based on the experiences of the employees with the method ODI. In addition, it was practiced with a former customer to check whether it worked or not. All the structured interviews took place between the M1 and M2 milestones.

The involved employees were satisfied with the results of the structured customer visits. One of the employees responded: *"It told us what the showstoppers could be and those gave us a good feeling about the sensitivity around each."* The same employee indicated *"Yes, I am satisfied. I think it gave the answers"* and *"So, I think in this phase of the project, it did what it meant to do."*

However, one employee indicated some points that required some additional attention. First, the results can be overinterpreted. Second, the results depend on the interviewer's skills and integrity meaning that the interviewer should have a neutral attitude and should not bias the customer. This can be prevented by extensive training of the interviewer. Third, it is important to select the right customer. The group of customers visited was sometimes very diverse which mean that it was hard to generalize the results.

Application tests

In the market at which Delta is targeted, it is not only important to use the product but also to finish the product outcome. To test whether the applications can be executed with the prototype, application tests were executed. The exact procedure of the application test is described in appendix H. Different kinds of information can be gathered during the application tests. The employees experienced this method as very useful and have plans to conduct application tests with more customers.

Other notable results

One of the employees evaluated on the established relationship with a former customer. With this former customer the structured interview was practiced. The advantage of practicing with a former customer was that you should not take into account possible sales interests. This customer also benefited from this exercise because they learnt how they could think about buying a new product. Subsequently, the application test was conducted with the same customer. The involved employee of the CEM realized afterwards that this relationship was a good way to develop lead users. He further explained that when they want to involve lead customers, the sales people are asked for appropriate customers. However, these customers have not been involved in the whole process and prior tests. In this example, the former customer already has knowledge about the project and has been involved in the previous tests which make him an attractive customer for future tests in comparison with other random customers. Although this specific customer was probably not the most appropriate customer as a lead customer, it illustrates how a relationship can be built.

5.2.4 Project Epsilon

Project Epsilon is currently approaching the M2 milestone. Likewise the other projects, customers were involved over the course of this project. The moments that customers were involved are displayed in Figure 5.4. These methods are discussed in this section. In addition, some issues about the intended beta test are examined, although this has not yet occurred.

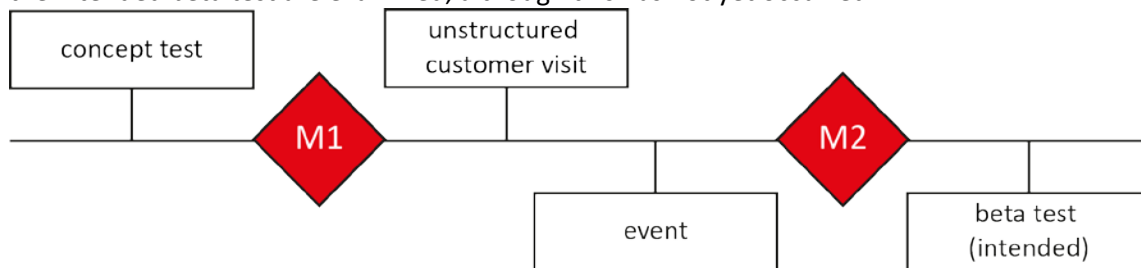


Figure 5.4. Overview of the customer involvement practices in project Epsilon

Concept test

Before the M1 milestone, a workshop with three customers was organized at the site of the CEM. The content of the workshop is explained in appendix H. The goal of this workshop was to test the concept and to collect customer feedback on the concept. The involved employees were very satisfied with the results of the workshop. It provided the team with ideas for new applications and they received constructive feedback on the concept.

After the first concept test with some customers, the development team produced a working model of the concept. That made it possible to do live demonstrations. This was done internally to the decision makers and also to the same customers as the workshop. Thereafter, this practice of testing the concept was applied during some customer visits, as explained in the next paragraph.

Unstructured customer visits

After the concept tests, a similar thing was done at the customers' own side which is explained in appendix H. Employees of the CEM went to customers, did a tour and gave a presentation about the concept as it was real. Then, feedback was collected on the concept and other aspects. This was achieved by holding discussions with the customers; no structured interview approach was applied.

These visits were also experienced as useful. One employee remarked that it is useful as long as you prepare the visits to ensure you can have the right discussion with the customer. It is really important to question the customer to detect the gaps in the product idea or concept. Otherwise, you only receive the general positive feedback.

Event

This event was organized by the CEM to launch another product publicly. However, the opportunity exists to show the software of Epsilon. At the moment of the event, the product was in a more developed stage than before. This enabled it to show people what Epsilon is in and gave a more detailed explanation. These were quick, one-to-one conversations where people could give their opinion. The purpose of this event was to validate the concept and to check whether people see value in the product.

The event was experienced as useful because they got a broader range of opinions in a relatively short timeframe. The event provided good insights into product specifications and target market. However, it remains a challenge to determine whether people are really going to buy the product.

Beta test (intended)

Currently, the team is planning the beta test which will take place when the M2 is approved. At this moment, there are plans for the type of customer who will participate in the test and for the type of features to include. The plan is that customers try to do their real work and tell the CEM which limitations they experience. The intended goal of this beta test is to validate the concept and the

product. As usually the goal of a beta test is to test the product on issues before it will be launched, one of the involved employees reflected as follows on the goal: *“Our case is a special beta test because we also want to test the concept.”* Questions like is Epsilon useful for customers, are the implemented functionalities the required ones, can people work with Epsilon, what should and should we not do the next release, will be tried to answer during this beta test. A summary of the proposed plan can be found in appendix N.

Remark about project Epsilon

The descriptions above gives the impression many customers are involved in project Epsilon. It is important to take in mind that customers gave their feedback and opinion about the intended product, but that none of them tried to use the product. As remarked in the paragraph about the intended beta test, the concept should still be tested. That is a big difference with the other three projects, especially because Epsilon will be a product without comparable competitor products on the market.

5.3 Results cross-case analysis

This section combines the results of the within-cases to compare the four projects with each other. The projects are compared on several aspects which is displayed in appendix I. This appendix was constructed based on the analysis of the interviews and the documents by content analysis. Recurrent subjects are summarized in tables for each applied customer involvement method. This section highlights the most important findings of those tables.

5.3.1 Applied customer involvement methods per project

In all projects, customer involvement methods or practices are applied in different stages of the NPD process. In Table 5.2, an overview is presented which customer involvement methods are applied in each project and the corresponding timing. This table was constructed based on the timelines presented in section 5.2 and appendix I. For methods applied between the M2 and M5 milestones, the exact moment of application was derived from the interview transcriptions.

Table 5.2 demonstrates that some methods were applied in more projects and others in only one project. For instance, structured customer visits were applied in three projects. In addition, the timing of structured customer visits is the same in the projects. Another example of a method applied twice, is the usability test. However, the timing of the usability test differs between the two projects.

Table 5.2. Cross-case analysis: applied customer involvement methods and timing in each project

	Alpha	Gamma	Delta	Epsilon
Application test			M1 and M2	
Beta test		before M5		after M2*
Concept test				before M1
Event				M1 and M2
Orientation customer visit	before M1		before M1	
Structured customer visit	M1 and M2	M1 and M2	M1 and M2	
Unstructured customer visit				M1 and M2
Usability test	after M2*	before M4		
Validation test		before M3		

* This is intended but not yet applied.

5.3.2 Collected information by involving customers

As explained in the within-case descriptions, each project involved customers to collect specific information or to reach some goals. This information helps to reach certain NPD goals. Based on carefully reading literature, the case study results and appendix I, the collected information of the customer involvement methods is assigned to NPD goals. For the projects Alpha and Epsilon, intentions have been formulated about what they would like to do in the next stages. Those

intentions also expressed the kind of information they would like to collect but because it is still not conducted. Because no information is available about the extent to which the information will be really collected, it is decided to exclude these methods in the cross-case analysis.

Because the contribution to the NPD goals differs between stages, three separate tables are constituted. These tables are presented in appendix J. The tables show that some collected information, such as required applications and identifying key buying criteria, contributed to multiple NPD goals. Other collected information, like price indication, only contributed to one NPD goal. In the phase between M1 and M2, all projects collected different kinds of information that still contributed to the same NPD goal. For instance, for the NPD goal 'assess market value of the product' all projects gathered other kinds of information to acquire more knowledge about the market and its customers.

5.3.3 Comparing the collected information per applied method

Analysis of the cross-case tables in appendix I demonstrates that the applied customer involvement methods collected different kind of information and contributed differently to NPD goals. Table 5.3 and Table 5.4 illustrate which information is collected by each customer involvement methods and how this information contributes to the NPD goals. As can be seen in the tables, the methods collected very different kinds of information.

Some methods are applied in more than one project, namely orientation customer visits in the projects Alpha and Delta, and structured customer visits in Alpha, Gamma and Delta. Although the structure of those methods was almost identical, other kind of information was collected as explained below.

The orientation customer visits in Alpha and Delta were both unstructured conversations with employees. However, the collected information differed enormously between the two projects. In Alpha, information about customers, market and technical issues were gathered to contribute to certain NPD goals. In contrast, in Delta the orientation customer visits were not meant to collect that kind of information. It was really about experiencing a customer visit and about preparing an approach for the structured customer visits.

In three projects, structured customer visits were applied between the M1 and M2 milestones. As can be seen in the appendix, the approach of those visits differed between the projects. In Delta, a well thought-out structure was defined to obtain information from the customers they were not aware of. This structure motivated customers to underpin their thoughts and statements. In Alpha and Gamma, the approach was less structured. A list of questions on different topics existed, and for each customer there were addressed as many topics as possible. Likewise, the collected information and the NPD goals were different between the projects. In Delta, it was really about validating the product and identifying features/applications that did not meet customer requirements. In Alpha and Gamma, the emphasis was on understanding the customers and market, and acquiring insights in required features and applications. In all three projects, the collected information contributed to approximately the same NPD goals such as assess market value and assess technical and performance objectives.

Table 5.3. Overview of the collected information per method – before M1 and between M1 and M2

Available customer involvement methods	Orientation customer visit	Concept test	Event	Unstructured customer visit	Structured customer visit	Application test
Goal – information collected						
Assess financial and competitive situation (preliminary)						
Benchmarking: Where are we?					X	
Identify strengths and limitations of competitor’s products					X	
Information about competition and market trends					X	
Price indication		X				
Understand competitor’s products	X					
Assess market value of the product (preliminary)						
Acquire market and customer knowledge					X	
Early validation	X	X				
Identify key buying criteria	X					
Identify target customers		X				
Understand competitor’s products and their experiences	X					
Understand customer’s problems and unmet needs			X		X	
Understand market dynamics	X					
Understand the business	X	X		X	X	
Validate concept			X	X		
Validate product				X	X	
Verify the product’s attractiveness			X	X		
Assess technical and performance objectives (preliminary)						
Desired functionalities		X				
Identify blocking issues and showstoppers					X	
Identifying key buying criteria	X					
Receive feedback					X	
Required applications	X	X			X	
Test applications						X
Validate product				X	X	
Value of applications and specifications					X	
Determine product’s core requirements						
Desired functionalities		X			X	
Required applications	X	X			X	
Define product clearly						
Information about workflow and work structure					X	X
Required application and product specifications		X			X	
Value of applications and specifications		X			X	
Ensure product meet customer requirements – concept stage						
Understand customer’s problems			X			
Understand customer’s unmet needs					X	
Verify the product’s attractiveness			X			
Test product concept						
Early validation	X					
Suggestions for other uses		X				
Test concept		X				
Verify the product’s attractiveness						
Benchmarking: Where are we?			X		X	X
Value of applications and specifications					X	
Verify the product’s attractiveness			X			

Table 5.4. Overview of the collected information per method - between M2 and M5

customer involvement methods	Validation test	Usability test	Beta test
Goal – information collected			
Ensure product meet customer requirements – after development stage			
Information about customer’s workflow	X	X	
Is product usable at customer’s place			X
Validate quality	X		
Works the product as expected		X	
Input for marketing plan			
Acquire customer experiences		X	
Information for demonstrations		X	
Market trends	X		
Test product			
Identify blocking parts			X

5.4 The CEM’s framework

Based on the information from the semi-structured interviews and the documentation, a framework is constructed that presents the available customer involvement methods within the CEM and the stages in which the methods were conducted. This framework is displayed in Figure 5.5. In this figure, both literature and the CEM’s stages are presented.

