MASTER

Implementing stage-gate in a NSD context
the case of an engineering KIBS

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Implementing Stage-Gate in a NSD Context: the Case of an Engineering KIBS

by

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Abstract
In order to minimize the risk that success in the marketplace is not achieved, firms often employ review gates during new service development (NSD) projects. By means of review criteria at gates, progress is reviewed and go/kill decisions about project progress are made. To investigate and learn which innovations (NSD projects) are successful, marketplace performance must also be reviewed.

This study focuses on the review of NSD projects in an engineering firm in order to provide clear insights into the predecessors of development and marketplace performance. The aim is to investigate whether to use review gates during development and how to design review moments with review criteria during development and review measures after introduction of the new service in the marketplace that provide insights into NSD performance.

A literature review precedes a thorough empirical study in which a conceptual design of review gates and review criteria is derived from a survey study and a focus group meeting. The conceptual design is validated by former NSD projects. The results suggest that a stage-gate approach can provide clear insights into NSD performance during development. Furthermore, review criteria during development and review measures after introduction in the marketplace reflect the managerial tasks that need to be performed successfully to warrant NSD success. Several implications for NSD literature are discussed.
Management summary

This report is the result of my master thesis project, conducted at ARCADIS Nederland BV (ANL). ANL is an engineering firm, defined as a knowledge intensive business service (KIBS) active in the construction industry. The study focuses on the review of new service development (NSD) projects in order to provide clear insights into development and marketplace performance.

Introduction

For NSD projects, the risk exists that the final, long-term objective of success in the marketplace is not achieved within time and resource constraints. The long-term objective of success in the marketplace is better manageable and controllable when the NSD process is divided into feasible short-term objectives. Therefore, firms employ review moments or gates during NSD. Gates serve as quality checkpoints and provide focus in NSD as go/kill decisions about project progress are made.

By the use of success criteria at gates, progress is reviewed and go/kill and prioritization decisions are made (Tzokas, Hultink, & Hart, 2004). To investigate and learn which innovations are successful, performance must also be reviewed after launch (Storey & Kelly, 2001).

NSD at ANL needs more structure; insights into NSD performance during development and after introduction in the marketplace are needed to learn and to remain competitive. ANL realized that the use of a Stage-Gate approach (stage-gate) and review criteria during development and after introduction in the marketplace can provide these insights. Therefore, the following general research question has been investigated:

How can new service development projects within ANL be reviewed in order to provide clear insights into development and marketplace performance?

From a theoretical perspective this study fills two gaps in the literature regarding NSD and KIBS. The literature review shows that the use of stage-gate in (engineering) KIBS has never been studied. Furthermore, the use and importance of review criteria in reviewing NSD performance during development in service industries is not clear. This study aims to investigate both gaps in literature.

Research methodology

A development approach to problem-solving is used, in which the final solution is realized step-by-step (van Aken et al., 2007). Each step was designed and realized based on what was learned from previous steps. The research methodology is further explained in three steps:

Literature review

A literature review preceded the empirical research. and presented scholarly literature on the use of review gates and review criteria during NSD. First, scholarly literature about the use of stage-gate in service industries was discussed. Second, scholarly literature about the use of review measures after introduction in the marketplace was discussed for both product and service industries. Third, the use of review criteria during development was discussed for both product and service environments.

Empirical research

i) A case study analyzed current practices by investigating the “how and why” of control during NSD is organized. The focus of the case study was the current situation concerning the use of review criteria and review gates during NSD. Five NSD projects within ANL (Environmental business line) were studied in retrospect. The single case-study design as proposed by Yin (2003) was followed. NSD projects were selected and data were collected through one or two semi-structured interviews,
project documentation, and informal conversations. Qualitative data was analyzed by the method described by Aken, Berend & Bij (2007) using software package NVivo.

ii) A survey that put respondents in a NSD scenario was conducted to investigate whether review gates should be used during NSD and which review criteria and review measures should be used to review development and marketplace performance, according to the preferences of current employees. Knowledgeable respondents from business line Environment and the interviewees of the case study were included in the sample; 12 usable surveys were obtained resulting in a response rate of 28.6%. Most respondents were senior advisor or senior specialist and were between 40 and 50 years old.

iii) Results from the survey served as input for a focus group meeting with several NSD stakeholders throughout the organization. The focus group meeting was used to reach consensus within the organization about the review practices. The focus group consisted of four participants, namely a senior advisor (SA), a line manager, the new business manager and the financial director of ANL.

Validation
Validation was performed to investigate whether the conceptual design of review gates and review criteria performs its task; proceeding promising NSD projects and killing unpromising ones. The conceptual design was validated by interviewing innovators involved in former NSD projects. Each interview changed the conceptual design which iteratively led to the final design. The final design of review gates and review criteria is presented in Figure 12, Figure 13, and Figure 14.

Conclusions
The insights gained during the literature review, the empirical research, and the validation served as input for the general conclusions:

A) ANL can provide clear insights into NSD performance during development by employing a stage-gate approach.

Stage-gate can assist ANL in both selecting the most promising projects and bringing new service offerings to market. Each NSD phase will be followed by a review gate. Gates provide managers with focus in development and weed out misfits. Focus in development results in higher NSD performance and the weeding out of misfits results in resources being saved.

B) ANL can provide clear insights into development performance by using review criteria at the gates that reflect the managerial tasks that need to be performed successfully at each stage to warrant NSD success.

NSD progress is reviewed on different aspects throughout the different stages of the NSD process. After concept development, reviewing strategic criteria is most important and this review dimension stays important throughout the whole NSD project. After the proof of concept stage, technical criteria are crucial in reviewing NSD progress and this review dimension stays important afterwards. Financial criteria are most important after business analysis. Marketing criteria are important throughout the whole NSD project and gain importance after business analysis. The figure below presents the selected review criteria to review NSD progress during development. There is a difference between should-meet and must-meet criteria at each gate. Green colored criteria indicate the must-meet criteria at each gate.
ANL can provide clear insights into marketplace performance by using review measures that reflect the managerial tasks that need to be performed successfully in each timespan to warrant NSD success.

In the short-term, customer-based and internal review measures are most important to review marketplace performance. In the long-term, financial and customer-based performance are most important. The figure below presents the selected review measures to review NSD market performance.

<table>
<thead>
<tr>
<th>Review criteria</th>
<th>Strategic</th>
<th>Marketing</th>
<th>Technical</th>
<th>Financial</th>
<th>Intuition</th>
<th>Organizational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate 1 (Concept development)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Gate 2 (Proof of concept)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Gate 3 (Business analysis)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Theoretical implications

Several contributions to existing theory are presented. First, this study contributes to existing theory as it is the first to investigate the use of stage-gate in an engineering KIBS. Second, this study investigated the use and importance of review criteria during NSD. Despite some exploratory studies, the use and importance of review criteria in reviewing NSD performance during development in service industries was not clear. This study shows that multiple review criteria can be used to review development performance, reflecting specific goals of each stage.

Practical implications

Currently, review of NSD progress during development is performed more implicitly at ANL than on the basis of explicit review criteria. This study shows that the type of review criteria that can be considered at the several gates are very similar to the aspects of NSD progress that are currently reviewed implicitly. The change to explicit review criteria can be done by consciously using a score form instead of changing the current view on NSD management. Furthermore, this study accumulates in key tasks that can be conducted in order to implement the stage-gate approach.
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<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AENG</td>
<td>ARCADIS in England</td>
</tr>
<tr>
<td>ANL</td>
<td>ARCADIS Nederland BV</td>
</tr>
<tr>
<td>BD</td>
<td>Business Development</td>
</tr>
<tr>
<td>BPS</td>
<td>Business Problem Solving</td>
</tr>
<tr>
<td>EM</td>
<td>Evaluation Moment</td>
</tr>
<tr>
<td>HP</td>
<td>Hydrogen Peroxide</td>
</tr>
<tr>
<td>IVIP</td>
<td>Intangibility, Variability, Inseparability, and Perishability</td>
</tr>
<tr>
<td>KIBS</td>
<td>Knowledge Intensive Business Service</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>NBM</td>
<td>New Business Manager</td>
</tr>
<tr>
<td>NPD</td>
<td>New Product Development</td>
</tr>
<tr>
<td>NSD</td>
<td>New Service Development</td>
</tr>
<tr>
<td>OpCo</td>
<td>Operating Company</td>
</tr>
<tr>
<td>PD</td>
<td>Program Director</td>
</tr>
<tr>
<td>PL</td>
<td>Project Leader</td>
</tr>
<tr>
<td>PLC</td>
<td>Product Life Cycle</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment</td>
</tr>
<tr>
<td>SA</td>
<td>Senior Advisor</td>
</tr>
<tr>
<td>SI</td>
<td>Service Innovation</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Enterprise</td>
</tr>
<tr>
<td>TS</td>
<td>Technical Specialist</td>
</tr>
<tr>
<td>UvA</td>
<td>University of Amsterdam</td>
</tr>
<tr>
<td>V&amp;E</td>
<td>Vallei &amp; Eem (water board)</td>
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1 Research Context

1.1 Introduction

Development and launch of successful new products is essential for firm survival. Firms develop new products in order to gain profit, satisfy the needs of customers, and stay competitive in the marketplace.

For new product development (NPD) projects, the risk exists that the final, long-term objective of success in the marketplace is not achieved within time and resource constraints. By dividing the NPD process into feasible short-term objectives, the long-term objective of success in the marketplace is easier achieved. Therefore, firms employ review moments or gates during development efforts. Gates serve as quality checkpoints and provide for focus in NPD (Cooper, 2001). At these gates, go/kill decisions about project progress are made.

By the use of success criteria at gates, progress is reviewed and go/kill and prioritization decisions are made (Tzokas, Hultink, & Hart, 2004). As success in the marketplace has several dimensions, criteria used at the gates logically reflect those dimensions (Griffin & Page, 1996).

Decisions are made based on rational aspects, e.g. profit objectives and product quality, and/or based on irrational aspects, e.g. intuition and firm image (Storey & Kelly, 2001; Tzokas et al., 2004). To investigate and learn which innovations are successful, performance must also be reviewed after launch (Storey & Kelly, 2001).

Nowadays, services nowadays account for 60-70% of first world economies. In the United States and in the UK, services take care of approximately 75% of employment, and more than 50% of the labour force of Japan and Germany is employed in the service sector (OECD, 2006).

Despite the higher employment figures in services, the vast majority of research on Stage-Gate (stage-gate) and reviewing innovation performance during development and after introduction in the marketplace is focused on product industries and less on service industries.

In the 90s, service firms showed to be reluctant to adopt stage-gate (Cooper & Edgett, 1999). Recent years, much research has been conducted that investigated whether stage-gate contributes to new service development (NSD) success. Meanwhile, many service firms did adopt a stage-gate approach and now reap the benefits. Furthermore, the body of research on measuring NSD performance in the market has increased. However, NSD literature is rather silent about the use of review criteria to review NSD progress during development. Lack of research on this particular topic hampers development of knowledge and asks for further research.

This research focuses on the use of stage-gate and the review of NSD performance during development and after introduction in the marketplace in an engineering firm.

An engineering firm is defined as a knowledge intensive business service (KIBS) related to the construction industry. KIBS are (private) companies that rely heavily on professional knowledge or expertise related to a specific (technical) discipline and supply highly knowledge-based (intermediate) products and services to the business processes of other organizations (den Hertog, 2000); examples of KIBS are computer services, accountancy services, architecture, or engineering services.

The remainder of this chapter is structured as follows: first, the company involved is introduced. Second, the problem situation and the problem statement are presented. Third, the research questions are described. Finally, the NSD process of the company involved is presented.
1.2 Company introduction

This research is conducted at ARCADIS Nederland BV (ANL), an operating company (OpCo) of ARCADIS NV (ARCADIS). ARCADIS is a global company that delivers consulting, design, engineering, urban planning, architectural and project management services for infrastructure, environment and buildings for clients in the public and private sector.

Several mergers and acquisitions and expansion into emerging markets established ARCADIS recent years as a global top 10 design and engineering firm (ARCADIS, 2012). The company’s gross revenue between 2006 and 2012 more than doubled from EUR 1233 million to EUR 2544 million (ARCADIS, 2010, 2012).

In the Netherlands, ANL operates with 2,300 employees in a nationwide network of offices. ANL works on multidisciplinary issues with an organizational structure consisting of four business lines; Mobility, Water, Environment, and Buildings. An organizational chart of ANL (in Dutch) is presented in Appendix A. The four business lines are managed by a managing director and each business line is divided into market groups, which are divided into advisory groups.

1.3 Problem situation

The project started within the staff department Business Development (BD). BD supports and coordinates business lines in exploration opportunities, projects concerning multiple business lines and innovation projects. Each business line manages NSD projects themselves, however BD helps by stimulating and guiding ideas to business.

Based on initial meetings with the new business manager (NBM) and semi-structured interviews with members of a cross-functional team (i.e. Innovation Team), responsible for stimulating, professionalizing and monitoring NSD at the several business lines, the problem situation was defined and is described below.

At ANL, control during NSD projects is organized rather informally. Often, NSD team members communicate informally with management about the project by informing management about for example progress made or technical or economic feasibility. Sometimes, management and/or the NBM is involved and discusses for guidance and decides with the team about progress.

NSD teams experience a lot of freedom in their NSD efforts and hardly have to achieve (intermediate) objectives of management. Still, NSD projects are reviewed on several aspects, such as technical feasibility or market potential.

The NBM feels that not all aspects of a NSD initiative are reviewed consistently during NSD. When there is good overview of all the important aspects of the NSD initiative, one can determine best whether one should invest resources in the NSD project. Furthermore, importance of certain aspects (e.g. technical or economic feasibility) can be different at certain stages of NSD.

In order to raise the level of awareness of innovators and raise the level of quality of NSD, the NBM wonders which review criteria to use at which review moments during NSD.

During NSD, market and technical uncertainty must be reduced while keeping cost commitment low. The risk exists that the final, long-term objective of success in the marketplace is not achieved within time and resource constraints. The long-term objective of success in the marketplace is better manageable and controllable when the NSD process is divided into feasible short-term objectives. These feasible short-term objectives can be reviewed at (formal) gates, based on certain review criteria (Cooper, 2001).

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1 NSD control entails the means of an organization to keep NSD teams focused and eventually achieve their objectives.
At ANL, there is no articulated structure with the existence of review gates where a decision is made to either continue with the project, stop it prior to implementation, or put the project on hold until more information is gathered (Schmidt, Sarangee, & Montoya, 2009).

When certain projects were killed earlier, resources (e.g. money and time) maybe could have been saved and when other projects kept more focus, their performance (e.g. sales or profit) maybe could have been better.

In order to not cut creativity too early but at the same time to not spoil resources and control risk, the NBM wonders whether and where in the NSD process there should be review gates.

To investigate and learn which innovations can be and are successful, NSD performance must be reviewed during development and after introduction in the marketplace (Storey & Kelly, 2001). Currently, ANL does not have enough insights in NSD performance during development and does not have insights in performance of the new service in the marketplace. Understanding of which review criteria to use at which moments during development and after introduction in the marketplace provides ANL with these insights.

Important to mention is the following: new service development (NSD), or service innovation (SI), is not about service (or solution) development for specific customers but deals with development and launch of services that can be offered to the market as a whole, without (too much) customer specific requirements. In the remainder of this paper NSD and SI are used interchangeably.

1.4 Problem statement
The problem situation described in Paragraph 1.3 yields the following problem statement:

*Control of new service development projects does not provide clear insights into development and marketplace performance.*

NSD at ANL needs more structure; insights into NSD performance during development and after introduction in the marketplace are needed to learn, to remain competitive and to keep on building leadership positions.

1.5 Research objective
Based on the problem statement a research objective is derived. The research objective is to make practical recommendations to ANL and to the management of BD. These recommendations will be regarding 1) whether to use review gates during development and 2) how to design review moments with review criteria during development and 3) review measures after introduction of the new service in the marketplace that provide insights into NSD performance (in the remainder of this paper sometimes called “review practices”).

1.6 Research questions
In order to fulfill the research objective and to contribute to existing academic literature the following main research question will be answered:

*How can new service development projects within ANL be reviewed in order to provide clear insights into development and marketplace performance?*
In order to answer the main research question the following sub questions are defined and will be answered:

a. By synthesizing the existing literature, the following questions will be answered:

**RQ1** Which review criteria are used by engineering KIBS to provide insights into new service development performance during development and after introduction in the marketplace?

**RQ2** At which moments during new service development at engineering KIBS are review gates used where is decided to go/kill/hold/recycle the project?

During the literature review, two gaps are identified. The literature review shows that the use of stage-gate in (engineering) KIBS has never been studied. Furthermore, the use and importance of review criteria in reviewing NSD performance during development in service industries is not clear. In order to get better insights into these topics, both gaps are addressed in this research.

b. By collecting and analyzing empirical evidence, the following questions will be answered:

**RQ3** How and why is control of new service development projects organized in the current way?

**RQ4** Which review criteria can be used to provide insights into new service development performance during development and after introduction in the marketplace?

**RQ5** At which moments during new service development should review gates be used where is decided to go/kill/hold/recycle the project?

c. After creating the conceptual design of review practices, the following question will be answered:

**RQ6** What would the effect be of the proposed design of review criteria and review gates on the performance of former new service development projects?

This research will be conducted in the Environmental business line (Environment). The NBM experiences the greatest need for structuring NSD at Environment. Furthermore, Environment contriving most ideas and initiatives yields a good basis for improvement opportunities².

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²The recently created innovation database shows that Environment yields by far the most ideas and initiatives.
1.7 New service development process

In order to design review criteria and review gates for NSD, the NSD process of ANL is described. The NSD process of ANL is visualized in Figure 1.

ANL uses a NSD process that distinguishes four phases (Figure 1), labeled as idea generation, proof of concept, business analysis and implementation. During idea generation an idea is generated and economic and technical feasibility are examined globally, often based on little investigation or field experience. Issues at clients’ sites, derivative problems or changed regulations are the main drivers of NSD. In this phase, interested parties as potential customers, research institutes or (local) governments are approached to co-operate.

A significant part of NSD initiatives includes technical development. During the proof of concept phase, mainly technical feasibility is examined. In general, ANL chooses to progress a NSD initiative together with third parties to both share development costs and study technical and commercial feasibility in-field.

During business analysis, stakeholder and commercial analysis is undertaken. ANL always first studies technical feasibility before progressing to business analysis but both phases can also be performed more in parallel, as opposed to the sequential representation in Figure 1.

After successful business analysis, implementation of the new service follows. Implementation contains performing pilot projects with launching-customers, marketing to create awareness among all important stakeholders, and discussing organizational matters of the new service. Also, implementation can be performed more in parallel with business analysis, as opposed to the sequential representation in Figure 1.

In general, there is no articulated structure with the existence of review gates. During NSD, the project team receives mostly informal control. By means of self-control and involvement of line management and BD decisions about progress are made.

1.8 Report structure

The remainder of this report is structured as follows: Chapter 2 describes the research design and the methodology. The methodology provides the outline for the rest of the report. Chapter 3 presents the literature review which serves as theoretical basis for the empirical research. Then, the empirical research is presented in Chapter 4. Subsequently, the validation of the conceptual design is described in Chapter 5. Finally, Chapter 6 presents the conclusions of this research and the implementation plan needed to successfully implement the final design at ANL.
2 Research plan

In order to fulfill the research objective and answer the research questions a thorough research plan is needed. First, Paragraph 2.1 presents the research design and assignment approach. Second, Paragraph 2.2 presents the methodology of this research.

2.1 Research design

In this research the performance of a business process, the NSD process, is improved. A business problem solving (BPS) method is used that is theory-based and design-focused; the regulative cycle of van Aken, Berends, and van der Bij (2007) (Figure 2). In the regulative cycle a business problem is solved and the accompanied design is evaluated on its applicability. In this research, the final design of review practices is not implemented and evaluated due to time and organizational constraints.

![Regulative cycle](image)

Figure 2, Regulative cycle

2.1.1 Assignment approach

This research uses a development approach to problem-solving (van Aken et al., 2007). In the development approach, the final design of review practices is realized step-by-step. Each step is designed and realized based on what was learned from previous steps. The assignment approach is further explained in four steps:

1) **Literature review**: A literature review precedes the empirical research and presents scholarly literature on the use of review gates and review criteria during NSD. The collected literature is used to provide insights into the research context from a theoretical perspective and to serve as theoretical basis for the empirical research.
2) **Empirical research:** i) A case study analyzes current practices by investigating “how and why” control during NSD is organized. ii) Next to this, a survey that places employees in a NSD scenario is conducted to investigate preferred review practices. iii) Results from the survey serve as input for a focus group meeting with several NSD stakeholders throughout the organization. The focus group meeting is used to reach consensus within the organization about the review practices.

3) **Validation:** After the focus group meeting, the conceptual design of review criteria and review gates is focused on the organizational structure and organizational goals. Subsequently, the conceptual design is validated by interviewing innovators involved in former NSD projects.

4) **Design:** Based on the empirical analysis and the validation a final design for the use of review criteria and review gates is derived.

2.2 **Methodology**

After describing the assignment approach, the methodologies for the empirical research and the validation are defined in more detail. First, the case study and its methods of data collection and analysis are described. Second, the survey and its methods of data collection and analysis are described. Hereafter, the methodologies for the focus group meeting and the validation are described.

2.2.1 **Case study**

The case study analyzes current control practices during NSD in order to make the right recommendations for improvement. In particular, the current situation concerning the use of review criteria and review gates during NSD is investigated.

Case studies are preferred methods for research aiming to answer questions like “why and how” (Yin, 2003). The case study method is chosen because this part of the research aims to understand how and why control during NSD is organized in the current way. Furthermore, the case study method does not require control over the behavioral events (Yin, 2003), as is appropriate in investigating the NSD process that should not be manipulated.

This research makes use of a single, cross-sectional case study. The descriptive approach is used in order to both get answers to proposed questions and to stay open for other views. Subsequently, general conclusions are drawn concerning the review practices during NSD.

**Unit of analysis**

Before actual data collection starts, one has to determine the unit of analysis. The unit of analysis is the type of object that is the focus of interest of the research (Yin, 2003). In this research, the unit of analysis is the “new service development process”. Based on the semi-structured interviews and company documentation it is assumed that each NSD project follows the same NSD process, described in Paragraph 1.7.

**NSD project selection criteria**

As stated above, the unit of analysis of this research is the NSD process. Because the NSD process is only used during NSD projects and possible peculiarities are only present during execution of the projects, the current NSD process is examined through investigating multiple NSD projects.

Multiple NSD projects are more reliable, as their results are considered more vigorous. Before conducting the case study, one has to think thoroughly about which NSD projects to select. NSD
projects are selected that may produce contrasting and useful results for answering the research question. The NSD projects are selected based on the following selection criteria:

- “Implemented vs. killed/put on hold”: to get more insights in underlying aspects of review practices, several degrees of finishing are involved;
- “Technological component”: many NSD projects at ANL involve development of technological components as ICT or analysis tools that make part of the eventual service delivery. Therefore, each NSD project has to contain development of technology.

Data collection
Different sources of information are used in this research:
- Semi-structured interviews;
- Documentation of the NSD project;
- Informal conversations about the NSD project.

Interviews are one of the most widely used sources for collecting information for evidence in case studies (Yin, 2003). By using semi-structured interviews, insightful information concerning review practices is collected. Then, it is possible to identify relevant issues to understand the current situation. The new business manager (NBM) and the Innovation Team member of Environment select the NSD projects.

After selection, the key informants of the project are identified. Given the average organization of NSD, the number of innovators that can be interviewed per project is uncertain. Furthermore, it is doubtful that more than a few separate project leaders can be appointed. In order to increase reliability, it is aimed to interview two people per NSD project.

Interviewees are asked about current NSD review practices (i.e. review criteria used, size of review committee, decision-making process); the interview guide is based on the interview guide used by Aas (2011) in his exploratory research on management control during SI projects. The interview guide (in Dutch) is presented in Appendix B.

Interviews can provide for poor data because of poorly constructed questions and response bias of the interviewees (Yin, 2003). After conducting the interviews, available project documentation is analyzed to confirm and expand the information on NSD review practices. If information remains unclear after the interviews and analysis of the documentation, respondents are asked for additional clarification through phone calls and emails.

Data analysis
Data analysis is performed by use of the template approach (van Aken et al., 2007). The template approach uses existing concepts and theories from literature to code. This approach assumes that researchers know in advance in which subjects they want to create insights. Software package Nvivo is used to code transcribed text. Coded parts with existing codes, derived from the different interviews, can be placed in a cell or matrix. In this way, data can be displayed and analyzed in a systematic way. Each individual NSD project is analyzed independently, after which cross-project analysis is performed.

2.2.2 Survey
The survey is a useful research strategy in answering “what, where and how much” (Yin, 2003). By using a survey, information is gathered uniformly and quickly and quantitative data can be analyzed objectively. The survey is used to investigate which (what) review criteria to use at which moment (where) in the NSD process (Yin, 2003).
The survey investigates what the review practices should be. At ANL, there is no system in place that reviews or measures performance of NSD in the marketplace. Therefore, this research aims to follow the method used by Griffin and Page (1996). These authors state that there was little correlation in former research between measures product developers would like to use and measures currently used to judge NPD success.

Over one-third of the reasons given for why firms did not use measures they believed could yield most useful insights were because there were no systems or procedures in place to obtain the desired numbers. Therefore, it was believed that surveying what firms actually use as measures for NPD projects would not answer their research questions. Hence, their set of recommended measures was obtained from a scenario of a NPD project. In this survey simulation, the respondent became responsible for assessing post hoc the success on multiple dimensions of the hypothetical project.

**Data collection**

Respondents are put in a NSD scenario in which they are responsible for reviewing a NSD project. Respondents have to indicate (i) which review criteria they will use at which moment in the NSD project and (ii) whether they use a review gate. Furthermore, respondents have to consider which categories of review criteria they find most important. Knowledgeable informants as proven innovators and NSD project leaders within Environment shall do the survey. The survey (in Dutch) is attached in Appendix C.

**Data analysis**

Data analysis is performed by the use of descriptive statistics as frequency and utility of use.

### 2.2.3 Focus group meeting

Results from the surveys serve as input for a focus group meeting between several NSD stakeholders throughout the organization. A focus group is a group of people, led by a moderator, who meet for approximately 90 minutes. The moderator uses knowledge of group dynamics to guide the group in its discussion about a specific topic (Blumberg, Cooper, & Schindler, 2008).

The focus group meeting is used to reach consensus within the organization about the review practices. In order to increase practicability of the survey, review criteria are grouped into categories. During the focus group meeting, the task of the focus group panel is to indicate (i) the preferred review criteria per most important review categories and (ii) how eventual review gates should be employed in the organization. The moderator guides the group discussion by the use of theory and knowledge about the organization.

The aim is to form a focus group panel of six to eight participants from different positions within the firm. It is aimed that the focus group panel consists of (senior) advisors and line management involved in NSD, (a) team member(s) of the Innovation Team, the NBM, and the financial director of ANL. In this way, group size permits constructive discussion and group composition provides for sufficient heterogeneity to reach consensus.

Following a topical guide, the researcher steers the discussion to make sure that all relevant information is treated. The researcher makes sure that the group panel feels free to mention new, important insights about the review practices under consideration.

### 2.2.4 Validation

Validation is performed to investigate whether the conceptual design performs its task; proceeding promising NSD projects and killing unpromising ones. After the focus group meeting, the conceptual design is focused on the organizational structure and organizational goals. The conceptual design of
review gates and review criteria is validated by interviewing innovators involved in former NSD projects. In order to increase reliability, it is aimed to interview two people per NSD project.

2.3 Quality of the research

The aim of this research is to strive for inter-subjective agreement, consensus between actors who deal with a specific research problem (van Aken et al., 2007).

The basis for inter-subjective agreement on research results is provided by research-oriented quality criteria as controllability, reliability and validity. Below, controllability, reliability and validity of the research are discussed.