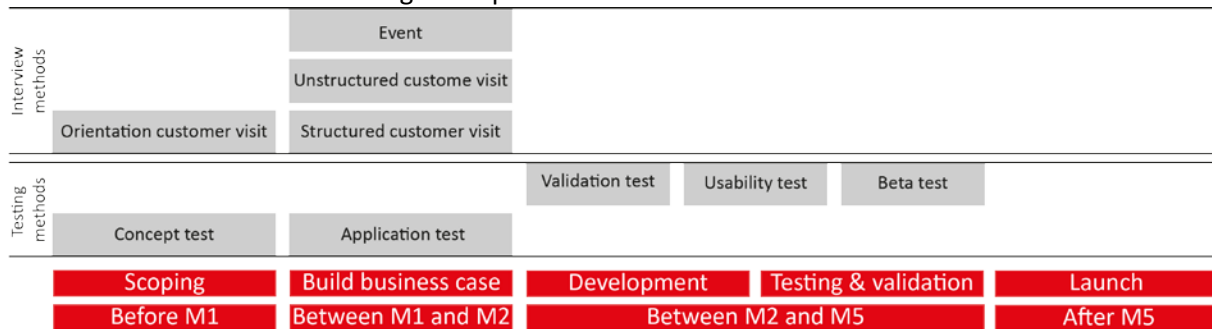


Figure 5.5. Framework of customer involvement methods applied within the CEM

5.5 Conclusion

This chapter presented the results of the case study which gave answers on sub-questions 6, 7 and 8. Important NPD goals in the CEM’s NPD process were identified, the applied customer involvement methods were explained and the experiences of the employees with those methods were discussed. It appeared that many different customer involvement methods were applied by the CEM. All those methods collected different kinds of information. However, methods were rarely repeated in other projects. Exceptions are the orientation and structured customer visits which were applied in multiple projects. However, difference existed between the execution, structure and collected information.

The information provided in this chapter was mainly descriptive. The next chapter contains an analysis of those descriptive results which enables selecting appropriate customer involvement methods for the CEM.

6 Evaluation

This chapter analyses the results of the previous chapters. As presented in Figure 1.2, this is achieved by taking three steps. First, the literature framework is compared with the framework of the CEM. Second, the customer involvement methods applied by the CEM are evaluated on eight dimensions to determine their effectiveness and usefulness. Third, the customer involvement methods of the literature framework are evaluated on whether they fit the information that the CEM would like to collect.

6.1 Comparing the frameworks

Until now, two frameworks were constructed that present available customer involvement methods in the NPD process, namely a literature framework and the CEM's framework. Between the two frameworks, some similarities and differences exist. These are discussed in the following paragraphs to provide an answer on sub-question 9 about the similarities and differences between the applied customer involvement methods within the CEM and the framework based on literature. In this comparison, the explained descriptions of the methods are taken into account to include some additional (dis)agreements. In Table 6.1 the identified similarities and differences are listed.

Table 6.1. Similarities and differences between literature and CEM's framework

Similarities	Concept test Prototype (usability + validation test) Beta test	In both frameworks In both frameworks In both frameworks
Differences	Crowdsourcing IA ZMET Events Unstructured customer visit Orientation customer visit Structured customer visit Application test	In literature framework, not in framework CEM In literature framework, not in framework CEM In literature framework, not in framework CEM In framework CEM, not in literature framework In framework CEM, not in literature framework In framework CEM, not in literature framework In framework CEM, not in literature framework In framework CEM, not in literature framework
Partial agreement	Consumer idealized design ODI Observation techniques and contextual inquiry	Literature framework, applied in structured customer visits Literature framework, applied in structured customer visits Literature framework, applied in orientation, structured and unstructured customer visits
Other issues	Contextual inquiry Lead customer method	Literature framework, similar as internally developed method DSI Literature framework, applied in one project by the CEM.

6.1.1 Similarities between the two frameworks

Comparing the two frameworks, some methods are reflected in both frameworks. Those methods are discussed in this paragraph and presented in Table 6.1. First, the method concept test is part of both frameworks. Within the CEM, this method is applied in the first stage. According to the literature framework, it can be applied in the scoping stage or the build business case stage. The CEM applied this method in a project for which no comparable products were known. Therefore, the new product concept was only evaluated by the customers and no comparison was made to alternative concepts.

Second, the beta test is presented in both frameworks. The timing is also the same: in both frameworks a beta test should be performed during the testing and validation stage. Two kinds of prototype tests were conducted by the CEM, namely the usability and the validation test. In the usability test, the prototype was tested in-house to check whether the product delivered the intended performance. The validation test was applied in the development stage to test the quality of the prototype.

In addition, some methods applied by the CEM contain parts of methods mentioned in the literature framework. This is presented in Table 6.1 in the row partial agreement. The orientation, structured and unstructured customer visits in the CEM's framework contain an observation part. During the visits, employees observe the operator, the current equipment and the workflow and ask some questions to the operator. Usually, those were short tours through the customer's place. The operator was not observed for hours while he was performing his daily work. So, these two methods of the CEM's framework include some aspects of observation techniques and contextual inquiry reflected in the literature framework.

Finally, in some applied methods characteristics of customer idealized design are recognized. By using consumer idealized design, customers are asked to design their ideal product by group sessions. In project Alpha, one of the questions in the structured customer visits was how the customer's ideal product would look like. The customers provided a description of their ideal product, including desired features and specifications. Furthermore, ODI is used as a starting point for the structured customer visit in project Delta.

6.1.2 Differences between the two frameworks

The main difference between the two frameworks is found in the kind of methods applied in the frameworks. In the literature framework, emphasis is put on isolated methods. In contrast, the methods applied by the CEM are more combinations of methods. The differences are listed in Table 6.1.

First, crowdsourcing, IA and ZMET presented in the literature framework are not part of CEM's framework. The CEM does not apply those three methods in their NPD process nor in other methods. The other way, some methods applied by the CEM are not reflected in the literature framework. Those methods are event, unstructured customer visit, orientation customer visit, structured customer visit and application test.

Second, some other issues were noticed in comparing the two frameworks which are listed in Table 6.1 in the row other issues. Contextual inquiry is not presented in the framework of the CEM. However, the CEM internally developed an observation and questioning method based on contextual inquiry, called Document Scene Investigation (DSI). In the selected projects, DSI was not applied but it is a well-known method within the CEM.

Finally, the lead customer method is not applied in the projects of the CEM as an isolated method. Some employees see opportunities in developing relationships with lead users in future. For instance, in project Delta a customer was repeatedly involved in practicing the structured interview approach and delivering feedback on the quality of the prototype. Building this kind of relationship with a customer will provide benefits to the CEM.

6.2 Dimensions

The previous section provided an answer on which similarities and differences exist between the customer involvement methods applied within the CEM and those recommended in literature. However, based on that comparison, it cannot be concluded what the CEM should do because it should be taken into account whether the currently applied methods were beneficial and effective. Therefore, eight dimensions are chosen that are important in considering whether a customer involvement method should be applied in certain stages of the NPD process or not. Research of Thia, Chai, Bauly, and Xin (2005) indicated factors that impact the adoption of customer involvement methods. Most of those factors were also mentioned by the CEM's employees during the interviews. In addition, the employees mentioned some additional factors that are important when considering the application of a certain method. Joining this information, eight dimensions were created. Below, these dimensions are listed and the corresponding definitions are provided.

- *Diversity of application*: the extent to which a method can collect different kinds of information.
- *Efficiency*: the extent to which a method is performed in the best manner with the least waste of time and effort.

- *Importance of customer selection*: the extent to which it is important to make a well thought selection of customers to acquire useful and comparable information.
- *Time*: the throughput time of a method.
- *Timing in NPD process*: the extent to which methods are applied in the correct stage of the NPD process.
- *Usefulness*: a method provides value to the company in terms of tangible and intangible benefits (Thia et al., 2005).
- *User-friendliness*: contains ease of use and ease of learning (Thia et al., 2005). Ease of use is the degree to which employees are able to apply a method without support of external parties. Ease of learning is the extent to which it is difficult or complex to learn applying a method.
- *Structuredness*: the degree to which a method has a fixed structure which should be followed to guarantee success.

6.2.1 Approach of evaluating the methods on the dimensions

The customer involvement methods applied by the CEM are evaluated on the defined dimensions. To increase the reliability of this research, several people were asked to evaluate the methods. Five (graduated) students were provided with a description of the dimensions, the values of the dimensions (see Table 6.2), the results of chapter 5, and a list of all interview statements per customer involvement method. Based on this information, they were asked to rate the customer involvement methods on the dimensions.

Table 6.2. Dimensions for the evaluation and the corresponding scale

Dimension	Values
Diversity of application	5 = very diverse, 1 = not very diverse
Efficiency	5 = very efficient, 1 = not very efficient
Importance of customer selection	5 = not very important, 1 = very important
Time	5 = very short duration, 1 = very long duration
Timing in NPD process	5 = correct stage, 1 = wrong stage
Usefulness	5 = very useful, 1 = not very useful
User-friendliness	5 = very user-friendly, 1 = not very user-friendly
Structuredness	5 = very structured, 1 = not very structured

6.2.2 Inter-rater reliability of the evaluation

To assess the reliability of the ratings, the interclass correlation coefficient (ICC) was calculated. Three types of ICC exist, depending on the selection of raters and whether the raters rate all or a part of the data (Shrout & Fleiss, 1979). In this study, ICC (2) was most appropriate because the same raters rated each case and raters were a random sample. ICC (2) is a 2-way random ANOVA design in which both cases and raters are separate effects. Two kind of reliabilities can be assessed, namely the reliability of a single rating or the reliability of a mean of several ratings. For this study, the latter was important because this measure tells how reliable the group of raters agree. If they agree, the mean of the five raters can be used. In addition, a decision should be made whether the consistency or the absolute agreement was assessed. Consistency considers the order of scores, and absolute agreement considers the order of scores and the relative values of the scores (Field, 2009). In this report, the ICC – absolute agreement was calculated because it should be checked whether the means represent the values of the single raters. The results of that calculation can be found in Table 6.3.

Dimensions which have values for ICC higher than 0,8 can be considered as reliable dimensions. As can be seen in the table, the dimensions ‘diversity of application’, ‘importance of customer selection’ and ‘structuredness’ have a ICC higher than 0,8. For those dimensions, it does not deliver problems when the mean of the raters is used.

The dimensions ‘efficiency’, ‘timing in NPD process’ and ‘user-friendliness’ have low values on the ICC. This means that the ratings for those dimensions were very diverse. Therefore, the mean is not a representative value and less importance is attached in further analysis to those dimensions.

Table 6.3. Values of the ICC absolute agreement for all dimensions

Dimension	ICC – absolute agreement
Diversity of application	0,855
Efficiency	0,385
Importance of customer selection	0,893
Time	0,622
Timing in NPD process	0,361
Usefulness	0,678
User-friendliness	0,438
Structuredness	0,893

Finally, the dimensions ‘time’ and ‘usefulness’ have values around the 0,6 and 0,7. The mean of those dimensions are, therefore, less reliable than the dimensions with values above 0,8. However, the mean of those dimensions can still be considered as reliable in the further analysis.

6.2.3 Results of evaluating the methods on dimensions

In Table 6.4 the evaluation of the customer involvement methods on the different dimensions is displayed. The values in this table are the mean of the five raters because the results of the inter-rater reliability check are good. For some dimensions, it is taken into account that the means were less reliable as explained in section 6.2.2.

Four methods were already evaluated in the previous paragraph as a similarity with the literature framework. This applies for the concept test, validation test, usability test and beta test. For those methods, the scores indicate aspects that can be improved for potential future applications. The validation, usability and beta test score relatively low on ‘diversity of application’. This can be clarified by the fact that those methods were applied to test certain aspects of the product. Therefore, less information was acquired about market and required applications. All four methods, score well on almost all dimensions. For the concept test, the customer selection was less important compared to other methods. However, the CEM should stay focused on selecting customers from the target market. Finally, the beta test should be applied more efficient and structured.

The remaining methods applied by the CEM are not part of the literature framework, namely orientation customer visit, application test, unstructured customer visit, event and structured customer visit. The method event scores low on the dimension ‘usefulness’ compared to the other methods. Therefore, events should not be considered as a customer involvement method but when the opportunity arises, it is a good way to receive much feedback in a short timeframe. However, it will not collect very detailed information about customer needs or required specifications.

For the other methods, Table 6.4 shows that they are appropriate for the CEM to apply. So, they can be applied in future projects. However, the table indicates for some methods some weaknesses that can be improved. It appears that customer selection is less important for the method orientation customer visits. This is caused by the early stage in which this method was applied. Orientation customer visits were used to explore the market and its customers which require a broader range of customers. In addition, this also clarifies the reason why orientation customer visits scored low on the dimension ‘structuredness’. The application test scores low on the dimension ‘diversity of application’. Likewise the methods validation, usability and beta test, the application test was intended to test one aspect of the product. Therefore, it collects less diverse information compared to other methods. The methods structured customer visit scores low on the dimension ‘time’. This can probably be explained by the time it took to arrange the customer visits and that a limited number of visits can be organized on the same day.

Table 6.4. Evaluation of the applied customer involvement methods on the dimensions

	Diversity of application	Efficiency	Importance of customer selection	Time	Timing in NPD process	Usefulness	User-friendliness	Structuredness
Before M1								
Orientation customer visit	4,4	3,2	3,6	4,2	4,8	3,8	4,4	1,0
Concept test	4,0	4,2	2,2	3,6	4,4	4,8	3,6	3,0
Between M1 and M2								
Application test	2,4	3,6	2,2	3,2	4,6	4,2	3,6	3,2
Event	3,6	3,4	4,6	3,8	4,8	2,8	4,4	2,0
Unstructured customer visit	3,6	3,6	1,8	3,4	4,8	3,8	3,8	2,4
Structured customer visit	4,8	3,0	1,8	1,4	4,4	4,6	3,0	4,0
Between M2 and M5								
Validation test	2,4	3,2	1,8	3,0	4,2	3,6	3,6	3,2
Usability test	2,8	4,0	1,8	3,0	3,8	4,2	3,2	3,2
Beta test	2,0	2,8	1,2	2,2	4,0	3,4	3,2	2,8

6.3 Matching the results

This section evaluates the available methods of the literature framework that the CEM does currently not apply to select customer involvement methods that provide opportunities for the CEM in future projects. This is achieved by comparing the information that methods are able to collect (Table 4.1) with the information that the CEM needs in every stage (appendix E and J). When similarities between those tables exist, the method was selected for the design.

Subsequently, the method was evaluated on some aspects, such as the newness to the CEM, the required experience, the diversity of information that can be collected, and the collected information in comparison with the time period. When all those aspects were positively judged, the method was evaluated as appropriate to use for the CEM. To give clear insights into the considerations which methods are (not) appropriate for the CEM, all available methods of the literature framework are shortly discussed per stage. The conclusions of the evaluation are presented in Table 6.5.

Table 6.5. Overview of the methods and their appropriateness in each stage of the CEM's NPD process

	Before M1	Between M1 and M2	Between M2 and M5
Methods not appropriate for the CEM	Crowdsourcing ZMET	Crowdsourcing	ZMET
Methods appropriate for the CEM but not really beneficial	Contextual inquiry Observation technique ODI	Contextual inquiry Observation technique ODI	Contextual inquiry Observation technique
Methods appropriate for the CEM	Lead user method Consumer idealized design IA	Lead user method Consumer idealized design IA	Prototype test Beta test Lead user method IA

6.3.1 Scoping stage – before M1

Methods not appropriate for the CEM

Crowdsourcing only delivers feedback on the product concept. In addition, this method can cause problems with confidentiality issues. The CEM wants to limit the information they announce to the market before the product launch. Therefore, this method is not really appropriate for the CEM to apply.

ZMET can only help the CEM to uncover customer's latent needs. Because other methods are available that also covers this information and collects other useful information, ZMET is not an efficient method to apply for the CEM.

Methods appropriate for the CEM but not really beneficial

Contextual inquiry and observation techniques are both methods that can deliver useful information to the CEM. However, those methods are very similar to the internally developed method DSI and the CEM will therefore benefit relatively little by applying those methods in their NPD process. However, both methods will be useful to apply as part of other methods, such as during customer visits and beta tests. The method ODI can deliver much information about the market. A big disadvantage of this method is that you need to be really experienced to collect the desired results. Mostly, external companies are hired to help a company with this method. Most employees of the CEM will not be able to conduct the interviews without extensive training.

Methods appropriate for the CEM

Lead user method is a useful method for the CEM which can help to collect diverse information. However, some problems can arise. A big problem is the discrepancy between the customer and the the CEM organization which causes that the CEM's employees cannot approach customers when they want as they are very dependent on the sales channels. However, the CEM has to deal with this problem in almost every kind of customer contact because this structure of customer contact is embedded in the organizational structure. Therefore, careful attention should be paid to the organization and the implementation of lead users.

Consumer idealized design can provide the CEM with some useful information about the value of the market and important product attributes. This method is also appropriate because it has not many similarities with the methods currently applied by the CEM. Therefore, this method can add a new dimension to customer involvement within the CEM. IA is a method which can provide the CEM with preliminary sales information. In addition, concepts can be evaluated with competitive products or alternative concepts. So, IA can be a useful method to apply for the CEM.

6.3.2 Build business case stage – between M1 and M2

For the build business case stage almost the same methods are available as in the first stage. The only difference is the method ZMET which is not available in the build business stage. Moreover, the information that is required to achieve the NPD goals are almost the same as in the first stage but the information should be more detailed than in the first stage. Likewise, the customer involvement methods that are appropriate according to literature are the same as in the scoping stage. Lead user method, consumer idealized design and IA can also contribute to define the product clearly by identifying product requirements or attributes.

6.3.3 Development and testing & validation stages – between M2 and M5

The methods prototype and beta test are already applied by the CEM in this stage of the NPD process. The execution of those methods can be improved by applying contextual inquiry and observation techniques during prototype and beta tests. Contextual inquiry and observation techniques will not contribute to the collection of information by using it as an isolated method but are helpful when customers use the developed product or prototype during a test.

IA can provide the CEM with information about sales forecast because customers compare the developed product with competitor's products. In addition, this can also deliver quantitative data to underpin the marketing story which is currently not available. Lead users can provide feedback on the product or prototype and detect any problems. The same lead users as in the early stages can be approached. ZMET can only improve the advertising research. This is something considered as not really important by the employees of the CEM. Therefore, ZMET is less appropriate to apply for the CEM.

6.4 Conclusion

In this chapter, customer involvement methods were identified that the CEM can continue using and new method that can be beneficial for the CEM to apply according to literature. Based on this information, a framework is constructed that presents which customer involvement methods the CEM can apply during the NPD process for radical products in the next chapter.

7 Design

In the previous chapter, methods that are appropriate for the CEM to use in the NPD process were identified. Based on that information, it is possible to construct the framework for the CEM which presents which customer involvements methods the CEM should apply in each stage of the NPD process and what kind of information they can collect with it. This is illustrated in paragraph 7.1. In this paragraph sub-question 10 is answered about what the CEM should change based on the similarities and differences identified in the previous chapter. Subsequently, a detailed plan for one of the studied projects is elaborated based on the design in section 7.2.

7.1 Design for the CEM

Based on the information in chapter 6, methods that are appropriate to apply by the CEM are detected. Those methods are either selected from the literature framework or CEM's framework. The design is presented in Figure 7.1 and further explained below. In Appendix K, this design can be compared to the original frameworks from the CEM and literature.

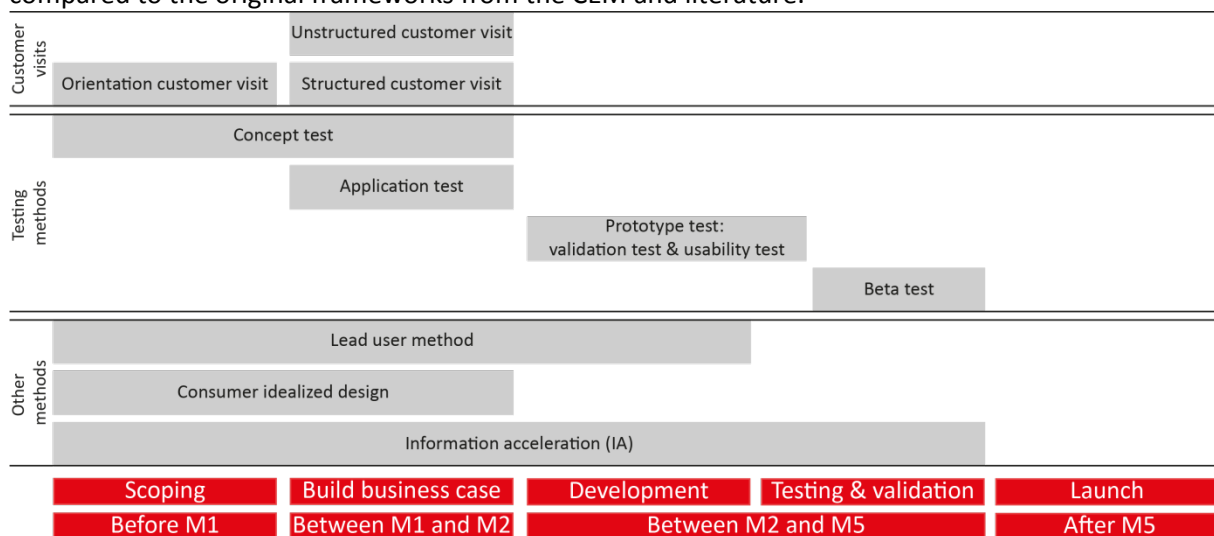


Figure 7.1. Design of appropriate customer involvement methods for the CEM

Three different kinds of customer visits can be applied. Customer visits are always a combination of observation techniques or contextual inquiry and interviewing. First, orientation customer visits can help to practice the approach of the structured customer visits. In addition, it can help to target the market and identify opportunities. However, it is recommended to switch quickly to the structured customer visits because these will collect more detailed and representative information. Unstructured customer visit are only useful when a concept can be presented to the customer such as is conducted in project Epsilon. Likewise, the customer's place is observed and the customer is asked questions to detect whether the concept is valuable for the customer. The structured customer visits can collect very different information. For this method, it is very important to document the structure and to follow this structure.