Controllability of the research

In order to make sure that research results are controllable, researchers have to describe in detail how they executed their study. By describing the study in such a detailed way that others are able to replicate it, controllability is secured. Controllability of research is secured in this research by revealing in this report how the study is executed: How data is collected, how respondents are selected, what questions are asked, and how will data are analyzed.

Reliability of the research

Research results are reliable when they are independent of the following characteristics of a study and can therefore also be found in other studies; independent of the conducting researcher, the respondents, the measuring instruments used and the specific situation in which the study was performed (van Aken et al., 2004).

Interviews depend on personal characteristics of the interviewer. By standardizing data collection, analysis and interpretation, dependence on the researcher is lowered and reliability is increased. The case study makes use of semi-structured interviews, a case study database and a software package, NVivo, that helps the researcher to work and analyze systematically.

Interviews can provide for poor data because of poorly constructed questions and response bias of the interviewees. This research serves reliability by using multiple sources of evidence. This data triangulation combines multiple sources of evidence and entails a combination of semi-structured interviews, project documentation and informal conversations (Yin, 2003). Furthermore, the same holds for the other empirical research; by only employing a survey there is a chance that no consensus is reached. Therefore, a focus group meeting is held.

Different people within a company can have diverging views on topics. In social science, this is inevitable; people have their own view of the world, from their own place in the organization. By combining perspectives of organizational members from different, but concerned places in the organization, an inter-subjective view is created. The research makes sure that as many as possible roles who are involved in the research context are involved in the interviews, survey and focus group meeting; within time and organizational constraints there is looked after a sufficient number of respondents.

Another source of unreliability might be differing circumstances under which research takes place. For example, an interviewee’s answers to questions might be influenced by recent negative experiences. A good way of dealing with different circumstances is to carry out measurements at different moments in time and place. By means of a prolonged stay in the organization, the researcher will become an insider and will be able to sense what is desirable for the organization.
Validity of the research

Research results are valid when the way they are generated is justified. Thus, validity implies reliability. Different types of validity exist, namely construct, internal, and external validity (van Aken et al., 2007).

Construct validity is the extent to which a concept that is measured corresponds to the real meaning of that concept. Construct validity is assessed in this research by the researcher himself. Also, triangulation of research instruments is at place at – mainly – the case study part that improves construct validity.

Internal validity assesses the measurement of concepts; internal validity concerns relationships between phenomena. Internal validity is improved when suggested relationships from literature are approved in the results of this research. Furthermore, systematically analyzing case studies and surveys improves internal validity.

External validity includes the ability to generalize research results to other departments in the organization and other organizations. The external validity of the research depends on the level of differences and similarities between Environment, other business lines and other organizations. External validity can be improved by increasing the number of studied objects (for example, case studies, interviewees, respondents of the survey).

This Chapter presented the research plan. The next Chapter presents the literature review that precedes the empirical research and presents scholarly literature on the use of review gates and review criteria during NSD.
3 Literature review

The literature review is a critical discussion of state-of-the-art scholarly literature and serves as theoretical basis for the empirical research; by synthesizing existing literature, RQ1 and RQ2 are answered. Paragraphs 3.1 to 3.4 present the scholarly literature. The literature review is concluded in Paragraph 3.5.

3.1 Definition of new service development

Toivonen and Tuominen (2009) define SI (or NSD) as:
A service innovation is a new service or such a renewal of an existing service which is put into practice and which provides benefit to the organization that has developed it; the benefit usually derives from the added value that the renewal provides to the customers. (p. 14)

Amara, Landry, and Doloreux (2009) describe SI and the elements subject to change. The authors define SI as one or more changes in six dimensions (Table 1).

Table 1, Dimensions of SI

<table>
<thead>
<tr>
<th>SI dimension</th>
<th>Description (This dimension is about ..)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product dimension</strong></td>
<td>the introduction into the marketplace of a new or significantly improved good or service.</td>
</tr>
<tr>
<td><strong>Process dimension</strong></td>
<td>the implementation of a new or significantly adapted production process (not delivery, unless production and delivery are integral).</td>
</tr>
<tr>
<td><strong>Delivery dimension</strong></td>
<td>changes in the delivery process of the service. Examples can be changes in time aspects (just-in-time) or the introduction of technologies for delivery of voice communications over the internet.</td>
</tr>
<tr>
<td><strong>Strategic dimension</strong></td>
<td>the implementation of new or significantly changed business strategies such as the targeting of different market segments.</td>
</tr>
<tr>
<td><strong>Managerial dimension</strong></td>
<td>the implementation of new or significantly changed management practices such as the use of a stage-gate process or certain knowledge management.</td>
</tr>
<tr>
<td><strong>Marketing dimension</strong></td>
<td>the implementation of new or significantly changed marketing strategies such as the use of new marketing instruments.</td>
</tr>
</tbody>
</table>

Den Hertog (2000) argues that different dimensions of SI are not independent. Amara et al. (2009) found indeed that product, process, strategic, managerial and marketing dimensions of SI are complementary and that many patterns of complementarities exist.

These results show that innovation in services is incomprehensible by simply distinguishing between product and process innovations and, furthermore, these results entail that both technological as well as non-technological aspects of innovation exist.

Throughout this literature review, NSD or SI refer to all the above; however, there is mainly referred to the product dimension (Amara et al., 2009).

Characteristics of services and new service development

De Brentani (1991) describes characteristics of services that let them differ from most tangible products and which affect NSD in a way that makes it different from NPD. In general, the intangibility, variability, inseparability, and perishability (IVIP) of services affect both its development and marketing. These characteristics are described below.

Services are usually intangible. Although services are often accompanied by physical elements (e.g., a carrier with its trains and rails), the biggest part of a service consists of an intangible experience (e.g., a consultant giving advice to a client).

In general, services depend on input from both company personnel and the customer. Therefore, the service delivery and outcome and thus the customer’s experience can be variable for each service encounter.
Many services are simultaneously produced by the firm and consumed by the customer (e.g., riding of the train and traveling of the customer). This inseparability generally equates to simultaneous production and delivery in the presence of the customer.

Since the inseparability of production and consumption, services cannot be inventoried (de Brentani, 1991) and therefore are perishable.

3.2 Stage-Gate

A Stage-Gate approach (stage-gate) in NSD has a dual purpose. It assists service firms in both selecting the most promising projects – doing the rights projects – and bringing new service offerings to market – doing the projects right (Cooper & Edgett, 1999).

Stage-gate can be seen as a roadmap to steer new services from idea to implementation, and beyond. Most often, this roadmap results in a model consisting of five or six stages, in which each stage presents the best-practice activities that should be undertaken to develop proficiently. Gates precede stages; at gate meetings, management makes the go/kill and resource allocation decision. Figure 3 shows a general NSD stage-gate process, which is explained below.

![Stage-gate process for service innovation](image)

**The stages**

During stages, team members from several functional disciplines (i.e. marketing, technical, or financial) perform varying activities in parallel. Each stage is designed to collect information to advance to the subsequent gate.

As resources invested increase, risk is controlled by getting grip on uncertainties associated with the project (Cooper & Edgett, 1999); risk is perceived as an interplay between the amounts at stake and the associated level of uncertainty. Stage-gate is designed to drive uncertainties down along the way of successive stages.

**The gates**

Gates precede stages; gates represent review moments, at which management makes the go/kill and resource allocation decision. Use of gates provides focus in development, prioritizes projects and provides the funnelling effect in NSD management. The structure of each gate is straightforward. Each gate includes the following (Cooper, 2008):

- **Required deliverables**: deliverables are the results of completed activities performed in the previous stage (e.g. business plan, marketing plan). Generally, each gate entails standard deliverables and expectations of the NSD team are made clear.
- **Review criteria**: review criteria usually are used in the form of a checklist that contains must-meet and should-meet criteria; must-meet criteria are used to weed out the misfits and should-meet criteria are used to prioritize promising projects.
- **Output**: each gate yields certain output. A decision is made (go/kill/hold/recycle), followed by an agreed action plan and upcoming deliverables for the subsequent gate.
The gatekeepers

At the gates, gatekeepers decide together about the project. Typically, gatekeepers have the authority to confirm budgets and resources required to proceed with the project. Therefore, usually management constitutes the gate committee. Also, gatekeepers should make part of different functional disciplines, as resources are required from different areas.

In many firms, the composition of the gate committee somewhat changes from gate to gate; as amounts at stake increase, more senior managers or business line executives become gate keepers. However, the composition should not change too radically. This might lead to total restart of assessing the project, which might impair progress made.

3.3 Reviewing NSD success in the marketplace

Success of a new service in the marketplace is rather elusive and subjective. NSD success entails many aspects, as customer acceptance, revenue goals met, or speed to market. The remainder of this Paragraph is structured as follows: first, Paragraph 3.3.1 discusses reviewing tangible NPD success in the marketplace. Then, reviewing NSD success in the marketplace is discussed in Paragraph 3.3.2.

3.3.1 Reviewing new product development success in the marketplace

A firm should determine the type of project or firm strategy situation to be measured and choose its success measures accordingly (Griffin & Page, 1996).

Griffin and Page (1996) show that for several project strategies customer satisfaction and customer acceptance were the most useful customer-based success measures (Appendix D); market share goals was selected as the most useful customer-based success measure for new-to-the-company products or product improvements. Furthermore, the financial success measure of meeting margin goals was only useful for cost reduction projects.

At the program level, firms employing a business strategy of not focusing on innovation should measure efficiency of their product development efforts (i.e. Defenders and Reactors should focus on ROI and fit with strategy). On the other hand, firms being at the forefront of innovative developments need to review their program’s part in company growth (i.e. Prospectors should focus on percentage of profits and sales).

A shortcoming of the study of Griffin and Page (1996) is that the three types of project-level success measures (i.e. customer-based, financial, and technical performance) are treated as equally important to the firm. The question is whether managers treat success measures as equally important or assign a particular weighting to each success measure.

The results of Molina-Castillo and Munuera-Alemán (2009) indicate that managers weigh performance indicators differently, which is crucial in the analysis of NPD performance assessment. Furthermore, a time horizon of NPD success measurement needs to be considered, as managers clearly score their innovative products differently in the short-term and in the long-term. The authors used the stages of the product life cycle (PLC) to define short-term (i.e. introduction and growth) and long-term (i.e. maturity and decline) NPD performance.

3.3.2 Reviewing new service development success in the marketplace

Success measurement of innovative products and services has been widely investigated in tangible product sectors and not much within service industries. Meanwhile, also marketing managers in services acknowledge the importance of assessing performance of their innovative services.

Manion and Cherian (2009) investigated whether strategic types of service marketers (SMs) in financial services (i.e. Prospectors, Defenders, or Analyzers) match the performance indicators they employ to assess NSD performance. Their findings correspond to the results of Griffin and Page
Their study shows that Prospectors value growth performance measures (e.g. future opportunities, new sales) as more important, Defenders value efficiency performance measures (e.g. success rate) as more important than Prospectors, and Analyzers attach more importance to objectives-related performance measures (e.g. strategic fit, management opinion) than Prospectors.

Therefore, Prospectors, Defenders, and “hybrid” Analyzers should base their NSD success measures on the strategy pursued.


Operational performance reflects executional aspects of the project (i.e. adhering to schedule, quality goals) and product performance reflects commercial results of the project (i.e. adhering to profit goals, customer satisfaction); both constructs are mainly based on the performance measures of Griffin and Page (1996).

Their results indicate that operational performance affects product performance positively (Appendix E). This indicates an anticipated positive consequence of managing projects decently. The reverse is also true, which is probably because of a halo-effect related to subjective data. Furthermore, customer satisfaction and competitive advantage add the most to product performance, followed by gained reputation, and adhering to profit and revenue goals. Quality adds the most to operational performance; captured knowledge and adhering to budget follow as second and third. Apparently, adhering to the schedule does not contribute to operational performance.

Research on reviewing NSD performance in the marketplace builds primarily on the results of Griffin and Page (1996). In general, NSD success is multi-faceted and consists of interrelated dimensions as rather financial success (e.g. sales, profit), rather customer-based success (e.g. customer satisfaction, customer loyalty), and rather technical or operational success (e.g. quality of the new service, adhering to budget). A firm should determine the strategic situation to be measured and choose its success measures accordingly.

### 3.4 Reviewing NSD performance per stage of the project

Success criteria determine the way progress is reviewed at gates. In this way, poor performing projects are singled out and killed; only the most promising projects proceed to the next stages (Cooper, 2008). The remainder of this Paragraph is structured as follows: first, Paragraph 3.4.1 discusses the use of success criteria in reviewing tangible NPD performance during development. Then, the use of success criteria in reviewing NSD performance during development is discussed in Paragraph 3.4.2.

#### 3.4.1 Success criteria in new product development gates

In the early 2000s, Hart, Hultink, Tzokas, and Commandeur (2003) and Tzokas, Hultink, and Hart (2004) investigated the use of review criteria to control performance at different review gates in the NPD process.

Hart et al. (2003) investigated which review criteria and which broader defined review dimensions are used most frequently at the different gates. Tzokas et al. (2004) built on this study and investigated both which review gates are perceived as most important for achieving eventual success in the market and how firms use their guideposts at the different gates of their NPD process. The study of Tzokas et al. (2004) is discussed below.
**Review dimensions and review gates**

The review criteria of Tzokas et al. (2004) were grouped in five review dimensions (Table 2). A general NPD process was used that consists of six stages. Table 2 shows the use of review criteria at the different NPD gates; shadowed boxes indicate that criteria are used by more than 50% of the firms in the sample.