Subsequently, several methods to test the concept or product are part of the design. The application, prototype and beta test are already applied by the CEM. The concept test was only applied in one project but this is a good way to test early whether a market exists for the product and to receive feedback. The concept can be presented to customers by slides, sheets or a simple prototype. In addition, the output of the product can be tested to acquire feedback that is useful in formulating the product specifications by the application and validation tests. In later stages, the whole product can be tested on usability in a usability test. The final test is the beta test where a customer tried to use the products in his own environment for a certain period of time.

The other methods part of the design are lead user method, consumer idealized design and IA. Lead user method should be applied during all stages to build an integrative relationship with

customers such as suggested by Lagrosen (2005). Lead users can deliver all kinds of information to the CEM. Furthermore, the CEM will considerably benefit from involving the same customers because the customers will learn what kind of information the CEM needs. Consumer idealized design can be part of customer visits by asking questions to their ideal product during the interview. However, it can also be applied as a separate method by inviting customers who will develop an ideal product in a session. Finally, IA can be used in all stages. It can be used to test a concept or evaluate several concepts. In later stages, IA can be applied to forecast sales and to receive feedback on the product. All the kind of information that can be gathered by the methods of the design is summarized per stage in appendix L.

7.2 Detailed plan for project Epsilon

Based on the design described in paragraph 7.1, a detailed plan for project Epsilon is established. This project is selected because it was in the first stages of the NPD process. In addition, a plan for how to involve customers for this project was not yet developed. For project Epsilon, it is very important to collect information from customers because no comparable products exist in the market. Therefore, it is very important to identify the customer needs to develop a product that meets the market demand.

Project Epsilon is approaching M2; the plan clarifies how customers should be involved in the stages after the M2 milestone. In this plan, a constraint was taken into account, namely that the product launch is estimated at April 2015.

The plan is established by joining the information that the team would like to collect and the framework presented in Figure 7.1. Because the development of the product is almost finished, the emphasis is on validating the concept and testing the product. Therefore, the design consists of a usability test and a beta test. A detailed roadmap can be found in appendix M.

Parallel to the development of this detailed plan, another plan was constructed by the current project team of Epsilon. The CEM planned to perform a beta test. The details of this beta test are summarized in appendix N.

The two different designs (detailed plan of this thesis and the CEM's plan) are compared to provide possible improvements to the CEM's plan. First, it is recommended to extend the testing with a usability test prior to the beta test. The usability test gives the opportunity to test the product with target customers who do not have the intended product but products for which Epsilon will be available in future. In this way, more feedback can be gathered on Epsilon while the customers still represents the target market.

Second, both plans for the beta test are in general the same. However, some small differences can be recognized which can be considered as attention points. For instance, the log book must force the customer to take detailed notes about all the completed and uncompleted jobs while using Epsilon. This guarantees that more feedback will be gathered than when customers are only asked to take notes. In the proposed design, an interim interview and end interview are scheduled, whereas in the CEM's own plan the end interview is only proposed. The interim interview creates the opportunity to early detect problems which can be adapted with some additional explanation. Finally, it is really important that the customer in the beta test fits the defined requirements. In other words, the customer must really do the work that Epsilon is built for. The beta test will be more successful if better customers are involved instead of more customers. The CEM can learn more from some customers who belong really to the target customers instead of many customers that are outside the target market of Epsilon.

7.3 Conclusion

This chapter constructed a framework that can guide the CEM's employees to select the most appropriate customer involvement method in each stage of the NPD process. When employees have determined which information they would like to collect, they can select a customer involvement method based on the tables of Appendix L. For one of the studied projects, a detailed plan is constructed that presents the usage of the framework.

8 Discussion and conclusion

This chapter presents the conclusion of this research. First, the main findings of this research are given to answer the research question. The research question is answered based on the information obtained for the sub-questions. Second, the implications for managers and recommendations for the CEM are discussed. Subsequently, the contributions to literature are explained. Finally, this chapter presents the limitations of this research and suggestions for future research.

8.1 Main findings

Customer involvement is defined as any interaction between customers and the design process (Kaulio, 1998). Customer involvement methods are the tools to identify customers' wants and needs. Many firms face problems in structuring the involvement of customers (Karkkainen & Elfvengren, 2002). In addition, firms have the inclination to use methods in other stages than they were intended to (Nijssen & Lieshout, 1995). As the CEM also experiences customer involvement as unstructured, the aim is to answer the following research question: *Which method of customer involvement should the CEM apply in each stage of the NPD process for radical products to acquire information about customers, market and business?*

To enable answering this question, the research is divided into a literature study and a case study. This literature study indicated that current literature has paid attention to customer involvement methods. However, the focus is mainly on the isolated methods and the influence of customer involvement in general on NPD performance. In addition, the existing frameworks to select available customer involvement methods for radical products focus on B2C companies. Based on a review of the customer involvement methods described in literature, a framework is developed that presents the available customer involvement methods in each stage of the NPD process for radical products in a B2B market.

In the case study, a tailored framework for the CEM is developed that guides employees to select appropriate customer involvement methods in the NPD process of radical products. This framework is developed by interviewing employees involved in radical projects to identify customer involvement methods applied within the CEM. In addition, the required information in each stage of the NPD process is compared to the literature framework to identify methods that can be valuable for the CEM. Based on the evaluation of the customer involvement methods applied by the CEM and mentioned in literature, it is confirmed that the CEM should continue using concept test in the scoping and build business stages, and validation test, usability test and beta test in the development and testing and validation stages. Furthermore, orientation customer visit, application test, unstructured and structured customer visits can be applied in future projects. For all those methods, points of improvement are identified that ensure better results will be acquired in future executions (see section 6.3. and appendix I). Finally, some methods of the literature framework are also useful for the CEM, namely IA, lead user method and consumer idealized design can be applied in the scoping and build business stages. In the development and testing and validation stages, contextual inquiry and observation techniques are good methods to support the information collection during prototype and beta tests. Based on those methods, the framework that structures the customer involvement in projects within the CEM is designed which is illustrated in Figure 7.1. This framework answers the research question of this report.

During the analysis of the case study results, it appears that the CEM is really concerned about the importance of developing a product that fits the customers' needs and wants. In the analysed projects, it is striking that almost no similar methods were applied. This especially applies to the first stages of the NPD process. Presumably, the projects that are currently approaching M2 will include usability and beta testing such as in project Gamma.

Some problems existed in all projects. For instance, the selection of customers is a problem faced in almost all the projects. Even when a structured method was developed beforehand, unrepresentative customers did not deliver the desired results or information. Therefore, it is very

important to select the right customers and to define requirements for the target customers when customers are involved.

Another problem regularly mentioned are the difficulties caused by the organizational structure. The CEM's employees are not allowed to contact customers by themselves but the sales organization has the lead in approaching customers to participate in visits or tests. It is very important for the CEM to clarify the requirements for customers to the sales organization to ensure representative customers are involved. As the CEM has little influence on the customer selection, communicating clear requirements to the sales organization is very important.

Currently, customer involvement is organized in the projects. When information is needed in a project, employees arrange customer visits to hold interviews, or to ask feedback on deliverables of the prototype. This caused that in every project, a new approach of involving customers is developed. This is the reason why almost all detected customer involvement methods are only applied once. Another consequence of organizing customer involvement in projects is that it is unclear who is responsible for customer involvement. As currently nobody is explicitly responsible for customer involvement, the lead is only taken by employees when the available information is lacking which results in a longer development process.

8.2 Managerial implications

This research established a framework that guides companies in selecting customer involvement methods in each stage of the NPD process. Applying methods according to the framework will not automatically lead to successful results. This research also gives insights into conditions important when customers are involved. Those insights can be useful for managers when they consider approaching customers.

First, it is important to select the right customers that represent the market for which the product is intended. A suitable method can lead to suboptimal results when customers are not representative. Second, it is important to follow structured methods and to document the method's structure. Documentation of the exact procedure prevents employees to fall in potential pitfalls. Third, customer involvement is often initiated by project members. Companies should determine which department is the process owner of customer involvement. Especially companies with a matrix organisation should embed customer involvement in the functional organization instead of within projects. This ensures that knowledge is available, accurate and accessible. Fourth, it is important to limit the number of people that conduct the methods. As appeared in the case study, involving a huge number of employees causes that everybody gathers the same general information but details are not collected. Involving a limited number of employees in the process of customer involvement will increase the results of the contacts. Final, companies should maintain close relationships with their customers. Those kinds of relationships are important to ensure customers are willing to participate in future projects and that they feel their input is appreciated.

8.3 Recommendations for the CEM

This research was conducted within the CEM which enables it to give specific recommendations to the CEM. These recommendations are listed below:

- It is important to appoint a process owner of customer involvement who is in the lead of involving customers. The process owner should be aware of all the available customer involvement methods and the collected information with methods. The CEM has a matrix organization with functional departments and projects. Customer involvement should be embedded in a functional department to ensure all projects have access to this knowledge. Within the CEM this should be embedded in the departments strategic planning and marketing; strategic planning in the stages before the M2 milestone and marketing in the stages after the M2 milestone. The responsible person for customer involvement should be concerned with all the information about customers and the methods to collect this information. In addition, the process owners must have a proactive position for the involvement of customers in the projects.

This ensures that projects are proactive in involving customers instead of involving customers when the information is lacking.

- Applied methods to involve customers should be described and documented in reports. Those reports should be saved in a knowledge base. Currently, every time customers are involved a new structure is designed while sometimes prior applied methods are suitable. Therefore, applied methods should be documented and consulted when employees are considering to involve customers. This also ensures that the applied methods are optimized and employees become experienced in applying methods. When a process owner of customer involvement is appointed, this knowledge sharing can be one of his responsibilities.
- Customer selection is very important to ensure the acquired results are representative for the target market. Selecting customers outside the target market means results are diverse and not consisted.
- In projects, a limited number of employees should be in charge of customer involvement. As explained in paragraph 8.2, it is beneficial that a small group of employees conduct the methods to increase the diversity of the collected information.
- Customer reports should be documented in databases accessible to all departments. Currently, the information exchange is shared via e-mail between different departments. R&D has a database to share customer reports which is not accessible for other departments.
- When the results of collected customer information are analysed, the CEM should take into account from what kind of customers those results were obtained. This is also related to the fact that sometimes customers are involved that do not represent the intended target market. Furthermore, employees should be aware that the possibility exists that feedback given by one customer can be more important to adjust the product than a small issue observed by many customers.
- The framework of Lagrosen (2005) indicated three relational levels of customer involvement. The CEM applies methods that fit the first two levels of relationships (transactional and facilitative), such as observations, testing and customer visits. In contrast, the third level, integrative relationship, is not represented in the CEM's NPD process. This relationship contains an integrated product development team including representative customers. By involving lead users in different stages of the NPD process, the CEM will also benefit of this integrative relationship.