**Table 2, Review criteria at the different NPD gates**

<table>
<thead>
<tr>
<th>NPD evaluation gates</th>
<th>Evaluation criteria</th>
<th>Market-based</th>
<th>Financial-based</th>
<th>Product-based</th>
<th>Process-based</th>
<th>Intuition-based</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Customer accepance</td>
<td>Customer satisfaction</td>
<td>Sales objectives</td>
<td>Sales growth</td>
<td>Market share</td>
</tr>
<tr>
<td>Idea screening</td>
<td></td>
<td>49</td>
<td>33</td>
<td>27</td>
<td>29</td>
<td>32</td>
</tr>
<tr>
<td>Concept testing</td>
<td></td>
<td>53</td>
<td>28</td>
<td>14</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Business analysis</td>
<td></td>
<td>31</td>
<td>23</td>
<td>54</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>Product testing</td>
<td></td>
<td>39</td>
<td>37</td>
<td>12</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Test market</td>
<td></td>
<td>70</td>
<td>64</td>
<td>16</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Post-Launch, short term</td>
<td></td>
<td>60</td>
<td>62</td>
<td>49</td>
<td>41</td>
<td>38</td>
</tr>
<tr>
<td>Post-Launch, long term</td>
<td></td>
<td>37</td>
<td>36</td>
<td>44</td>
<td>49</td>
<td>48</td>
</tr>
</tbody>
</table>


After idea screening, technical feasibility, market potential, product uniqueness, and also customer acceptance (not shadowed) are reviewed. It is clear that ideas proceed for further exploration that are technically feasible and attractive for the market. Furthermore, sometimes intuition is used to assess the idea because concrete technical and market information is lacking.

After concept development, the concept is more elaborated and management gathers more concrete information. Then, concept testing is focused at customer acceptance and technical feasibility. After business analysis, management has to decide to commit substantive resources for development and has to choose among other attractive NPD projects. Therefore, management most frequently uses potential sales, margins, market potential, and profit objectives. Clearly, financial criteria are preferred over technical criteria.

After product development, the product is tested and management needs to determine whether the product meets the required specifications. Therefore, product performance, quality, and technical feasibility are reviewed most frequently.

Performance of the test market is reviewed on customer acceptance, customer satisfaction, product performance, and quality. Customers’ reactions to the prototype and its technical performance are assessed.

Expectations of performance are reviewed at the short-term, post-launch gate. To detect problems affecting the product line or even the broader corporate image, especially customer satisfaction, customer acceptance, and sales in units are assessed.

In the long-term, product performance is reviewed on its economic contribution to the company, namely sales and profits. Customers are aware of the product and its technical performance is clear. Still, customer satisfaction is assessed as changes in customers’ expectations can affect their satisfaction.
The above suggests that firms use different review criteria at the different NPD gates, reflecting the specific goals of each stage in order to secure NPD success (Tzokas et al., 2004).

Carbonell-Foulquié, Munuera-Alemán, and Rodríguez-Escudero (2004) also investigated usage and relative importance of several sets of review criteria at four gates in the NPD process. In contrast to Tzokas et al. (2004), a sample of 77 successful and highly innovative products of Spanish manufacturing firms was used. Their findings are in line with Tzokas et al. (2004) and show that strategic fit criteria are most important at the initial screening, technical feasibility is most important at the concept and development gates, and financial performance and customer acceptance criteria gain importance towards launch of the new product (Appendix F).

**Number of review gates and review criteria per gate**

Schmidt et al. (2009) conducted a large study among 425 firms and investigated the number of 1) review gates used, 2) review criteria per gate and the proficiency with which several review criteria are used and compared between incremental and radical NPD projects.

Their findings show that the number of review criteria increases as NPD projects progress. Interestingly, the results show that more review criteria are used to assess incremental NPD projects than radical NPD projects. Review proficiency was also found to be lower for radical NPD projects than for incremental ones. These findings surprise given the high costs and low chances of success of radical innovation. A possible explanation might be that managers doubt about which review criteria to use during radical NPD.

Schmidt et al. (2009) defined NPD performance as improvement of the likelihood of NPD success by reducing NPD uncertainties. Only review proficiency was associated with NPD performance. Specifically, only proficiently reviewing marketing criteria (e.g. customer satisfaction, product advantage) at the initial screen is linked to NPD performance. This contradicts Tzokas et al. (2004), who found that the product and market testing gates were seen as most important for eventual NPD success.

Successfully passing the initial screen can trigger reluctance to kill the project at a later moment in time. This “escalation of commitment” during NPD is harmful since negative feedback is ignored, the faulty project continues, and expensive resources are wasted. Therefore, regardless of the level of innovativeness, reviewing NPD progress is important throughout the whole NPD process.

### 3.4.2 Success criteria in new service development gates

Kelly and Storey (2000) investigated whether service firms generate and screen new service initiatives systematically. Their survey study among leading service firms was conducted in finance, telecommunication, transport and media in the UK. Screening of new service initiatives seems to be performed rather systematically; nearly half of the firms investigated (48%) employs formal screening. Table 3 shows the results of respondents’ answers to “open” questions concerning screening criteria.
Although 74 different criteria were stated, broader review dimensions could be identified. Clearly, financial implications (i.e. costs, likely profit) dominate the screening criteria.

These results are in line with later exploratory research of Aas (2011) in which he found that a minimum of review criteria is used in SI, dominated by financial criteria. The results (Appendix G) indicate that project ideas were screened (i.e. ex-ante) particularly on the basis of financial criteria (e.g. net present value) and/or compliance with business strategy.

Evaluation practices of NSD varied extensively among the firms. Three firms made use of a well-defined stage-gate process; still, all firms evaluated NSD projects. Development review was mostly done by reviewing technical performance, development costs, and meeting deadlines (Aas, 2011). Finally, NSD performance in the marketplace (ex-post) was evaluated by using a very limited number of measures. Especially financial measures were used; potential learning or image effects were not measured.

**3.5 Conclusions**

The literature review is concluded by answering the research questions:

**RQ1** Which review criteria are used by engineering KIBS to provide insights into new service development performance (1) during development and (2) after introduction in the marketplace?

(1) The use (and importance) of review criteria in reviewing NSD performance during development is hardly studied in service industries; this, despite exploratory studies of Storey and Kelly (2000) and Aas (2011) in financial, business, and oil services. Future research should investigate the use (and importance) of review criteria during (whole) development in engineering KIBS.

(2) Blindenbach-Driessen et al. (2010) investigated performance assessment of innovation projects in Dutch engineering and construction firms. Innovation project performance consists of two constructs, labeled as operational performance (i.e. adherence to budget, quality, and captured knowledge) and product performance (i.e. adherence to profit goals, adherence to revenue goals, gained reputation, and customer satisfaction). However, more research is needed to generalize their findings. In general, NSD success is multi-faceted and consists of interrelated dimensions.
RQ2  At which moments during new service development at engineering KIBS are review gates used where is decided to go/kill/hold/recycle the project?

Research in stage-gate has been performed in many service industries and many service firms nowadays use review gates throughout their entire NSD process. However, the use of stage-gate in engineering KIBS has never been studied. Future research should investigate whether stage-gate also benefits NSD practices in engineering KIBS.

3.5.1 Gaps in literature

Two gaps in literature have been identified. Research in stage-gate has been performed in many service industries and many service firms nowadays use review gates throughout their entire NSD process. However, the use of stage-gate in engineering KIBS has never been studied. Future research should investigate whether stage-gate also benefits NSD practices in engineering KIBS.

Second, the use and importance of success criteria in reviewing NSD performance during development in service industries is not clear; this, despite exploratory studies of Storey and Kelly (2000) and Aas (2011) in financial, business, and oil services. Therefore, this is the second identified gap in literature.

Both gaps are addressed in the empirical part of this research.

Proposition of review dimension for (engineering) KIBS

Finally, a review dimension is proposed that is important for reviewing NSD performance during NSD in KIBS. As stated before, KIBS are knowledge-driven and developing new services entails many complementary forms of innovation, requiring the contribution of differing sources of (internal and external) knowledge (e.g. suppliers, clients, or universities) (Amara et al., 2009).

Usually, KIBS are not function-based but projects-based (i.e. organized around projects instead of functional processes). Furthermore, using multidisciplinary teams appeared to negatively affect innovation performance in project-based firms; an explanation might be that these firms need expertise within their innovation teams instead of multidisciplinary collaboration (Blindenbach-Driessen & van den Ende, 2010). Furthermore, in much services, it is rare to find firms producing new knowledge through R&D departments and employing specialized R&D workers and managers (Miles, 2008). Therefore, the following proposition is made:

Reviewing “available expertise” (both internally as well as externally) is important during NSD in KIBS.

This proposition is investigated in the empirical research which is presented in the next Chapter.
4 Empirical research

This Chapter presents the results and findings of the empirical research. The aim of this chapter is to provide information in order to answer RQ3 to RQ5. To provide an answer to RQ3, the results and findings of the case study are presented in Paragraph 4.1. Results and findings of the survey study and the focus group meeting help answering RQ4 and RQ5, presented in Paragraphs 4.2 and 4.3.

4.1 Case study report

This Paragraph presents the results and findings of the case study. First, data collection and sources are described in Paragraph 4.1.1. Then, Paragraphs 4.1.2 to 4.1.6 separately describe the NSD projects and the control during the projects, after which Paragraph 4.1.7 presents general conclusions of the cross-projects analysis and answers RQ3.

The findings of the separate NSD projects are presented by a short, chronological description of the innovation process with its’ activities and persons involved. Then, findings regarding control during development are described. Furthermore, detailed descriptions of the NSD projects are presented in appendix H to appendix L.

4.1.1 Data collection and sources

This Paragraph describes characteristics of data collection and sources. The unit of analysis of this research is the NSD process. The NSD process is examined through including multiple NSD projects into the single case study. The selection of NSD projects was based on the criteria “Implemented vs. killed/put on hold” and “Technological component”.

The selected NSD projects, their classification and their interviewees are presented in Table 4. Control during the project is described on the basis of the four phases of the NSD process at place, namely idea generation, proof of concept, business analysis and implementation.

Table 4, Classification of selected NSD projects

<table>
<thead>
<tr>
<th>NSD project</th>
<th>Implemented vs. killed/put on hold</th>
<th>Interviews</th>
<th>Project role/Discipline interviewee</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>Implemented</td>
<td>√</td>
<td>Marketing/senior advisor/project leader/commercial director In-Situ</td>
</tr>
<tr>
<td>Blue Water Program</td>
<td>Put on hold</td>
<td>√</td>
<td>Technical specialist/senior specialist, marketing/account manager</td>
</tr>
<tr>
<td>MUDTRAP</td>
<td>Implemented</td>
<td>√</td>
<td>Innovator/senior project leader</td>
</tr>
<tr>
<td>AppStore</td>
<td>Killed</td>
<td></td>
<td>Innovator/senior advisor</td>
</tr>
<tr>
<td>Steenmeel</td>
<td>Killed</td>
<td>√</td>
<td>Technical specialist/senior specialist, technical specialist + marketing/senior specialist³</td>
</tr>
</tbody>
</table>

- All interviews took place with a single respondent present;
- All eight interviews were conducted face-to-face (in Dutch);
- The average interview lasted 53 minutes (ranging between 44 and 66 minutes);
- The interviews were recorded and transcribed from tape to text. These transcriptions covered 39 pages (Calibri; 11pt).

Available project documentation was used to confirm and expand the information on control during NSD projects. If necessary, respondents were asked for additional clarification through phone calls and emails. Furthermore, reports of the single projects were sent to informants for their comments.

³ At the time of writing this paper, this senior specialist has left ANL.
There can be concluded that the conditions regarding triangulation - set in the methodology section – are met.

4.1.2 NSD project 1: PFOS

Short description PFOS

In spring 2011, ANL discussed together with Dutch airport Schiphol opportunities to do business together. It became clear that Schiphol had to cope with a major PFOS problem; PFOS is a harmful chemical for the natural environment that is in fire fighting foams and is difficult and expensive to break down.

ARCADIS in England (AENG) developed a technique that is able to break down PFOS and ANL developed this technique further to a commercially viable one. Four multi-disciplinary employees of ANL performed technical and economic feasibility analysis. In a laboratory of ANL, the technique was further developed and after development the multi-disciplinary project team expanded by involving employees from other countries. The goal of the international team was threefold; gaining awareness and financial support of the (international) organization and targeting the major PFOS problem in the right way.

From the start of the project, ANL involved potential customers to identify the scope and stakeholders of the PFOS problem. January 2014, ANL and a German airport agreed to perform a pilot project and finalized matters to start the project. A detailed description of PFOS is presented in Appendix H.

Control during development

Idea generation was skipped as the PFOS project was initiated by a targeted customer demand. Proven technical feasibility of AENG and the existence of the In-Situ remediation team of ANL made that the senior advisor (SA) took on the challenge to convince Schiphol to be able to break down PFOS significantly faster and cheaper than the other engineering firm. Because of a possible project, management assigned budget in order to achieve a suitable solution for Schiphol.

The multi-disciplinary team investigated whether the technique could be commercially applicable and eventually came to a commercially viable solution. Thus, this proof of concept phase was initiated rather quickly and took a few months. The team’s work was managed autonomously; by means of self-control and informal communication with line management the team made progress and reviewed its own work on the basis of technical feasibility and efficiency of the technique. The team was both aiming for a (paid) solution for Schiphol and felt by knowledge and experience in the field of in-situ remediation that the technique had huge market potential. Therefore, the team continued to work on the innovative project.

After it became clear that the project for Schiphol would be postponed indefinitely, the team started to exceed the initial budget and continued to work most of their activities overtime. During business analysis, the international team engaged in informal self-control and communication with line management about progress.

Feedback of Environmental management in the several countries and BD on a marketing plan is a review moment in the process. By rather implicitly reviewing the marketing plan, potential revenues were acknowledged and BD advised to apply for a patent. By winning the (internal) Imagine contest, extra budget was available and by convincing European management of the potential revenues, corresponding budget was granted. Both contents are review moments in the process and budget was granted after a rather implicit review of potential revenues.

In 2013, PFOS started to compete with business projects for the same resources (i.e. available working hours). Project work became too complicated and because of lack of control and mandate, the team asked for management that is allowed to assign resources and budget.
The program director (PD) of the In-Situ soil remediation team became project leader (PL) and implementation and commercialization of the project became more structured. During monthly project review meetings of PLs, progress was reviewed on the basis of development costs and progress made. Before 2013, NSD progress was not structurally reviewed and management never made a clear go/no go decision and did not give authority by allocating budget.

In 2013, progress was reviewed more structurally; consciously waiting for external input made that project work was silent for a while. Figure 4 shows a visual representation of reviewing NSD progress; formal review gates were not present.

![Figure 4, Review of NSD progress of PFOS](image)

### 4.1.3 NSD project 2: Blue Water Program

**Short description Blue Water Program**

In the summer of 2009, ANL started a co-operation with the University of Amsterdam (UvA). The UvA had developed, on a laboratory scale, a method to reduce blue algae (algae) with hydrogen peroxide (HP); the UvA partnered with ANL to scale up their method to a full-scale method.

During a project for the municipality of Veendam (Veendam), ANL started with small experiments in a lake and eventually worked its way to a full-scale solution. By the use of a boat and a specially designed frame, the whole lake was reduced of algae. During 2009, ANL performed two more projects in which it had to reduce algae in a lake.

In 2010, because of the size of the algae problem and three successful projects, two multi-disciplinary team members (Water and Environment) started an innovation initiative, which yielded several commercial possibilities. The team investigated the economic feasibility of two variants they had in mind; performing single treatments or offering a fixed “bathing warranty”, the Blue Water Program.

After market research in 2013, it became clear that offering a fixed guarantee does not have enough market potential. Since the full-scale method with HP works effectively, ANL is still willing to perform single treatments. A detailed description of the Blue Water Program is presented in Appendix I.

**Control during development**

Initial idea generation was performed by the UvA. The SA attending the discussion meeting felt by knowledge and experience in the field of water quality that the idea of the UvA would provide ANL with possibilities for business. Idea generation was reviewed by the SA on the basis of expert judgment.

The project for Veendam was divided into a small-scale experiment and a full-scale experiment; both experiments were reviewed on the basis of the amount of algae reduced, the time of operation,
and the final concentration of HP in the water. In fact, this **proof of concept** phase was reviewed on the basis of technical feasibility.

After two additional experiments, ANL evaluated the algae concept. The concept was proven to be technically feasible. However, limits of applicability had to be more clear (such as, the frequency of HP treatments and its effect on the long-term). One also saw that reducing algae in bathing water generated much media attention from national and local TV channels; simply, because algae is a huge problem for bathing water and the technique reduces it quickly and innovatively. With this evaluation the team evaluated the **proof of concept** phase on the basis of technical feasibility and was stimulated by the gained reputation.

Business analysis was performed intermittently and the conclusion after both times was negative. First, after consultation with management in 2010, the decision was made not to invest in resources needed (e.g. boat, frame) because it was not clear what potential revenues were. Secondly, after market research in 2013 the team drew the conclusion and reported to management that potential revenues are too low. **Business analysis** was reviewed at a clear gate by participative decision making of management and the team; potential revenue was the main criterium. Therefore, the project was put on hold. Figure 5 shows a visual representation of reviewing NSD progress; one review gate was used after business analysis.

Figure 5, Review of NSD progress of the Blue Water Program

4.1.4 NSD project 3: MUDTRAP

**Short description MUDTRAP**

In 2007, a project leader (PL) had an innovative idea about dredging of waterways. Dredging of waterways is performed regularly, which leads to high operation costs and destruction of the soil. The PL started thinking about a system that makes sure that dredging is history. He thought and sketched in a tank construction.

After one year, the PL contacted potential customers (for example, municipalities and water boards) to test their view on the concept. Then, the PL was told that another company was also working on something similar. He contacted this company and they decided to co-operate. Next, a consortium was created of ANL, a builder, and two freelancers; together, the members of the consortium applied for a patent, MUDTRAP®.

In 2010, the team recreated a waterway in a shed in Werkendam and a student performed tests to investigate the efficiency of the MUDTRAP. The team was satisfied with the efficiency (i.e. technical feasibility and operation costs) of the MUDTRAP and proceeded with approaching potential launching-customers.

In 2012, water board Vallei en Eem (V&E) wanted a MUDTRAP to increase its water quality. Subsequently, the consortium installed a MUDTRAP in the water of V&E and agreed to evaluate the MUDTRAP on efficiency in autumn 2013. A detailed description of MUDTRAP is presented in Appendix J.
**Control during development**

In 2007, the PL performed concept development. In April 2008, the PL wrote an investment proposal. Management granted the required budget and the PL continued his work. Thus, *idea generation* was reviewed at a gate by management. In fact, the concept was reviewed on the basis of product advantage, the potential of a patent, and strategic renewal (i.e. the possibility of a new technology).

In 2008 a consortium was created consisting of ANL, a builder, and two freelancers. In September 2009, the four parties of the consortium signed a cooperation contract in which duties and responsibilities were made explicit per consecutive phase. The team agreed to discuss progress quarterly; fixed points of discussion were progress made and actions planned, developments costs of the project, and “go/no go”. Especially during and after the development phase, several “go/no go” moments were planned. In order to proceed to the next phase, all parties involved had to agree in a joint written statement; otherwise, there would be a “no go” decision.

After the tests of the student the team discussed matters and was satisfied with the efficiency of the MUDTRAP. Therefore, the *proof of concept* phase was reviewed at a gate by all parties involved; MUDTRAP was reviewed on technical feasibility and operation costs (i.e. efficiency) and development costs of the project. In May 2011, the team wrote a business plan for further elaboration of the MUDTRAP®; it was clear what the revenue model could be, but market potential was still unclear. *Business analysis* was reviewed at quarterly gate meetings on the basis of progress made, actions planned and development costs.

Implementation was executed at the end of 2012 in the water of V&E. It was agreed to evaluate the MUDTRAP one year later on efficiency, in autumn 2013. Also, during and after the implementation phase, the team discussed progress quarterly. In fact, *implementation* at V&E and the introduction of the MUDTRAP in the market were reviewed. Fixed points of discussion were workload of the different parties, market success of MUDTRAP, project costs and expected investments, and “go/no go”.

Important to note is that the PL never had to be accountable to management for the MUDTRAP project, probably because clear agreements were made with the consortium. Also, the PL’s function within ANL is partly to create new business opportunities by innovation; over the years, he has proven his ability to innovate and to create value for the organization. Figure 6 shows a visual representation of review criteria used during the project phases and after introduction in the market; the project proceeded through the use of “go/no go” gates.

![Figure 6](image-url)
4.1.5  NSD project 4: AppStore

Short description AppStore

In 2012, a SA was told that many small and medium enterprises (SMEs) have difficulties with risk of dust explosions. To control these risks, firms must satisfy certain guidelines (i.e. compliancy). Firms have to demonstrate that they are compliant and ANL consults firms about compliancy.

The SA combined the recent dust explosions with ANL’s market position and developed a new service concept; an online platform for SMEs having difficulties with compliancy. The AppStore should be a platform with access to tools and applications developed by ANL, offering quick compliancy scans to SMEs.

In autumn 2012, a specific innovation program was started within Environment and The AppStore concept was given the opportunity to be developed. In December 2012, the SA initiated market research to test the view on the concept of potential customers. A market research agency started calling the potential SMEs. Because of the upcoming Holidays, not much response was generated. It became clear that SMEs were not interested in the concept. Therefore, in February 2013, the SA decided with management to kill the project. A detailed description of AppStore is presented in Appendix K.

Control during development

In August 2012, the SA performed concept development and wrote an innovation proposal to the director of Environment. Subsequently, the AppStore concept was given the opportunity to be developed within the new innovation program at Environment. Thus, idea generation was reviewed at a gate by management. In fact, the concept was reviewed on the basis of strategic renewal (i.e. potential new market segment) and intuition. Furthermore, the SA had a good view of activities to undertake. The SA did not worry about technical feasibility of the AppStore. Therefore, the proof of concept phase was not performed.

Biweekly, the SA had planned meetings with the Innovation Team member of Environment. During these meetings, they discussed progress made and possible next actions. Then, the SA initiated market research to test the view on the concept of potential customers.

In January 2013, the SA and the Innovation Team member decided to kill the project. The project was killed on the basis of product advantage (i.e. low value proposition) and strategic fit of Environment (i.e. focus on multinational clients).

A few weeks later, during a last session of the innovation program, the SA presented her project to the director of Environment and again was decided to kill the project. Therefore, business analysis was killed at gate a by consultation between management and the SA. Figure 7 shows a visual representation of reviewing NSD progress; the project proceeded and was killed through the use of “go/no go” gates.

Figure 7, Review of NSD progress of AppStore
4.1.6 NSD project 5: Steenmeel

**Short description Steenmeel**

End 2008, two technical specialists (TSs) at Environment started an innovation initiative and brainstormed about minerals to improve soil quality. The two TSs thought of the mineral rock dust. Scientific research showed that rock dust captures carbon dioxide and works as a nutrient supplier. The need for fertilizer would be reduced, making agriculture more sustainable. The TSs saw possible market potential and got offered time to continue research.

In order to investigate practical applicability, a pilot project started, subsidized by the Province of Utrecht. Furthermore, the team contacted the market (e.g. governments, universities, news media, potential partners) to create awareness and discuss business opportunities. Therefore, ANL agreed with Norwegian Nordic Mining about supply of certain minerals and cooperation on the “project” and signed a cooperation contract with Ankerpoort, another mineral supplier.

In 2010 and 2011, several research projects were performed in which the practical feasibility of the rock dust concept was further elaborated. In November 2011, a large research project started, named SUPERSOILS. Researchers from several universities and one TS (ANL) further investigated the rock dust concept, supported by the government and several companies.

Begin 2012, disagreements about future directions made that the cooperation between ANL and Ankerpoort ended. Despite growing interest, few revenues were made on all development efforts. Therefore, management of Environment decided in Summer 2012 to kill its share in all initiatives concerning rock dust. A detailed description of Steenmeel is presented in Appendix L.

**Control during development**

End 2008, TSs of ANL knew that agricultural revenues and soil quality declined and the market asked for more sustainable agriculture. Two TSs were brainstorming about the use of the mineral rock dust. The two TSs saw possible market potential and got offered time to perform research. Therefore, this idea generation phase was reviewed by participative decision making of management and the team; based on expert judgment and strategic renewal (i.e. the possibility of a new market) innovation efforts continued.

The proof of concept phase started in 2009. The two TSs performed small in-house experiments. Furthermore, several research projects would start that investigated the practical feasibility of the rock dust concept. Therefore, the proof of concept was reviewed continuously on the basis of technical feasibility. During quarterly internal meetings the team discussed and evaluated progress made and actions planned. Business line and market group management was informed continuously and sometimes participated in activities and/or decision-making.

In December 2010, ANL and Ankerpoort signed a cooperation contract in which both parties aimed to cooperate in further investigating practical and economic feasibility. Duties and responsibilities were made explicit, even as goals and deliverables. The feasibility study was divided into four phases, each phase followed by a “go/no go”. In August 2011, both parties decided “go” and continued the feasibility study. This decision was based on progress made and actions planned.

Begin 2012, disagreements about future directions made that the cooperation between ANL and Ankerpoort ended. In Summer 2012, management of Environment decided to kill its share in all initiatives concerning rock dust; the main criterion to stop was too few revenues generated and little prospects in the short-term. Furthermore, a strategic shift to not concentrate on the market of soccer fields (interest in rock dust) anymore, made that all initiatives had to be killed. Therefore, also business analysis was reviewed continuously on the basis of progress made, actions planned, and eventually potential revenues.

Figure 8 shows a visual representation of reviewing NSD progress; proof of concept and business analysis were performed in parallel. Furthermore, business analysis was reviewed continuously using
“go/no go gates”. The project proceeded by informing management continuously and was killed through the use of a “go/no go” gate after business analysis.

![Figure 8, Review of NSD progress of Steenmeel](image)

### 4.1.7 Cross-project analysis

This Paragraph presents the cross-project analysis concerning control during the investigated NSD projects. The findings of the cross-projects analysis help answering the research question:

**RQ3**  *How and why is control of new service development projects organized in the current way?*

First, the review of NSD progress during development is presented. Second, measurement of NSD success in the marketplace is described.

**Review of NSD progress during development**

Table 5 shows the cross-projects review of NSD progress during development. These results show that NSD projects start because of varying reasons and are reviewed on varying aspects after idea generation. As earlier research suggests, NSD projects are reviewed according to their strategic situation (Mansion & Cherian, 2009). For example, PFOS started because of targeted customer demand but AppStore started because of the potential of a new market.

Notably, the data in Table 5 are not all-encompassing which means that some reviewed aspects are unmentioned. Furthermore, review of NSD progress during development is performed more implicitly than on the basis of explicit review criteria.

After the proof of concept, mainly technical feasibility of the developed technical concept is reviewed. Dependent on the concept, the proof of concept entails small-scale lab tests and/or full-scale tests in practice. For PFOS, the proof of concept phase encompassed small-scale lab tests but for the Blue Water Program, the proof of concept phase encompassed a small-scale and full-scale experiment in a lake.

After business analysis, potential revenues are most important to review. At that stage, technical feasibility is clear and finances are important (i.e. potential revenue, development costs). Because of long development times, reviewing strategic fit is also important at this stage.
Table 5, Cross-project review of NSD progress during development

<table>
<thead>
<tr>
<th>Phase + gate?</th>
<th>PFOS</th>
<th>Blue Water Program</th>
<th>MUDTRAP</th>
<th>AppStore</th>
<th>Steenmeel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea generation</td>
<td>Targeted customer demand</td>
<td>Expert judgment</td>
<td>Product advantage</td>
<td>Strategic renewal</td>
<td>Expert judgment</td>
</tr>
<tr>
<td>Gate review?</td>
<td>no</td>
<td>no</td>
<td>yes (internal)</td>
<td>yes (internal)</td>
<td>no</td>
</tr>
<tr>
<td>Proof of Concept</td>
<td>Technical feasibility</td>
<td>Technical feasibility</td>
<td>Technical feasibility</td>
<td>Development costs</td>
<td>Technical feasibility</td>
</tr>
<tr>
<td>Gate review?</td>
<td>no</td>
<td>no</td>
<td>yes (internal)</td>
<td>-</td>
<td>no</td>
</tr>
<tr>
<td>Business Analysis</td>
<td>Potential revenue</td>
<td>Potential revenue</td>
<td>Development costs</td>
<td>Product advantage</td>
<td>Potential revenue</td>
</tr>
<tr>
<td>Gate review?</td>
<td>no</td>
<td>yes (internal)</td>
<td>yes (external)</td>
<td>yes (internal)</td>
<td>yes (external and internal)</td>
</tr>
</tbody>
</table>

From the project data it becomes apparent that review gates are exception rather than rule during NSD. Team members experience a lot of freedom in their innovation efforts and hardly have to achieve certain objectives for management. However, management granting budget for development efforts is a review gate in the process. Interestingly, AppStore was subjected to two review gates. However, this project was included in a specific innovation program.