8.4 Theoretical implications

One of the most surprising findings of this research is the fact that interviews and customer visits can be successfully applied in the NPD process of radical products. Ulwick (2002) stated that asking customers what they want is useless because they do not know what they want. As Veryzer (1998b) further explained, customers cannot compare radical products to existing ones which makes it hard to image how new products should be used. However, interviews and customer visits can be used to understand how customers perceive products and competitor products, how needs and preferences are influenced and how their buying behaviour is influenced. All those things are important to consider in the NPD process (van Kleef et al., 2005). This research showed that interviews combined with observing the customers in their own environment can collect different kinds of information that are required in the NPD process of radical products.

Additionally, this research identifies that companies are unfamiliar with formal customer involvement methods. Most methods applied within a company are practices developed in-house. This is in agreement with the findings of Nijssen and Lieshout (1995) that companies are unaware of the naming and content of formal customer involvement methods. In addition, Lagrosen (2005) mentioned that the use of formal customer involvement methods is infrequent by industrial firms.

Furthermore, this research confirms that different stages of the NPD process require different customer involvement methods. This was also noticed in research of Nijssen and Lieshout (1995) and Lagrosen (2005). In contrast to the research of Nijssen and Lieshout (1995), this research indicates that companies apply the methods in the intended stages.

This research proves that it is unclear who is responsible for customer involvement in a matrix organization. According to Majava, Nuotilla, Haapasalo, and Law (2014), product management is responsible for the collection of the customer needs. However, R&D should also understand those needs to ensure the right product features are developed (Majava et al., 2014). As Ottum and Moore (1997) explored, the marketing should organize the information gathering from customers, but the whole NPD team should interpret the results. Literature has paid less attention to who is responsible for customer involvement within companies but has focused on collaboration between marketing and R&D departments. Research into the collaboration of marketing and R&D departments in the NPD process has mainly focused on the effect of this collaboration on new product performance (Leenders & Wieranga, 2008). However, little research has investigated the effect of collaboration between marketing and R&D on NPD performance when customers are involved in the NPD process.

This research also indicates the importance of selecting the right customer to ensure the desired results are collected. Lettl (2007) highlighted the importance of involving the right customers at the right time. In his research, it is also stated that companies that have a radical NPD process should involve inventive users instead of ordinary users. While this was not confirmed in the present research, it did prove that it is very important to select customers that represent the intended target market.

Several studies have stated that each stage of the NPD process requires different customer involvement methods (Veryzer, 1998b; O'Connor, 1998). This is also demonstrated in this research. The extensive literature review proved that most customer involvement methods can be applied in several stages of the NPD process, however their contribution to the NPD goals differs depending on the specific stage in which they are applied.

8.5 Limitations and future research

This research has some limitations which should be taken in mind. First, the framework established in this research is not tested in the field. Testing the framework means that the method should be applied during the NPD process of projects. Since a usual NPD project takes more than a year, it was not possible to test the collected information from the customer involvement methods. Therefore, it is not validated that the methods collect the intended information. Second, the case study approach has some limitations. In this research, four cases (projects) were analysed. Only one of the projects was approaching the M5 milestone, the other three projects were reaching the M2 milestone. This caused that information about the stages development and testing and validation was only based on one project. In addition, the findings were collected within one firm which makes it hard to generalize the results to other companies. However, as this research had a focus on B2B companies, the recommended involvement methods will be likely applicable to them. Future research should focus on multiple companies in several industries to test whether the developed framework will be applicable in all settings. Third, a limitation can be found in the process of collecting and coding the information. All the information was collected and coded by one researcher. When multiple researchers were involved in this process, the reliability of this research would increase. Future research can take this limitation into account by conducting the coding process by more than one researcher. Fourth, in this research the focus of customer involvement was on real customers, information from market agencies or sales people was not taken into account. The involvement of those actors can also realize valuable information. How those inputs can contribute to NPD outcomes should be investigated in future research.

While discussing the limitations of this research, some suggestions for future research are already offered. Future research on this topic should be conducted on more cases within multiple companies in different industries. This research made a first contribution in linking customer involvement methods to NPD outcomes. Furthermore, it would be interesting to extend the definition of customer involvement by including information from sales people and market agencies. During the interviews, many employees emphasized that those inputs can deliver additional valuable information for the NPD process. Additional research could investigate how those inputs contribute to reaching the NPD goals.

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Appendices

A. Consulted company documents

Document	Which chapter/section
Project milestones	Introduction
Presentation customer contact	Introduction
Milestone checklist	Results – sub-question 6
Invitation workshop Epsilon	Results – project Epsilon
Notes of the workshop Epsilon	Results – project Epsilon
Sales presentation for workshop Epsilon	Results – project Epsilon
Brochure Epsilon	Results – project Epsilon
External contact reports Gamma	Results – project Gamma
Customer visit reports Alpha	Results – project Alpha
Alpha questionnaire June 2014	Results – project Alpha
Customer visits Alpha high level description	Results – project Alpha

B. Interview guide

Introduction

I am master student at the University of Technology in Eindhoven. For my graduation project I investigate how the CEM can involve customers in their new product development process. To structure my research, I selected four projects including project [name]. For these projects, I will investigate which methods they applied to collect information about market and customers. And then I compare this with findings of the literature study. Based on this comparison, I will create a framework which customer involvement methods the CEM can apply in each stage of the new product development process and what kind of information they can collect with it.

So, the goal of this interview is to collect information about project [name], information that is required for the continuation of the project and of course about customer involvement.

Interview procedure:

The interview is confidential and you will stay anonymous in the report. Is it fine for you if the interview is recorded and transcribed for data analysis?
Recordings will be deleted when the research project is finished.

General questions

What is your function within the CEM?
What is/was your function in project [name]?
What is/was your responsibility within project [name]?

New product development process

Was project [name] structured as Stage-Gate or V-Gate?
In which stage is project [name] at this moment?
Are you involved within project [name] from the start of the project?
What were the main goal(s) of each phase in the NPD process and which questions should be answered at each milestone or gate?

Customer involvement methods

Did you involve customers in the NPD process of project [name]? If yes:
In which stages of the NPD process were customers involved?

For each stage in which customer involvement was applied:

Were any systemic methods used? If yes: which ones? If no: can you describe the practices which were used?
For which goals or which questions that should be answered did you involve customers?
What kind of information did you gather with the customer involvement?
To what extent were all the questions for the milestone answered? Were formal customer involvement methods or informal practices applied?
What was the reason to apply this specific method/practice?
What were the positive aspects of the applied method?
Were there any negative aspects?
If you had the same question/problem again, would you apply the same method? If no, would you apply another method or no customer involvement?
Would another method be more useful?

For each stage no customer involvement was applied:

Had it been useful to gather customer feedback or information in this stage?

Do you think the involvement of customers led to other results?

Which stages of the NPD process have the potential to increase the level of customer involvement?
What is your own experience with customer involvement within the CEM?

These were the questions that I prepared for you. Do you want to add something about customer involvement or your experience with customer involvement?

Closing

Thank you for your contribution and time. Would you like to receive my final report?

I will send you a summary with the statements/quotes that I probably use in my analysis. You are free to give feedback to this summary. The findings will remain anonymous.

C. Details of the interview participants

Project	Department	Function	Date of interview	Duration interview
General	R&D	Business Analyst	30 September	28 minutes
	R&D	Usability designer*	13 October	60 minutes
Alpha	Marketing	International product manager	22 October	35 minutes
	Strategic Planning	Portfolio director	6 October	41 minutes
Gamma	Marketing	Product line manager	30 September	16 minutes
	Marketing	Product manager	14 November	29 minutes
	R&D	Product architect	14 October	27 minutes
	R&D	Project leader	18 September	40 minutes
	R&D	Quality leader	3 October	22 minutes
	R&D	Quality leader	15 October	27 minutes
	R&D	Usability designer	6 October	50 minutes
Delta	R&D	Product architect	7 October	54 minutes
	Strategic Planning	Portfolio director	7 October	55 minutes
Epsilon	Marketing	International product manager	30 September	54 minutes
	Marketing	Product manager	9 October	25 minutes
	R&D	Project leader	1 October	16 minutes
	Strategic Planning	Portfolio director	16 October	38 minutes

* Low involvement in projects Gamma and Delta.

D. Coding frame

Template approach	
<p>Customer involvement methods</p> <ul style="list-style-type: none"> Advisory group Back to the future Beta test Concept test Customer visits – unstructured customer visit Events Lead customer Orientation interview – orientation customer visit Structured interview – structured customer visit Usability test Validation test – quality test <p>Stages of the NPD process</p> <ul style="list-style-type: none"> Before M1 Between M1 and M2 Between M2 and M5 	<p>Dimensions</p> <ul style="list-style-type: none"> Diversity of application Effectiveness Efficiency Flexibility Importance of customer selection Time Timing in NPD process User-friendliness Usefulness <p>Others</p> <ul style="list-style-type: none"> Challenges Realized changes

E. Comparison of important goals per NPD stage

Table E.1. Summary of important goals per stage of the NPD process based on literature study

Stage	Goals
Scoping	<p>Assess financial and competitive situation (preliminary).</p> <p>Assess market value of the product (preliminary).</p> <p>Assess technical and product performance objectives (preliminary).</p> <p>Determine product's core requirements.</p> <p>Identify key risks and challenges.</p> <p>Specify required resources.</p> <p>Test product concept.</p>
Build business case	<p>Assess financial and competitive situation.</p> <p>Assess market value of the product.</p> <p>Assess technical and product performance objectives.</p> <p>Build a business case with product definition, project justification and detailed project plan.</p> <p>Define the product clearly.</p> <p>Verify the product's attractiveness.</p>
Development	<p>Develop prototype or final product design.</p> <p>Ensure product meet customer requirements.</p> <p>Complete marketing plan.</p>
Testing and validation	<p>Finalize financial analysis.</p> <p>Test marketing plan.</p> <p>Test the product, production and marketing with customers.</p>
Market launch	<p>Execute market launch plan and operation plan.</p> <p>Measure, control and adjust the marketing plan.</p>

Table E.2. Summary of important goals per stage in the NPD process of the CEM

Stage	Goals
Before M1	<p>Define a project plan.</p> <p>Estimate target dates for M2 and M5 milestones.</p> <p>Preliminary information about product, market and customer requirements.</p>
Between M1 and M2	<p>Assess risks for the subsequent stages.</p> <p>Assess the expected costs, amount of sales and expected revenues.</p> <p>Define the competition.</p> <p>Define the product, product features and functionalities.</p> <p>Define the target market.</p> <p>Write underpinned plan for the subsequent stages.</p>
Between M2 and M5	<p>Conduct beta test.</p> <p>Finish hardware.</p> <p>Formulate launch strategy.</p> <p>Run validation path.</p> <p>Start industrialization.</p>
After M5	<p>Worldwide availability of the product.</p>

F. Underpinning selection of customer involvement methods – literature study

3.5.3. Methods with conflicting results in prior investigations

Category appraisal and conjoint analysis

About the appropriateness of category appraisal and conjoint analysis as a customer involvement method for radical products, the studies of Janssen and Dankbaar (2008) and van Kleef et al. (2005) are contradictory. Janssen and Dankbaar stated that the methods can be applied in the development of technologically really new products. In contrast, van Kleef and colleagues assessed that those methods are more useful for incremental products.