When cooperating with external parties, a formal stage-gate approach is used and duties and responsibilities are made explicit; during MUDTRAP, certain review aspects were even made explicit on paper.

The fact that ANL is a project-based organization and not an organization that develops and sells tangible products makes that control of NSD is organized in the current way.

Measurement of NSD success in the marketplace

Table 6 shows the cross-project review of NSD success in the marketplace. Reviewing NSD success occurs rather implicitly and no explicit review measures are defined. However, review of implementation and short-term market success of MUDTRAP are made explicit in the cooperation contract.

Financial aspects as development costs, expected investments, and (financial) market success seem important aspects in reviewing NSD short-term success. Investments might be needed as technical applicability turns out to be different than expected. Therefore, efficiency of operation in practice is also reviewed. Review of long-term NSD success is not investigated in the case study. At ANL, there is no system in place that measures NSD success in the marketplace; measuring long-term success is gathered under regular business review.

Table 6, Cross-project review of NSD success in the marketplace

<table>
<thead>
<tr>
<th>Phase\NSD project</th>
<th>PFOS</th>
<th>MUDTRAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation</td>
<td>Development costs</td>
<td>Efficiency of operation</td>
</tr>
<tr>
<td>short-term</td>
<td>Progress made</td>
<td>Workload different parties</td>
</tr>
<tr>
<td>performance</td>
<td></td>
<td>Market success MUDTRAP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project costs, expected investments</td>
</tr>
</tbody>
</table>
4.2 Survey study

The survey was used to investigate what the review practices should be. The results from the survey served as input for the focus group meeting. First, the survey is described in Paragraph 4.2.1. The sample and data collection are described in Paragraph 4.2.2. Finally, the results are presented in Paragraph 4.2.3.

4.2.1 Survey

Review criteria during development

To investigate the use of review criteria during development, the survey made use of criteria used in several articles investigating the use of review criteria during development (Storey & Kelly, 2001; Tzokas et al., 2004; Schmidt et al., 2009; Blindenbach-Driessen et al., 2010; Martinsuo & Poskela, 2011). The articles were combined and the total number of review criteria resulted in 21, grouped into six dimensions.

Blindenbach-Driessen et al. (2010) found in their research on performance assessment of innovation projects that the use of market share as a criterion is inapplicable in the engineering and construction industry. Therefore, the measure market growth was dropped. The strategy-based dimension was taken from Martinsuo and Poskela (2011).

In order to increase the practicability of the survey and to maximize the chance that respondents really consider review criteria, the most important review criteria were grouped into categories. To enhance reliability, two innovators at ANL and two Innovation Management (IM) students were asked to group the most important review criteria out of the initial 21. Criteria were included that were chosen by at least two people. When a criterion was selected once, the researcher used knowledge of the organization to decide about inclusion. The results of the grouping task are presented in Table 7.

Table 7, Dimensions of review criteria after the grouping task

<table>
<thead>
<tr>
<th>Financial</th>
<th>Marketing</th>
<th>Technical</th>
<th>Intuition</th>
<th>Strategic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit objectives</td>
<td>Cost within budget</td>
<td>Total financial resources</td>
<td>Synergy with firm's strategy</td>
<td>Brand image</td>
</tr>
<tr>
<td>Time-to-market</td>
<td>Customer acceptance</td>
<td>Technical feasibility</td>
<td>Innovation</td>
<td>Innovation strategy</td>
</tr>
</tbody>
</table>

Review measures after implementation of new service

To investigate the use of review measures to review NSD success, the survey made use of measures used in several articles investigating the use of review measures after implementation (Griffin & Page, 1996; Storey & Kelly, 2001; Molina-Castillo & Munuera-Alemán, 2009). The articles were combined and the total number of review measures resulted in 22, grouped into four dimensions.

Following Molina-Castillo and Munuera-Alemán (2009), NSD success was measured in the short-term and in the long-term. Short-term was defined as the introduction and growth phases of the product life cycle (PLC) and long-term was defined as the maturity and decline phases of the PLC. Also here, two innovators at ANL and two IM students were asked to perform the grouping task. The results of the grouping task are presented in Table 8.
Innovation process model

The process model used in the survey is inspired by the NSD process of ANL and process models used by Schmidt et al. (2009), Alam and Chad (2002) and Wilson et al. (2012). This general innovation process consists of the phases idea generation, concept development and testing, business analysis and implementation.

NSD scenario

Respondents were put in a NSD scenario in which they were responsible for reviewing a NSD project. Many NSD at ANL involves development of technological components. The case study made clear that ANL engages in open innovation and involves many parties (e.g. potential customers, suppliers, governments) in its NSD efforts. Development of a technological component and the open character of NSD were used to define the “type” of NSD scenario.

Respondents had to indicate 1) which review dimension they use at which moment in the NSD project and 2) whether they use a review gate. Furthermore, respondents had to consider which review dimensions they thought “would provide the best insights into 1) potential success (during NSD) and 2) short-term and long-term performance of the launched service (after implementation)”.

Respondents had to indicate relative usefulness of review dimensions by allocating percentages (adding up to 100%) across their selections; they were free in choosing the amount of dimensions. Furthermore, respondents could explain their choices in a few words. The survey also collected demographic data about the respondents. The survey (in Dutch) is attached in Appendix C.

4.2.2 Sample and data collection

The sample was purposefully selected from a list of organization members that proved to be involved in innovation activities; it was expected that knowledgeable respondents would generate most useful data. A random sampling plan to find knowledgeable respondents seemed less feasible (Griffin & Page, 1996).

Employees were selected from the list that work in Environment. Furthermore, all interviewees from the case study were included in the sample. Since many NSD projects are cross-disciplinary, some employees initially work for another business line (mostly Water). A total of 42 innovators was chosen for the present sample.

The survey was sent by e-mail to the selected innovators. The mailing contained a short introduction of the research and the survey. The survey could be filled in digitally. A first and second reminder were sent respectively one and two weeks after the first mail. Finally, the mailings resulted in 15 returned surveys. Of these 15 returned surveys, 12 usable surveys were obtained resulting in a

---

4 Respondents were free to choose the amount of useful dimensions, ranging from one to five dimensions (during the NSD project). When fewer than five dimensions were chosen by a respondent, allocations provided were adapted by multiplying the assigned score by an allocation factor “number of dimensions chosen over five”. In this way, the average allocation per dimension was 20%, regardless of the number of chosen dimensions. The same principle holds for allocations concerning reviewing after implementation (four dimensions).
usable response rate of 28.6%. This response rate is consistent with previous studies on reviewing innovation success (Tzokas et al., 2004; Mansion & Cherian, 2009).

Demographic information about the sample is presented in Table 9. Although the majority of the respondents was involved in no more than five NSD projects the last three years, three respondents indicated that they were involved in ten NSD projects. One respondent, a project leader and innovation manager, indicated that he was involved in 30 NSD projects the last three years. It has to be noted that there is no single definition of innovation at ANL and NSD projects can vary in terms of magnitude and time. The innovation manager’s survey results did not differ significantly from the others. Furthermore, most respondents were senior advisor or senior specialist and most respondents were between 40 and 50 years old. Results hardly differ across different functions or ages.

4.2.3 Survey results

This Paragraph presents the results of the survey study. First, the use of review dimensions during development is described. Then, the use of review measures to review NSD success is described.

Review dimensions during development

The data in Table 10 shows the average usefulness of review dimensions for each evaluation moment (EM) and the decision about a gate, a formal “go/no go”.

The results suggest that the strategic and marketing review dimensions are most useful in reviewing potential NSD success after idea generation. No statistically significant differences between review dimensions are present.

Respondents explained that an idea should fit business strategy and it has to be clear whether the market is interested. It is preferred to involve a customer who is willing to co-finance development efforts. Furthermore, the idea or concept should be technically feasible. However, an expert judgment should be sufficient at this stage. Subsequently, innovators seem to want to formally decide about go/no go of the NSD projects.

Reviewing concept development and testing entails clearer differences in relative usefulness of review dimensions. The financial review dimension is seen as the most useful, followed by the marketing and technical review dimensions. At this second EM, these review dimensions are statistically significantly more useful than reviewing on the basis of strategic criteria or intuition. Respondents explained that the developed and tested concept should be reviewed on potential revenues, acceptance by customers, and technical feasibility.
Interestingly, one respondent stated that the strategic dimension already is reviewed after idea generation but still has to be reviewed during development. This finding is in line with reviewing strategic fit during NSD, described in the case study report. Subsequently, innovators seem to want to formally decide about go/no go of the NSD project.

Table 10, Review dimensions during development: Average usefulness of review dimensions for each evaluation moment and decision about formal “go/no go” (n = 12)

<table>
<thead>
<tr>
<th>Type of criteria \ evaluation moment (EM)</th>
<th>EM1 (idea generation)</th>
<th>EM2 (concept development and testing)</th>
<th>EM3 (business analysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial dimension</td>
<td>14,17</td>
<td>24,08</td>
<td>27,25</td>
</tr>
<tr>
<td>Marketing dimension</td>
<td>20,67</td>
<td>20,5</td>
<td>19,83</td>
</tr>
<tr>
<td>Technical dimension</td>
<td>13,75</td>
<td>19</td>
<td>17,08</td>
</tr>
<tr>
<td>Intuition</td>
<td>14,92</td>
<td>5,42</td>
<td>0,83</td>
</tr>
<tr>
<td>Strategic dimension</td>
<td>21,5</td>
<td>9,33</td>
<td>8,33</td>
</tr>
<tr>
<td>Gate (formal Go/No Go)</td>
<td>yes (66,67%)</td>
<td>yes (83,33%)</td>
<td>yes (91,67%)</td>
</tr>
<tr>
<td></td>
<td>no (33,33%)</td>
<td>no (16,67%)</td>
<td>no (8,33%)</td>
</tr>
</tbody>
</table>

Note: The numbers in this table are the average allocation of percentages apportioned to the review dimension for each evaluation moment. Review dimensions in bold indicate the review dimensions with statistically significantly higher usefulness than the not bold ones (t-test, p < 0,05); between the review dimensions in bold themselves are no statistically significantly differences.

At reviewing business analysis, differences in relative usefulness are more crystallized. The financial review dimension is seen as most useful, followed by the marketing and technical review dimensions. However, financial criteria are even more useful to review potential NSD success than before. Also here, these review dimensions are statistically significantly more useful than reviewing on the basis of strategic criteria or intuition.

Respondents explained that the business case has to be promising; potential revenues are important, potential customers have to accept the new service/product and it should be technically feasible and efficiently for both the customer and ANL.

Review measures after implementation of the new service
The data in Table 11 shows the average usefulness of review dimensions for each term. The results suggest that reviewing customer-based performance is by far the most useful in the short-term. Although the other three dimensions are less useful, no significant differences between usefulness of dimensions are present.

Respondents explained that the number and interest of customers are important aspects of NSD performance. Also, (future) market potential has to be clear; financial performance is subordinate in the short-term, but especially during these times of economic crisis short-term revenues are important.

Three respondents did not consider technical performance as useful. However, some respondents explained that technical performance like meeting functionality or compliancy specifications has to be reviewed in the short-term.

In the long-term, financial and customer-based performance are considered most useful. These review dimensions are statistically significantly more useful than reviewing technical and internal performance. In fact, technical issues should be solved by then. In the long-term, financial performance is considered most important.

Respondents explained that generated and future revenues are important. Successful revenues are generated when customers are satisfied about the new service/product. Furthermore, customers’ expectations should be managed in order to prolong the lifetime of the service, predict future investments, or cross-sell other services.
Table 11, Review measures after implementation of the new service: Average usefulness of review dimensions for each timespan (n = 12)

<table>
<thead>
<tr>
<th>Type of measures \ term</th>
<th>Short-term (introduction and growth)</th>
<th>Long-term (maturity and decline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial performance</td>
<td>21.56</td>
<td>34.58</td>
</tr>
<tr>
<td>Customer-based performance</td>
<td>30.83</td>
<td>28.75</td>
</tr>
<tr>
<td>Technical performance</td>
<td>18.33</td>
<td>10.42</td>
</tr>
<tr>
<td>Internal performance</td>
<td>16.77</td>
<td>15.83</td>
</tr>
</tbody>
</table>

*Note:* The numbers in this table are the average allocation of percentages apportioned to the review dimension for each term. Review dimensions in bold indicate the review dimensions with statistically significantly higher usefulness than the not bold ones (t-test, p < 0.05). Customer-based performance was statistically significantly more useful than technical and internal performance, but not than financial performance. Between the review dimensions in bold themselves are no statistically significantly differences.

The results from the survey study served as input for the focus group meeting. The results indicate that financial, marketing, and technical criteria are considered more useful than strategic criteria and intuition for reviewing potential NSD success at gate two and three. Also, financial and customer-based performance are considered most useful for measuring NSD performance.

Following the development approach (van Aken et al., 2007), the focus of the focus group meeting is enhanced by using only the statistically significantly more useful review dimensions as input. The next Paragraph presents the findings of the focus group meeting.

### 4.3 Focus group meeting

The focus group meeting was used to reach consensus within the organization about the review practices under consideration. Results from the survey served as input for the focus group meeting. During the focus group meeting, the task of the focus group panel was to indicate both preferred review criteria across the most important review dimensions and how eventual review gates should be employed in the organization.

The focus group panel indicated preferred review practices EM. The EMs of the survey were adapted and four EMs were considered; the three EMs during the NSD project and NSD performance in the market (both short-term and long-term success). As stated before, in order to enhance the focus of the focus group meeting, only statistically significantly more useful review dimensions served as input for the relevant EMs. Because at EM1 and at the short-term after implementation no statistically significantly differences between review dimensions were present all review dimensions were used.

Furthermore, a “type” of NSD scenario was defined. The participants had to focus on a NSD scenario in which a technological component has to be developed and tested in practice and NSD involves both innovators across business lines as well as third parties. Furthermore, the innovation team has to aim for a launching customer.

The composition of the focus group panel and data collection during the focus group meeting are described in Paragraph 4.3.1. Then, the findings of the focus group meeting are presented in Paragraph 4.3.2.

#### 4.3.1 Composition focus group panel and data collection

The aim was to form a focus group panel (group) of six to eight participants. It was intended that the group would consist of SAs and line management involved in NSD, (a) team member(s) of the Innovation Team, the new business manager of BD, and the financial director of ANL. In this way, group size permits constructive discussion and group composition provides for sufficient heterogeneity to reach consensus.
Due to urgent core business, the group eventually consisted of four participants, namely a SA (involved in the PFOS project), a line manager (project leader during commercialization of PFOS), the NBM and the financial director of ANL (involved in three NSD projects the last three years). The smaller group size lowered reliability of the findings but due to time and organizational constraints the focus group meeting proceeded with these four participants.

Following a topical guide, the researcher steered the meeting to make sure that all relevant aspects were treated. The meeting started with an introductory presentation of the research and organization of the meeting itself. To guide the meeting, the researcher also presented some suggestions of review criteria and interpretation of gates, based on findings from literature and the case study. Therefore, reviewing of “right knowledge in the team”, “right personalities for the tasks at hand”, and “right external parties involved” were suggested, as using “self managed gates” or “virtual gates”. Subsequently, the group indicated preferred review practices per EM.

For each EM, the group received five minutes time to indicate preferred review practices. On printed posters, participants had to indicate preferred review criteria across the several review dimensions. Based on former research each participant had to indicate four review criteria across the several review dimensions (Hart et al., 2003; Aas, 2011). Furthermore, insightful explanations of respondents of the survey were shown to focus the review practices on the specific research context (NSD at ANL).

Although the survey results favor the use of review gates, again participants had to indicate whether a review gate should be used and how eventual review gates should be employed in the organization. Furthermore, the group was allowed to write down additional review criteria. Appendix M shows the poster of EM1 (the posters of EM2 and EM3 have the same design) and Appendix N shows the poster of NSD performance in the market; both are written in Dutch.

The researcher instructed the participants to not discuss during this “first round”. After each poster, the researcher handed the next poster to the group and analyzed the former poster to steer the discussion afterwards. After all EMs were considered, each EM was discussed by the group for 10 minutes. The researcher steered the discussion to make sure that all relevant information was discussed and consensus was reached.

Next, Paragraph 4.3.2 presents the findings of the focus group meeting.

4.3.2 Findings focus group meeting

This Paragraph presents the findings of the focus group meeting. Furthermore, the following research question is answered:

RQ5  At which moments during new service development should review gates be used where is decided to go/kill/hold/recycle the project?

RQ4 is answered after the validation. Figure 9 presents the selected review criteria to review NSD progress during development and Figure 10 presents the selected review measures to measure NSD success in the marketplace.

After discussing review practices at each EM, single review criteria/measures had certain scores (i.e. ranging from zero to four times selected), additional review criteria/measures were discussed, and consensus was reached about the use of criteria, measures, and gates.

All participants agreed that a review gate at each EM during development should be used. Therefore, each NSD phase will be followed by a review gate. Participants agreed that the gate committee should consist of management having dominant interest, management not having dominant interest, and BD. In this way, RQ5 is answered. Subsequently, review criteria had to be selected. Review criteria that were indicated at least twice by the participants were selected.
In order to identify general key performance indicators (KPIs) for NSD, the results of the focus group meeting were discussed with a financial engineer. In general, ANL aims for a break-even time of three years; ANL generally aims to be profitable within three years. Therefore, this KPI was included in the conceptual design. However, no other KPIs could be identified. Furthermore, “chance to be the first to market” at the second gate (indicated once by participants) was selected. It once happened that ANL was developing a new service and it became clear that another company was already launching the same service; reviewing this criterion during future NSD projects can prevent this situation.

Also, the name of the first stage (“idea generation”) was changed to “concept development” since the initial idea already has been generated and concept development better suits activities performed. Next, possible absence of certain review criteria at gates (where they might belong) was discussed with the NBM. The selected review criteria to review NSD progress during development (Figure 9) are discussed below.

<table>
<thead>
<tr>
<th>Review criteria</th>
<th>Financial</th>
<th>Marketing</th>
<th>Intuition</th>
<th>Technical</th>
<th>Strategic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected revenue/Revenue objectives</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Break-even time</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer acceptance</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chance to be first to market</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intuition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Technical feasibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Synergy with firm’s technical resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Fit with firm’s strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Strategic renewal (e.g. feasibility of new product platforms, new technology)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Value proposition to customer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>People involved in the NSD project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Partnerships/launching customers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Internal acceptance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Impact on society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Figure 9, Selected review criteria to review NSD progress during development

At gate 1, the review criteria “expected revenue”, “fit with firm’s strategy”, “strategic renewal”, “customer acceptance”, and “intuition” were selected. Furthermore, deciding about go/no go based on intuition is considered an “expert judgment”; an expert judgment that combines intuition with knowledge and experience about the market and technology. Additionally, participants indicated that a clear value proposition is important to proceed to the next phase. A clear value proposition and fit with firm’s strategy stay important throughout the whole NSD process.

At gate 2, “revenue objectives”, “break-even time”, “customer acceptance”, “technical feasibility”, and “synergy with firm’s technical resources” were selected. Additionally, participants indicated that reviewing whether the right people are involved concerning expertise and/or tasks to be done is important. Furthermore, internal acceptance within the company (“dealing with non-believers”) should be reviewed.

At gate 3, “revenue objectives”, “break-even time”, “customer acceptance”, and “technical feasibility” were selected. Additionally, participants indicated that reviewing if and whether the right partnerships or launching customers are involved is important. Reviewing for both the right people involved and internal acceptance is also important at gate 3.

NSD projects at ANL have to cope with many and sometimes conflicting societal interests, as during NSD of the Blue Water Program: in many cases, algae make an environmental and societal problem but no real economic problem. Therefore, hardly any organization feels the urge and
responsibility to finance the algae remediation. Hence, reviewing business analysis on impact on society is important.

The selected review measures to measure NSD success in the market (Figure 10) are discussed below.

<table>
<thead>
<tr>
<th>Review measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
</tr>
<tr>
<td>Return on investment (ROI)</td>
</tr>
<tr>
<td>Met profit goals</td>
</tr>
<tr>
<td>Number of new customers</td>
</tr>
<tr>
<td>Competitiveness</td>
</tr>
<tr>
<td>Future potential</td>
</tr>
</tbody>
</table>

**Short-term** X X X X X X X X X X
**Long-term** X X X X X X X X X X X

Figure 10, Selected review measures to measure NSD success in the marketplace

For the short-term, the review measures “return on investment (ROI)”, “customer acceptance”, “number of new customers”, “future potential” and “strategic fit” were selected. Additionally, participants indicated that internal marketing of the new service is important to increase applicability of the new service and expand its volume. Internal acceptance within the organization facilitates this process. Furthermore, NSD success enhances the innovative image of the company. Therefore, “innovative image” was included as review measure in the short-term.

For the long-term, the review measures “met profit goals”, “ROI”, “number of new customers”, and “competitiveness” were selected. Additionally, participants indicated that whether and how the lifecycle of the service can be prolonged has to be reviewed. In this way, future investments or hirings can be planned.

Consensus was reached about which review criteria and review measures to use that provide insights into performance of NSD during development and after introduction in the marketplace. Therefore, the conceptual design of review gates and review criteria includes the selected review criteria of Figure 9.

The next Chapter presents the findings of the validation of the conceptual design of review gates and review criteria.
5 Validation

Validation was performed to investigate whether the conceptual design of review gates and review criteria performs its task; proceeding promising NSD projects and killing unpromising ones. The conceptual design was validated by interviewing innovators involved in former NSD projects.

First, the conceptual design is presented in Paragraph 5.1. Second, the selected NSD projects and data collection are described in Paragraph 5.2. Third, the findings of the validation are presented in Paragraph 5.3.

5.1 Conceptual design

Validation was performed to investigate whether the conceptual design performs its task; proceeding promising NSD projects and killing unpromising ones. Hence, the conceptual design focuses only on the stage-gate model and its review criteria and not on the review measures to measure NSD success in the market.

Usually, review criteria are used in the form of a checklist that contains must-meet and should-meet criteria; must-meet criteria are used to weed out the misfits and should-meet criteria are used to prioritize promising projects (Cooper, 2008). Therefore, if a NSD project does not meet the must-meet criteria, it is killed immediately. In order to prioritize NSD projects and to benchmark NSD performance, should-meet criteria are scored; review scores are added weighted or unweighted. A score of 60/100 is usually required to proceed to the next stage (Cooper, 2008).

The conceptual design consists of review gates accompanied by must-meet criteria and should-meet criteria that should be scored; the cumulative, unweighted scores of should-meet criteria should score at least 60/100 to proceed to the next stage.

Figure 11 shows the conceptual design of gate 1 (in Dutch). The review criteria of gate 1 (Figure 9) are used.

Since AppStore and Steenmeel were killed because of no strategic fit, “fit with firm’s strategy” is a must-meet criterion. No other must-meet criteria are defined for this gate.

The other review criteria of gate 1 are should-meet criteria (0 – 10 scales). Also, “customer acceptance” is changed into “client need”, since ANL usually aims for clear “problem-solving” innovations, and “intuition” is changed into “expert judgment”.

A NSD project that fits with the firm’s strategy should at least meet a score of 30/50 (relatively 60/100) to proceed to the proof of concept stage. Furthermore, the conceptual design specified the gate committee (i.e. management having dominant interest, management not having dominant interest, and BD) and the gate deliverable (i.e. development budget form).

The conceptual designs of gate 2 and gate 3 are similar. Next to fit with firm’s strategy, the must-meet criteria at gate 2 are “technical feasibility” and “break-even time”. When a new product or service is not technically feasible, NSD is killed. Furthermore, a new service should be profitable within three years. At this gate, innovators already have some understanding about market potential. Therefore, a break-even time of three years is a must-meet criterion at gate 2.

The remaining criteria at gate 2 (Figure 14) are should-meet criteria; a NSD project that passes the must-meet criteria, should at least score 45/70 to proceed to business analysis.

At gate 3, before implementation, the must-meet criteria of gate 2 still hold. Furthermore, “partnerships / launching customer(s)” is also a must-meet criterion. A NSD initiative must have a launching-customer willing to perform a pilot project in order to proceed to implementation. Again, the remaining criteria are should-meet criteria and a NSD project that wants to proceed to implementation has to score at least 36/60.
Toetsingscriteria

**Must-meet criteria:**

<table>
<thead>
<tr>
<th>Criterium</th>
<th>Score (0-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategische vernieuwing (kans op nieuwe markt, nieuw product platforms, nieuwe technologie)</td>
<td></td>
</tr>
<tr>
<td>&quot;Client need&quot; (product probleem/reason to buy)</td>
<td></td>
</tr>
<tr>
<td>Waarde propositie voor de klant</td>
<td></td>
</tr>
<tr>
<td>Schatting van de opbrengst</td>
<td></td>
</tr>
<tr>
<td>&quot;Expert judgment&quot; (op basis van kennis/ervaring met markt en technologie)</td>
<td></td>
</tr>
</tbody>
</table>

N.B. De project aantrekkelijkheidsscore wordt bepaald door de ongewogen optelling van de afzonderlijke scores. Een score van 30/50 is doorgaans vereist voor een go-beslissing.

5.2 NSD projects and data collection

The conceptual design was validated by running former NSD projects through the conceptual design of review gates with their review criteria. As the task of the conceptual design is to proceed promising NSD projects and kill unpromising ones, both successful and unsuccessful NSD projects were included in the validation.

Because NSD at ANL entails activities with many (third) parties and can continue for several years, the process can be rather chaotic. In order to navigate the innovator in interpreting the review practices in the right way, only investigated and known NSD projects are included in the validation. Furthermore, NSD projects had to be used that are in line with the NSD scenario of the survey and the focus group (i.e. development of technological component, open innovation, aiming for launching customer). Therefore, PFOS (successful), Blue Water Program (on hold/unsuccessful), and MUDTRAP (successful) are used for the validation.

In order to increase the reliability of findings, it was aimed to interview two people per NSD project. The one innovator of MUDTRAP, one innovator of PFOS, and two innovators of the Blue Water Program were interviewed. Due to time constraints, no second innovator of PFOS could be interviewed, which lowered reliability of findings.

The conceptual design was sent by e-mail beforehand, accompanied by a short introduction of the purpose of the interview. In order to let the innovators’ response during the interview be as unbiased as possible, the score scale of the review criteria was covered.

During the interview, the innovator had to score the review criteria retrospectively (i.e. review criteria had to be scored as if the innovator did score them at the time of the actual gate). The researcher guided innovators through the stage-gate design by mentioning and discussing important
matters of the NSD project. In this way, innovators recalled information more easily and some valuable statements concerning stage-gate were made.

The next Paragraph presents the findings of the validation.

5.3 Findings validation

The findings are presented according to the chronology of interviews of the NSD projects. Each interview changed the conceptual design. Therefore, the score of each interview is presented together with the main comments on and the changes to the conceptual design.

In order to maintain the readability of the report, changes to the conceptual design are only presented by detailed descriptions. The final design of the three gates is presented in Figure 12, Figure 13, and Figure 14. Furthermore, while discussing the former NSD projects, this Paragraph provides an answer to the research question:

RQ6  What would the effect be of the proposed design of review criteria and review gates on the performance of former new service development projects?

MUDTRAP

First, the conceptual design was validated by the MUDTRAP project. Table 12 shows the score of the project.