Furthermore, both methods do not meet all the requirements set in section 3.4.1. In category appraisal, customers evaluate a set of competing products in which product concepts can be included. They rank or rate the product on sensory, preference or perceptual attributes (Janssen & Dankbaar, 2008). Then, statistical analysis is applied to display the competitive structure of the product category on a map. The final map shows the customers' perceptions on product attributes, relationships between product attributes and the intensity of competition between the products (van Kleef et al., 2005). In conjoint analysis, customers also evaluate products on several product attributes. This evaluation identifies important product attributes (Green, Krieger, & Wind, 2001)

These short descriptions already indicated that both methods do not meet the requirements of collecting customer and market information. Category appraisal and conjoint analysis are methods to translate customer data into customer preferences. Therefore, both methods are not further investigated as customer involvement methods.

3.5.4. Preliminary investigation of the remaining methods

Consumer idealized design

Consumer idealized design allows customers to design their ideal product without concerning the product's feasibility (Ciccantelli & Magidson, 1993). This method has received little attention in literature but can be an interesting method to apply during the NPD process. In addition, all the requirements are met. Therefore, this method will be included in the further analysis in section 3.5.

Innovation templates

Little is written about the method innovation templates. Goldenberg, Horowitz, Levav, and Mazursky (2003) described innovation templates as a technique for 'listening to the voice of your product' instead of 'listening to the voice of your customer'. With the aid of five templates, developers can systematically change an existing product into a new product (Goldenberg et al., 2003). A template is a means to transform existing solutions into a new solution (Hauser, Tellis, & Griffin, 2006).

Originally, this method is designed to help developers generating new product ideas. However, Janssen and Dankbaar (2008) changed the method to another approach. Customers are provided with components and attributes of the product and are asked to make a new concept. The five templates can be used to systematically change the product. The original application of innovation templates by Goldenberg and colleagues was developed to help development teams to generate ideas, and not as a means to involve customers in the NPD process. In addition, empirical evidence that innovation templates can be applied as a customer involvement method does not exist. Therefore, there is decided to exclude innovation templates in further analysis.

Lateral thinking

Lateral thinking is a method in which participants learn to look at things in different ways (Janssen, 2011). The participants need a training to develop the skills required for lateral thinking sessions. Little is written about lateral thinking in a NPD context. In addition, empirical research results are not present. Janssen (2011) explained that lateral thinking sessions can deliver new ideas in an explorative way. So, it does not deliver specific answers for the NPD process. In conclusion, lateral

thinking does not meet all requirements. Consequently, lateral thinking is excluded in further analysis.

Probe and learning

The method probe and learning is a kind of trial-and-error method to improve prototypes till a good product concept is achieved (Lynn, Morone, & Paulson, 1996). The trial-and-error description implies that probe and learning is not a real structured method to collect customer and market information but a methodology to structure the whole NPD process. Therefore, it does not meet the requirements of section 3.4.1. Consequently, probe and learning is not included in further analysis.

Toolkit for innovation

In toolkit for innovation, the consumers receive a toolbox with components which help the consumers to develop the product with all the functionalities they want or need (von Hippel & Katz, 2002). In a B2B setting, the customers can develop a custom product which would be an incentive for the customer to invest effort in the toolkit (Jeppesen, 2005). In the original definition of von Hippel (2001) toolkits for innovation is a technique that allows users to design a novel product by trial-and-error and delivers immediate feedback on the potential product ideas. Toolkits for innovation were applied in various fields such as computer ships, food and fashion (Franke & Piller, 2004). However, successful applications in high-tech or industrial fields have not been proved. In addition, it seems very hard to make it applicable for an industrial B2B company. Therefore, it is not included in the further analysis.

Visioning

Visioning is a method to formulate or focus on a strategy for uncertain projects (O'Connor & Veryzer, 2001). It does not uncover customer needs but links known information to technologies. Therefore, the method does not meet the requirement of collecting customer information and is not included in further analysis.

G. Project descriptions

Project Alpha

At the moment, the project is between the M1 and M2 milestones. The product is targeted to a new market in which some competitors are present. However, the product is differentiating positioned in terms of estimated price and application quality in comparison with the competition. The product will be closely related to the product developed in project Delta but will address another market. During the whole process, the team involved customers.

Project Gamma

The product developed in this project will be a successor product for two prior products. Originally, the product was targeted for a new market in which the CEM has currently not any products. Over the course of the project, the project was redefined and other target markets were selected. Currently, the product is positioned for three different markets; the CEM has not experience in all those markets. This project is totally managed as a milestone project and is now between the milestones M4 and M5. This project is more progressed than the other three.

Project Delta

In this project, a product is developed for a market in which the CEM does not have a product yet. It is an existing market in which competitors are already active. The goal is not to replicate the competitor's product but to develop a product that meets the customer needs which are not fulfilled by the competitor's existing products. The project is currently between the M1 and M2 milestones.

Project Epsilon

This project is a special project because it is meant to develop software instead of hardware. The project is approaching the M2 milestone. When the M2 milestone is approved, there will soon follow a customer confrontation because the technology is further developed than usually after the M2 milestone.

H. Description applied methods by the CEM

Project Alpha – structured customer visits – customer’s place

- Structured interview with the owner of the company.
 - o Questions are asked about:
 - Business, applications, trends.
 - Current equipment (competitor’s product).
 - Any future investment plans.
 - Technology preferences.
 - Ideal product.
 - Other product related aspects.
 - Workflow/usability.
 - Price.
- Tour through the shop.
 - o Look at their business, equipment, how they operate, and their workflow.
- Interview with the operator with the same questions as the interview with the owner.

Project Gamma – structured customer visits – customer’s place

- Ask the customer several questions in agreement with the booklet.
 - o When an interesting aspect is appointed, ask more in-depth questions to gain a deep understanding.
- Ask the customer to complete spider graphs.
 - o Spider graphs about different topics were presented in which the customer assesses the importance of quality, robustness, etc. on a scale from 1 to 10 for application X.
- Tour through the company.
 - o Observe the customer’s equipment, workflow, and other aspects.
 - o Pictures and movies are taken to facilitate the knowledge transfer between project members.

Project Gamma – validation test: quality – customer’s place

- Customers are asked to send files to the CEM.
- These files are applied on the new product (prototype) and predecessor product.
- Customer applies the same file on his own product.
- Questions are asked about:
 - o What do you think about it?
 - o Is this an improvement?
 - o What is better?
 - o Is this acceptable?

Project Gamma – usability test – in-house

- Invite a couple of customers that represent the target customers.
- Set up a room like a room with the developed product, the predecessor product and a computer.
- A script is written to guide the customer through the test.
 - o Start asking the customer to conduct simple actions.
 - Simultaneously, questions are asked about the customer’s daily activities.
 - o Make the actions more and more specific.
 - o When a customer does not achieve to complete an action, questions are asked like ‘What did you try so far? Did you try this and this?’ to stimulate the customer to think aloud.
 - o The customer could say everything he wants; positive and negative comments.

Project Delta – orientation customer visits – customer’s place

- Employees introduced themselves.
- Start conversation with shop manager or operator.
 - o Prepare some aspects that you would like to know.
 - o Try to steer the conversation towards these aspects.
- Tour through the company to get additional information.

Project Delta – structured customer visits – customer’s place

- Ask the customer what are the most important aspects for him considering a new product -> key buying criteria.
- Ask the customer ‘How important are all these aspects?’
 - o Rating from 1 (not important at all) till 5 (extremely important).
 - o Asking why, why, why...?
- Customer has a known reference product.
- Ask the customer ‘How satisfied are you with what your product now delivers?’
 - o Talk about the same aspects (key buying criteria).
 - o Rating from 1 (not important at all) till 5 (extremely important).
 - o Asking why, why, why...?
- Explain the concept and show product outcomes to the customer.
- Ask the customer ‘How satisfied would you be on the same aspects?’
 - o Rating from 1 (not important at all) till 5 (extremely important).
 - o Asking why, why, why...?
- Comparison between reference product and concept product.
 - o Ask to explain the difference in ratings.

Project Delta – application tests – customer’s place

- One of the customers of the orientation interviews is selected.
- Applications are defined.
- Customer sends files to the CEM.
- The customer applies the files on their own product.
- The CEM applies the same files on the prototype.
- Customer edits the product outcome with different applications and does this with the own product outcome and the CEM’s product outcome.
- Customer is asked to give feedback on both applications about several aspects.

Project Epsilon – concept test – in-house

- Invite a couple of customers to the site.
 - o The customers sign a non-disclosure agreement (NDA).
 - o All the customers are in the same room in the same time.
- All the attendees introduce themselves.
- Present slide presentation about the concept as it is a real product.
- Give a short demonstration on how the product would look like.
 - o Customers can comment and make suggestions during the demonstration.
- Hold a workshop in which the concepts are discussed and discussion between the customers is stimulated.
 - o Some topics to discuss are prepared.

Project Epsilon – unstructured customer visits – customer’s place

- Tour through the customer’s side.
 - o To see the equipment and workflow they currently got.
 - o To have a nice idea how the indented product can be useful for them before the presentation started.

- Give a presentation to the customer about the software as it is real.
 - o With the aid of conceptual slides, PowerPoint slides
- Discuss with the customer whether the concept fits in their work.

I. Cross-case analysis

Table I.1. Orientation customer visits in projects Alpha and Delta

Orientation customer visits		Before M1
Projects	Alpha	Delta
Elements	Unstructured conversations with customers within the bounds they want to talk about.	Employees introduced themselves. Unstructured conversation with shop manager or operator while having some elements in mind. Tour through shop.
Goals and collected information	Early validation. Identifying key buying criteria. Required applications. Understand the business. Understanding competitor's products the customer's experiences. Understanding market dynamics.	How can future interviews work? How useful is it to show things.
Goals achieved	Yes. Direction is set and target market is narrowed.	Yes. Defined approach for structured customer visits.
Contribution to NPD goals	Assess market value of the product. Assess financial and competitive situation. Assess technical and product performance objectives. Determine product's core requirements.	-
Realized changes	None	Defined the approach of the structured customer visits.
Timing in NPD process	Good	Okay.
Duration	Short – multiple sessions	Short – 2 sessions
Required experience of employees	Low. Just go and talk with customers.	Low or none.
Fixed structure	None, just talking within the boundaries of subjects. Not a fixed structure or structured questionnaire.	None.
Challenges	-	-

Table 1.2. Concept test in project Epsilon

Concept test		Before M1
Project	Epsilon	
Elements	Sales pitch about concept. Demonstration. Workshop with discussions.	
Goals and collected information	Desired functionalities. Early validation. Identify target customers. Price indication. Required applications. Suggestions for other uses. Test concept. Value of applications and product specifications.	
Goals achieved	Yes, absolutely.	
Contribution to NPD goals	Assess financial and competitive situation. Assess market value of the product. Assess technical and performance objectives. Define product clearly. Determine product's core requirements. Test product concept.	
Realized changes	Ideas for new applications. More structured concept on how Epsilon should function and look. The development team produced a kind of working model.	
Timing in NPD process	Ok.	
Duration	Short – 1 day	
Required experience of employees	Medium	
Fixed structure	Medium. Topics were prepared that they would like to discuss.	
Challenges	Hard to receive feedback when customers are not able to see the product. Attention paid to the setting of the workshop to ensure customers felt comfortable and truly express their opinion.	

Table I.3. Application test in project Delta

Application test		Between M1 and M2
Project	Delta	
Elements	Product outcome of prototype product. Customer finished those product outcomes. Feedback is asked.	
Goals and collected information	Benchmarking: Where are we? Information about workflow and work structure. Test applications.	
Goals achieved	Yes.	
Contribution to NPD goals	Assess technical and product performance objectives. Define product clearly Verify the product's attractiveness.	
Realized changes	No	
Timing in NPD process	Okay.	
Duration	Short – sessions	
Required experience of employees	Low	
Fixed structure	Medium	
Challenges	Customer selection	

Table I.4. Unstructured customer visits in project Epsilon

Unstructured customer visits		Between M1 and M2
Project	Epsilon	
Elements	Tour through shop. Sales presentation about the intended product. Discussion with customers (no structured approach)	
Goals and collected information	Understand the business. Validate concept. Validate product. Verify the product's attractiveness.	
Goals achieved	Yes	
Contribution to NPD goals	Assess market value Assess technical and product performance objectives.	
Realized changes	-	
Timing in NPD process	Okay.	
Duration	Medium – multiple sessions	
Required experience of employees	Low but requires good preparation.	
Fixed structure	None or low.	
Challenges	Good preparation is required; otherwise only general positive feedback is collected.	

Table 1.5. Events in project Epsilon

Event	Between M1 and M2
Project	Epsilon
Elements	Short demonstration. Discussion with customers.
Goals and collected information	Benchmarking: Where are we? Understand customers' problems. Validate concept. Verify the product's attractiveness.
Goals achieved	Yes.
Contribution to NPD goals	Assess market value of the product. Ensure product meet customer requirements. Verify the product's attractiveness.
Realized changes	-
Timing in NPD process	Okay.
Duration	Short – 1 day - Lot of customers in a relative short time frame.
Required experience of employees	Low
Fixed structure	Low
Challenges	Hard to estimate if customers are really going to buy it.

Table 1.6. Structured customer visits in project Alpha, Gamma and Delta

Structured customer visits			Between M1 and M2
Projects	Alpha	Gamma	Delta
Elements	Structured interview. Observation.	Structured interview. Complete spider graphs. Observation.	Structured interview. Comparison of product outcomes. Tour through shop.
Goals and collected information	Identify strengths and limitations of competitor's products Receive feedback. Understand the business. Understand customer's unmet needs. Value of applications and specifications.	Acquire market and customer knowledge. Information about workflow and work structure. Required applications and product specifications. Information about competition and market trends.	Benchmarking: Where are we? Identify risks. Identify showstoppers and block issues. Validate product.
Goals achieved	Yes	Not completely; the desired story about 'what are we going to do' was not finished.	Yes.
Contribution to NPD goals	Assess financial and competitive situation. Assess market value of the product. Assess technical and product performance objectives. Define the product clearly. Ensure product meets customer requirements – concept stage Verify the product's attractiveness.	Assess market value of the product. Assess technical and product performance objectives. Define product clearly. Determine product's core requirements. Ensure product meets customer requirements – concept stage	Assess financial and competitive situation. Assess technical and product performance objectives. Define the product clearly. Identify key risks and challenges. Verify the product's attractiveness.
Realized changes	Roadmap changed by changing some high level requirements. Prioritization of functionalities changed. Some specifications excluded and included.	Product Specification Document (PSD) written, clientas ¹ are defined.	-
Timing in NPD process	Good	Good	Bad; earlier was preferred.

¹ Clientas are derived from personas and are descriptions of a group of customers who have similarities on some aspects. Because the CEM operates in a B2B market, the concept clientas refers to the shops as customers instead of users.

Duration	Medium – 25 visits	Long – 40 visits	Very long. Arranging of some visits was very time consuming. – 20 visits
Required experience of employees	Low but the involved employees were very experienced which resulted in less preparation of a structure.	Medium. Employees participated in a training to learn what kind of questions they should ask.	High. Practicing the structure was required.
Fixed structure	Medium. A questionnaire exists.	Medium. A booklet with all subjects was developed with the aim to touch the subjects interesting for the specific customer.	High. Interview based on asking for ratings and their motivation for those ratings.
Challenges	Selection of customers.	Selection of customers. Diverse group of employees who conducted the visits.	Overinterpretation of the results. Interviewer's skills and integrity. Selection of customers.

Table 1.7. Usability test in projects Alpha and Gamma

Usability test		Between M2 and M5	
Projects	Alpha (intended)	Gamma	
Elements	Use product and ask feedback.	Use product Combination of interviewing and observing.	
Goals and collected information	Collect user feedback. Validating product. What do customers like and what not?	Acquire customer experiences. Identify blocking parts. Information about customer's workflow. Information for demonstrations. Works the product as expected.	
Goals achieved	Unknown	Yes	
Contribution to NPD goals	Ensure product meets customer requirements. Test product. Validate product.	Ensure product meet customer requirements. Input for marketing plan. Test product.	
Realized changes	None but only little changes in product are possible.	Some changes in design.	
Timing in NPD process	Okay.	Earlier would be better but a working machine is required.	
Duration	Medium – some days	Medium – 3 days (6 customers)	
Required experience of employees	Low	Medium	
Fixed structure	Unknown.	Yes, a script was written.	
Challenges	Unknown.	Results depend on the customer selection.	

Table 1.8. Validation test in project Gamma

Validation test		Between M2 and M5
Project	Gamma	
Elements	Show product outcomes. Ask questions about quality. Observation.	
Goals and collected information	Information about customer's workflow. Market trends. Validate quality.	
Goals achieved	Yes.	
Contribution to NPD goals	Ensure product meets customer requirements – after development stage Input for the marketing plan.	
Realized changes	Received feedback used in further process.	
Timing in NPD process	Okay.	
Duration	Short – 4 sessions	
Required experience of employees	Low.	
Fixed structure	Medium. Product outcomes were shown and feedback was asked.	
Challenges	Customer selection.	

Table 1.9. Beta test in projects Gamma and Epsilon

Beta test		Between M2 and M5
Projects	Gamma	Epsilon (intended)
Elements	Place product at customer's place. Receive feedback. End interview.	No idea. Customer will work with the product and will be asked to give feedback.
Goals and collected information	Is product usable at customer's place (in customer's workflow)? Identify blocking parts.	Concept validation. Product requirements. Usability.
Goals achieved	Unknown	Unknown
Contribution to NPD goals	Ensure product meet customer requirements – after development stage. Test product	Test product. Test concept. Ensure product meets customer requirements
Realized changes	None. Only little opportunities to change the product.	-
Timing in NPD process	Okay.	Okay. The team was earlier ready to do this test.
Duration	6 weeks, but low involvement of employees.	Unknown
Required experience of employees	None. Medium to set up the machine.	Unknown
Fixed structure	No	Unknown
Challenges	Interpretation of results. Customer selection. Providing means to get customer's opinion.	Small number of customer -> representativeness.

J. Collected information and contributions to NPD goals

Table J.1. Collected information and contributions to NPD goals – before M1

NPD goals	Alpha	Gamma	Delta	Epsilon
Assess financial and competitive situation (preliminary)	X			X
• Price indication				X
• Understand competitor's products	X			
Assess market value of the product (preliminary)	X			X
• Early validation	X			X
• Identify key buying criteria	X			
• Identify target customers				X
• Understand customers	X			
• Understand market dynamics	X			
Assess technical and performance objectives (preliminary)	X			X
• Desired functionalities				X
• Identifying key buying criteria	X			
• Required applications	X			
Determine product's core requirements	X			X
• Desired functionalities				X
• Required applications	X			
Define approach of CI for next stage			X	
• How can future interviews work?			X	
• How useful is it to show things?			X	
Test product concept	X			X
• Early validation	X			
• Suggestions for other uses				X
• Test concept				X

Table J.2. Collected information and contributions to NPD goals - between M1 and M2

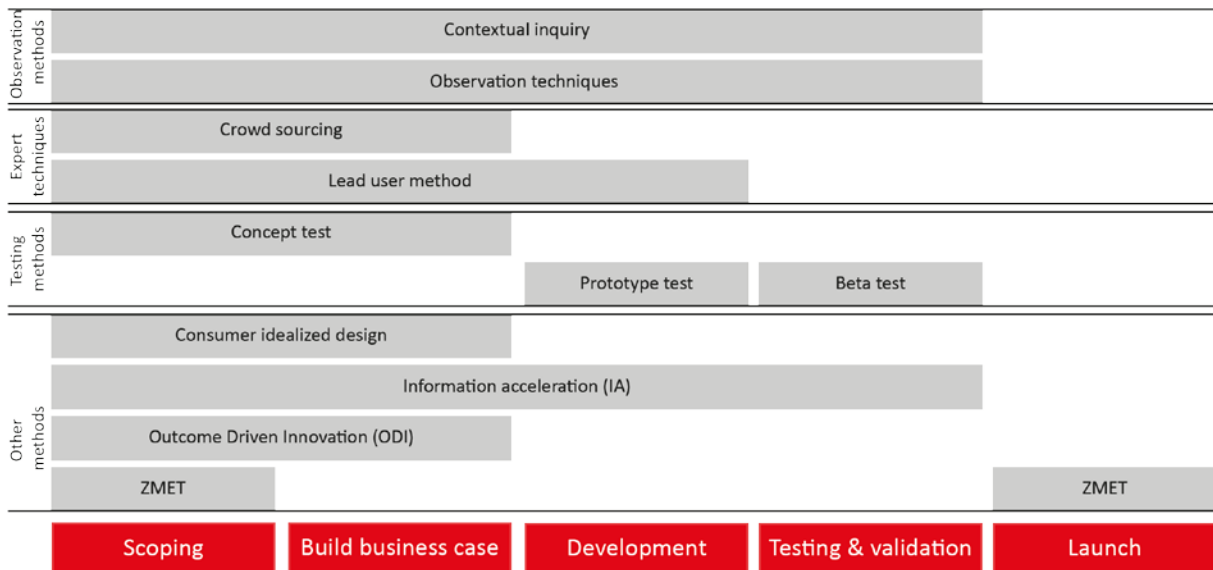
NPD goals	Alpha	Gamma	Delta	Epsilon
Assess financial and competitive situation	X		X	
• Benchmarking: where are we?			X	
• Identify strengths and limitations of competitor's products	X			
• Information about competition and market trends			X	
Assess market value of the product	X	X	X	X
• Acquire market and customer knowledge		X		
• Understand customer's problems				X
• Understand customer's unmet needs	X			
• Validate concept				X
• Validate product			X	X
• Verify the product's attractiveness				X
Assess technical and performance objectives	X		X	X
• Identify blocking issues			X	
• Receive feedback	X			
• Test applications			X	
• Validate product			X	X
• Value of applications and specifications	X			
Define product clearly	X	X	X	
• Information about workflow and work structure		X	X	
• Required applications and product specifications				
• Value of applications and specifications	X			
Determine product's core requirements		X		
• Required applications and product specifications		X		
Ensure product meet customer requirements	X			X
• Understand customer's problems				X
• Understand unmet needs	X			
• Verify the product's attractiveness				X
Identify key risks and challenges			X	
• Identify risks			X	
• Identify showstoppers			X	
Verify product's attractiveness	X		X	X
• Benchmarking: where are we?			X	X
• Identify showstoppers			X	
• Value of applications and specifications	X			
• Verify the product's attractiveness				X

Table J.3. Collected information and contributions to NPD goals - between M2 and M5

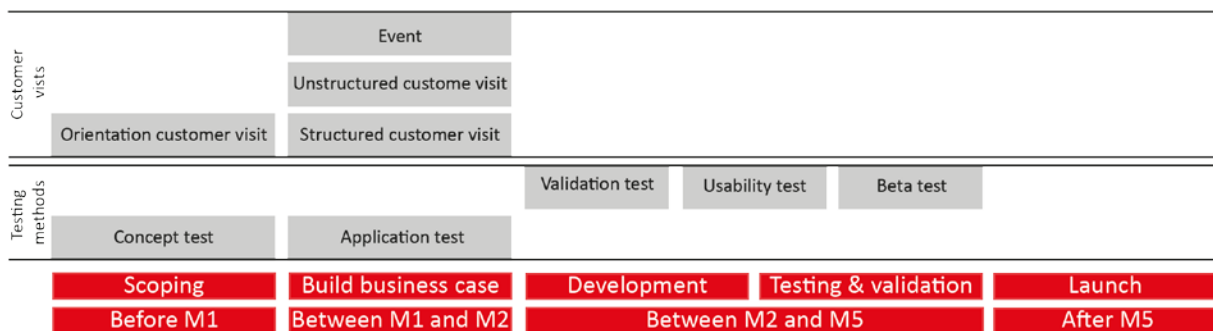
NPD goals	Alpha	Gamma	Delta	Epsilon
Ensure product meet customer requirements		X		
• Acquire customer's experiences		X		
• Does the product work as expected?		X		
• Is product usable at customer's place?		X		
• Validate quality		X		
Input for marketing plan		X		
• Customer experiences		X		
• Information for demonstrations		X		
• Market trends		X		
Test product		X		
• Does the product work as expected?		X		
• Is product usable at customer's place?		X		
• Validate quality		X		

K. Overview of construction design for the CEM

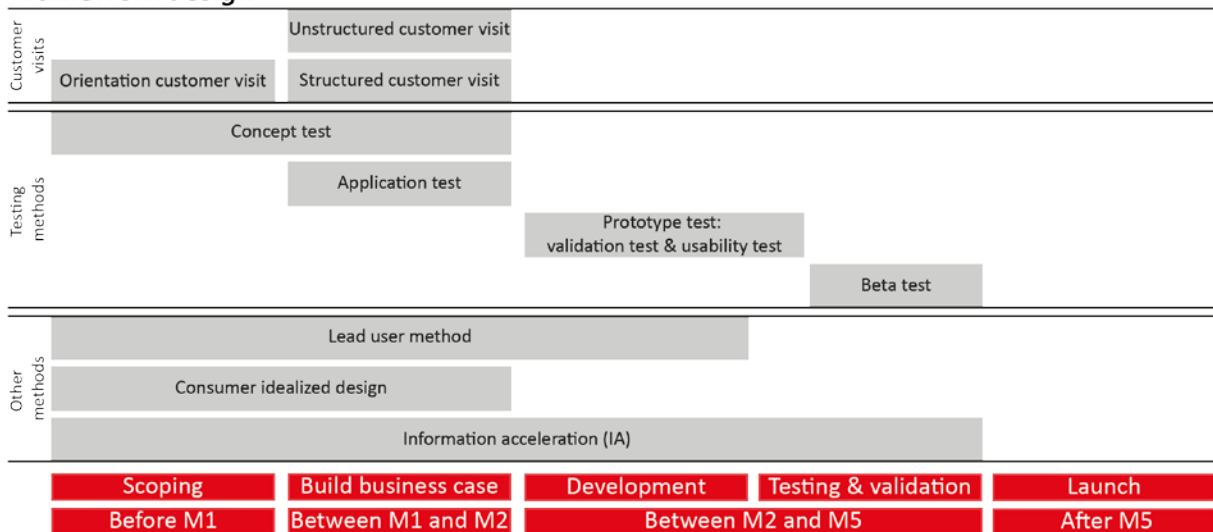
Framework literature



Framework CEM



Framework design



L. Design for the CEM: which information can be collected by each available customer involvement method

Table L.1. Collected information per method - before M1

Available customer involvement methods	Orientation customer visit	Concept test	Lead user method	Consumer idealized design	Information acceleration
Goal – information collected					
Assess market value of product (preliminary)					
Define target market			X	X	
Early validation	X	X			
Evaluate alternative concepts					X
Identify key buying criteria	X				
Identify target customers	X	X			
Identify underlying motives of product use			X	X	
Uncover customer's (latent) needs			X	X	X
Understand customer's work processes			X		
Understand customers	X				
Understand market dynamics	X				
Assess technical and product performance objectives (preliminary)					
Determine product's core requirements					
Desired functionalities	X	X		X	
Required applications	X			X	
Assess financial and competitive situation (preliminary)					
Forecast sales					X
Price indication		X			
Understand competitor's products	X				
Test product concept					
Early validation	X				
Receive feedback on product concept			X	X	X
Suggestions for other uses		X			
Test concept		X			
Define approach of CI for next stage					
How can future interviews work?	X				

Table L.2. Collected information per method - between M1 and M2

Available customer involvement methods Goal – information collected	Unstructured customer visit	Structured customer visit	Concept test	Application test	Lead user method	Consumer idealized design	Information acceleration
	Assess market value of the product						
Ensure product meet customer requirements							
Acquire market and customer knowledge		X					
Define target market					X	X	
Determine potential market size			X				
Evaluate alternative concepts			X				X
Identify underlying motives of product use					X	X	
Understand customer’s problems	X						
Understand customer’s unmet/latent needs		X			X	X	X
Understand customer’s work processes				X	X		
Validate concept	X	X		X			
Validate product	X	X					
Verify the product’s attractiveness							
Assess technical and product performance objectives							
Identify blocking issues		X					
Receive feedback on product concept		X	X		X		
Test applications				X			
Validate product		X					
Value of applications and specifications		X					
Assess financial and competitive situation							
Benchmarking: where are we?		X		X			
Identify strengths and limitations of competitor’s products		X					
Information about competition and market trends		X					
Define the product clearly							
Determine product’s core requirements							
Determine product’s requirements, specifications and required applications		X			X	X	X
Formulate product concept			X		X		
Identify important product attributes		X	X		X	X	X
Information about workflow and work structure		X		X			
Identify key risks and challenges							
Identify blocking issues		X					
Identify risks		X					

Table L.3. Collected information per method - between M2 and M5

Available customer involvement methods Goal – information collected	Prototype test: validation	Prototype test: usability	Beta test	Lead user method	Information acceleration (IA)
Ensure product meets customer requirements					
Collect customer’s experiences		X	X		
Does the product work as expected?		X	X		
Is the product usable at customer’s place?			X		
Test prototype	X	X		X	
Validate the quality	X	X	X		
Input for marketing plan					
Collect customer’s experiences			X		
Information for demonstrations		X			
Market trends			X		
Test product, production and marketing with customers					
Compare product with competitive products	X	X			X
Detect potential product problems	X	X	X	X	
Does the product work as expected?		X	X		
Forecast sales intentions and purchase probability				X	X
Is product usable at customer’s place?		X	X		
Receive feedback on product	X	X	X	X	X
Receive information on marketing aspects			X		X
Test product	X	X	X	X	
Validate quality	X	X	X		

M. Design for customer involvement in project Epsilon – after M2 milestone

Usability test

Customer's uses the software of project Epsilon in a short session to test the usability of the product. This test can be performed at the customer's place with a laptop of the CEM with the required software.

Goals

- Check the usability: is the product usable as the customer expected it.
- Check whether the product meets the customer requirements.
- Check whether the right customers are targeted.

Target customers

- Customers who have the product for which Epsilon is built.
- Customers who perform the jobs that Epsilon is intended to support.

Preparation

1. Determine which functionalities should be tested.
2. Write a script that guide customers through the test. Start asking the customers to conduct simple actions. Subsequently, make the actions more and more specific/difficult.
3. Make a list of questions that can be asked during the test.
4. Invite customers to participate in the usability test. Customers should be met the requirements of the defined target group.

Usability test

1. Give a short introduction on the product and demonstrate shortly the usage.
2. Explain the procedure of the usability test. Emphasize that the customer is allowed to say everything he wants (positive and negative comments, feelings, thoughts, etc.)
3. Start the test. Ask the customer to conduct tasks, start with the simple actions.
4. When a customer does not achieve to complete a task, ask questions such as 'What did you try so far? Did you try this and this? This stimulates the customer to share his thoughts which can be useful feedback.
5. Ask questions about the perceived usability, the customer's daily activities etc. The usability test is a combination of interviewing and observation.

Considerations: At customers' place or invite customers to CEM's place.

Customer's place:

- Customers are more willing to participate when it requires them less effort.
- Conducting the test at the customer's place gives the opportunity to observe the customer's workflow which gives additional information that can be useful during future stages.

CEM's place

- A special room is available for usability tests with cameras which enable the team to watch the test.
- The room can be arranged as shops for which Epsilon is targeted. This gives the opportunity to get also output.

Beta test

A small group of target customers uses the new product for six weeks in their own environment. The customer tries to perform all their activities with the new product. This test should be preferably performed after the results of the usability are known (and when necessary the product is adapted).

Goals

- Test prototype.
- Check if the product meets the customer requirements.
- Detect potential product problems.
- Receive feedback on product.

Target customers

- Customers who have the product for which Epsilon is built.

Preparation

1. Select customers that meet the requirements of target customers. Visit their shop to observe their workflow and daily jobs. In addition, interview the operator and shop owner to ensure they are really willing to try the new product.
2. Prepare training to make the customer familiar to use the product.
3. Prepare a log book that customer completes every day with details about the product usage, such as problems, usage errors, suggestions for improvements, completed jobs, jobs that the customer was unable to perform.
4. Investigate the possibility to install a camera to enable detailed observation of the product usage.

Beta test

1. Installation of the software in the customer's workflow by an S&S employee².
2. Give a short introduction on the product and demonstrate shortly the usage.
3. Customer uses the product to perform his daily activities. He records all the jobs he is (not able) to perform in the log book. For jobs that Epsilon does not support, he records the problems or the reasons of failing. Furthermore, suggestions for improvements, usage errors, problems can be recorded in the log book.
4. Customer can contact an S&S employee when errors are detected or problems are encountered.
5. A marketing employee (together with an S&S employee) calls the customer every week to discuss the progress, problems, etc.
6. After 3 weeks, a marketing employee visits the customer. He applies contextual inquiry. So, he observes the customer while he is using the product and interrupts to ask questions. The log book can be used as input for asking questions.
7. After 6 weeks, an end interview is conducted to collect all necessary information, such as the customer's overall experience, required improvements for product launch, and missing or unnecessary functionalities.
8. The software is removed from the customer's workflow.
9. All the collected information is analysed by the project team and shared to the stakeholders. It is important to take into account the type of customer when the information is interpreted.

² S&S employees are part of the department Service and Support.

N. The CEM's design for customer involvement in project Epsilon – after M2 milestone

Beta test

Goals

- Check the usability: Is a customer able to use the product?
- Check whether the software meets the customer requirements.
- Check whether we target the right customers.
- Check whether the software works or not?
- Check whether the product does what we expected that it does.

Target customers

- Customers who have the product for which Epsilon is built and performs the activities that Epsilon supports.

Procedure

1. Check if the customer is a good candidate for the beta test.
2. Software is installed at customer's place.
3. Customers get a training to learn using Epsilon.
4. Customer uses the software for six weeks in their own workflow. Customer tries to do their real work and tells the CEM what the limitations are.
5. Customer takes notes during the usage of the product.
6. Weekly conference call.
7. Customer visit: employee observes and questions the customer about Epsilon, the customer notes are used as input for the conversation.
8. Feedback sharing session with the involved project members.
9. End visit (after 6 weeks, when customer decided to quit, when sufficient amount of feedback is delivered).