Table 12, Score MUDTRAP on conceptual design

<table>
<thead>
<tr>
<th>Criteria \ Gate</th>
<th>Gate 1</th>
<th>Gate 2</th>
<th>Gate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must-meet criteria</td>
<td>Fit with firm’s strategy ✓</td>
<td>Fit with firm’s strategy ✓</td>
<td>Fit with firm’s strategy ✓</td>
</tr>
<tr>
<td></td>
<td>Technical feasibility ✓</td>
<td>Technical feasibility ✓</td>
<td>Technical feasibility ✓</td>
</tr>
<tr>
<td></td>
<td>Break-even time ✓</td>
<td>Break-even time ✓</td>
<td>Partnership / launching customer ✓</td>
</tr>
<tr>
<td>Should-meet criteria</td>
<td>37 (35/50)</td>
<td>41 (45/70)</td>
<td>39 (36/60)</td>
</tr>
</tbody>
</table>

Table 12 shows that MUDTRAP met all must-meet criteria at all gates. Furthermore, MUDTRAP scored high enough on the should-meet criteria to pass gate 1 (after concept development) and proceeded to the proof of concept stage.

MUDTRAP scored not higher than the cut-off criterion at gate 2, mainly because internal acceptance of the MUDTRAP project was very low at the time (i.e. score = 0). Because the MUDTRAP concept at that time was promising (e.g. score “first to market” = 10) and the score was close to “go”, the innovator proceeded to business analysis.

At gate 3, the project met all requirements, mainly because internal acceptance raised. Strict compliance with the should-meet criteria at gate 2 would mean that MUDTRAP, successfully developed, had to be killed at gate 2.

The innovator commented that the review criteria were too “vague” to score; people interpret criteria differently and therefore scores can differ heavily. He advised to divide criteria (whether relevant and possible) into topics that are more clear to grasp and therefore less subject to interpretation. Furthermore, he advised to add an “on hold-area” to the score spectrum. In this way, concepts can be changed to become promising or are put on hold, waiting for technical or market conditions to mature (Tzokas et al., 2004). His comments were incorporated in the design.

If possible, criteria were divided and made more concrete. It was aimed to keep the meaning of review criteria and their relative importance in place. Based on the MUDTRAP interview, a NSD project checklist of BD, and knowledge of the organization some criteria-specific changes were made.
Table 13 shows the criteria-specific changes to the conceptual design after the MUDTRAP interview.

**Table 13, Criteria-specific changes to the conceptual design after the MUDTRAP interview**

<table>
<thead>
<tr>
<th>Change (add (+), minor (●), drop (-))</th>
<th>Criteria-specific change</th>
</tr>
</thead>
<tbody>
<tr>
<td>● In order to clarify their meaning, review criteria were presented in question form.</td>
<td></td>
</tr>
<tr>
<td>+ Expert judgment (gate 1) was combined with “people involved in the NSD project” into four items reviewing availability and judgment of expertise (internally and externally). After all, considering open innovation at ANL, it might be that the right expertise is not present yet in the NSD team. Reviewing availability and judgment of expertise at gate 1 increases chances of NSD success.</td>
<td></td>
</tr>
<tr>
<td>+ Reviewing whether a new service can be first to market is also important at gate 1 and gate 3. After all, NSD might be better focused or resources might be saved when this criterion is already reviewed at gate 1. The same rationale holds for gate 3.</td>
<td></td>
</tr>
<tr>
<td>+ Reviewing whether a customer wants to invest is also important at gate 1 and gate 2. NSD cost and time benefits might be achieved when a customer is already involved in the early stages of NSD (Carbonell, Rodríguez-Escudero, &amp; Pujari, 2009). However, only after thorough business analysis, a NSD initiative must have a launching-customer. Therefore, this criterion is a should-meet criterion at gates 1 and 2.</td>
<td></td>
</tr>
<tr>
<td>- Synergy with firm’s technical resources (gate 2) was abandoned; must-meet of technical feasibility is sufficient.</td>
<td></td>
</tr>
<tr>
<td>+ Gate 2 and gate 3 should review the “possibility of a patent”. For a feasible technology, a patent is a strong marketing instrument and protects against competition. Furthermore, the case study report shows some successful examples of patent applications.</td>
<td></td>
</tr>
<tr>
<td>● Break-even time became a should-meet criterion at gate 2. After the proof of concept, a promising break-even time is important, but no must-meet. Only after thorough business analysis a NSD initiative must meet a break-even time of three years.</td>
<td></td>
</tr>
<tr>
<td>● People involved in the NSD project (gate 2 and gate 3) changed into two items asking “know-who” and “know-how” (internally and externally). Considering open innovation at ANL, reviewing both involvement of the right people for activities to be performed and involvement of the right people for their social network increases chances of NSD success.</td>
<td></td>
</tr>
<tr>
<td>- Customer acceptance and value proposition for the customer were interpreted as having much in common. Since NSD at ANL is much focused on value propositions, customer acceptance is abandoned.</td>
<td></td>
</tr>
<tr>
<td>● Impact on society (gate 3) was changed into the broader aspect of competitiveness. After all, not every NSD project needs to be concerned with this topic. Reviewing competitiveness, thus also other threats and opportunities, encompasses this threat to NSD success.</td>
<td></td>
</tr>
</tbody>
</table>

**PFOS**

Second, the thoroughly adapted conceptual design was validated by the PFOS project. Table 14 shows the score of the project.

**Table 14, Score PFOS on conceptual design**

<table>
<thead>
<tr>
<th>Criteria / Gate</th>
<th>Gate 1</th>
<th>Gate 2</th>
<th>Gate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must-meet criteria</td>
<td>Fit with firm’s strategy ✓</td>
<td>Fit with firm’s strategy ✓</td>
<td>Fit with firm’s strategy ✓</td>
</tr>
<tr>
<td></td>
<td>Technical feasibility ✓</td>
<td>Technical feasibility ✓</td>
<td>Break-even time ✓</td>
</tr>
<tr>
<td></td>
<td><strong>Partnership / launching customer X</strong></td>
<td><strong>Partnership / launching customer X</strong></td>
<td><strong>Partnership / launching customer X</strong></td>
</tr>
<tr>
<td>Should-meet criteria</td>
<td><strong>41 (39/65)</strong></td>
<td><strong>50 (39/65)</strong></td>
<td><strong>57 (36/60)</strong></td>
</tr>
</tbody>
</table>

Table 14 shows that PFOS met all must-meet criteria at the first and second gate and scored high enough on the should-meet criteria. However, no launching customer was found during business analysis. It has to be said that, because of no launching customer, project work was silent for a while in 2013. Therefore, the conceptual model was not adapted.

One small comment was made about a financial criterion at gate 2 and gate 3, return on investment (ROI) of the service; the innovator mentioned that potential spin-off is important to consider. Hence, the conceptual design was adapted.
Blue Water Program

Finally, the conceptual design was validated by the Blue Water Program project. Table 15 shows the scores of the project of the two interviews.

Table 15, Score Blue Water Program on conceptual design

<table>
<thead>
<tr>
<th>Criteria \ Gate</th>
<th>Gate 1</th>
<th>Gate 2</th>
<th>Gate 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Must-meet criteria (interview 1)</strong></td>
<td>Fit with firm’s strategy √</td>
<td>Fit with firm’s strategy √</td>
<td>Fit with firm’s strategy √</td>
</tr>
<tr>
<td></td>
<td>Technical feasibility √</td>
<td>Technical feasibility √</td>
<td>Technical feasibility √</td>
</tr>
<tr>
<td></td>
<td>Break-even time X</td>
<td>Break-even time X</td>
<td>Break-even time X</td>
</tr>
<tr>
<td></td>
<td>Partnership / launching customer X</td>
<td>Partnership / launching customer X</td>
<td>Partnership / launching customer X</td>
</tr>
<tr>
<td><strong>Should-meet criteria (interview 1)</strong></td>
<td>44 (&gt;39/65)</td>
<td>54 (&gt;39/65)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Must-meet criteria (interview 2)</strong></td>
<td>Fit with firm’s strategy √</td>
<td>Fit with firm’s strategy √</td>
<td>Fit with firm’s strategy √</td>
</tr>
<tr>
<td></td>
<td>Technical feasibility √</td>
<td>Technical feasibility √</td>
<td>Technical feasibility √</td>
</tr>
<tr>
<td></td>
<td>Break-even time X</td>
<td>Break-even time X</td>
<td>Break-even time X</td>
</tr>
<tr>
<td></td>
<td>Partnership / launching customer X</td>
<td>Partnership / launching customer X</td>
<td>Partnership / launching customer X</td>
</tr>
<tr>
<td><strong>Should-meet criteria (interview 2)</strong></td>
<td>55 (&gt;39/65)</td>
<td>49 (&gt;39/65)</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 15 shows that the Blue Water Program met all must-meet criteria at the first and second gate (both interviews) and scored high enough on the should-meet criteria (both interviews). However, at gate 3 it did not meet the break-even time required and no launching customer was found. The conceptual model performed its task; putting the Blue Water Program on hold after business analysis.

Both innovators indicated that score scales should inform the user about the meaning of scores (i.e. What does a score of 5 mean?). Furthermore, only single and clear questions should be asked per criterion. Hence, the score scales and some questions of the conceptual design were adapted to better inform the user.

Interestingly, the overall score of should-meet criteria at gate 2 increased relative to the score at gate 1 for interview 1. However, the overall score of should-meet criteria at gate 2 lowered relative to the score at gate 1 for interview 2. This difference illustrates the subjectivity of review criteria scores. Hence, in order to increase the objectivity of the gate decision, it is important to employ a gate committee consisting of multiple gate members.

Final design and important insights concerning Stage-Gate

The final design of the three gates is presented in Figure 12, Figure 13, and Figure 14. Furthermore, the innovator of PFOS indicated that the use of stage-gate is valuable because, when a “go” decision is made, the team formally receives budget to proceed and gains confidence because of support of management.

He also indicated that the use of stage-gate counters “escalation of commitment”, especially on the side of the team. Also the two innovators of the Blue Water Program valued stage-gate. They missed assessment and guidance, especially during the beginning of their NSD project; stage-gate with explicit review criteria provides for this.

NSD projects at ANL are initiated by an innovative idea, internally (e.g. MUDTRAP) or externally (e.g. Blue Water Program), or by an innovative customer demand (e.g. PFOS). Explicit use of review criteria also might benefit NSD projects that start by an innovative customer demand. After an innovative customer demand, ANL aims for the specific customer assignment and starts writing a project offer for the customer. When review criteria of the most appropriate gate (i.e. usually gate 1) are reviewed, a possible, future NSD project might benefit from more focus in the beginning and possibly experience NSD cost and time benefits.
Gate commissie: Lijnmanagement (procuratiehouder die dominant belang heeft en één lijnmanager die géén belang heeft) en B.D. (begeleidende rol)

Gate deliverable: Ontwikkelingsbudget aanvraagformulier

Toetsingscriteria

Must-have: ja/nee
Fit het product/dienst met de bedrijfsstrategie? ......

N.B. Wanneer bovenstaand criterium ja scoort, ga dan door naar de should-have criteria. Wanneer bovenstaand criterium nee scoort, wordt er gestopt met het innovatieproject.

Should-have:

<table>
<thead>
<tr>
<th>Criterium</th>
<th>Score</th>
<th>Score</th>
<th>Score</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategisch</td>
<td>Score (0-10)</td>
<td>Score (0-10)</td>
<td>Score (0-10)</td>
<td>Score (0-10)</td>
</tr>
<tr>
<td>Marktgericht</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Financieel</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Expert judgment</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Totaal</td>
<td>Score</td>
<td>Score</td>
<td>Score</td>
<td>Score</td>
</tr>
</tbody>
</table>

N.B. De project aantrekkelijkheidsscore wordt bepaald door de ongewogen optelling van de afzonderlijke scores. Een score van <26/65 betekent doorgaans stoppen, een score van 26-39/65 betekent extra huiswerk en een score van >39/65 betekent doorgaans door naar proof of concept.

Figure 12, Final design gate 1 (in Dutch)
**Gate commissie:** Lijnmanagement (procuratiehouder die dominant belang heeft en één lijnmanager die géén belang heeft) en B.D. (begeleidende rol)

**Gate deliverable:** Proof of concept

**Toetsingscriteria**

**Must-have:** *ja/nee*

- Fit het product/dienst met de bedrijfsstrategie?
- Is het product technisch realiseerbaar (“werkt het”)?

**N.B.** Wanneer bovenstaande criteria *nee* scoren, wordt er gestopt met het innovatieproject.

**Should-have:**

<table>
<thead>
<tr>
<th>Criterium</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welk probleem lost het product/dienst op?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat maakt het product/dienst voor klanten zo uniek/bijzonder?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Zijn individuele klanten bepalend voor succes in de markt?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is er een klant die wil investeren?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Kunnen we met dit product/dienst als eerste op de markt zijn?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Volgens welk verdienmodel rekenen we het product/dienst af?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat zijn de geschatte opbrengsten?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat is de terugverdientijd van het product/dienst?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is het rendement van het product/dienst? (o.a. spin-off)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is het mogelijker de techniek te patenteren?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is de juiste interne know-how en know-who betrokken? (competenties en/of mensen)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is de juiste externe know-how en know-who betrokken? (zelfstandig of in samenwerking met partners/ondernemers?)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is er intern draagvlak voor het product/dienst?</td>
<td>Score (0-5)</td>
</tr>
</tbody>
</table>

**N.B.** De project aantrekkelijkheidsscore wordt bepaald door de ongewogen optelling van de afzonderlijke scores. Een score van *<26/65* betekent doorgaans **stoppen**, een score van *26-39/65* betekent **extra huiswerk** en een score van *>39/65* betekent doorgaans **door naar business analyse**.

**Figure 13, Final design gate 2** (in Dutch)
**Gate commissie:** Lijnmanagement (procuratiehouder die dominant belang heeft en één lijnmanager die géén belang heeft) en B.D. (begeleidende rol)

**Gate deliverable:** Business plan

**Toetsingscriteria**

**Must-have:** ja/nee
- Fit het product/dienst met de bedrijfsstrategie?
- Is het product technisch realiseerbaar (“werkt het”)?
- Kunnen we de investering binnen drie jaar terugverdienen?
- Hebben we een launching customer?

**Should-have:**

<table>
<thead>
<tr>
<th>Criterium</th>
<th>Score (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welk probleem lost het product/dienst op?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat maakt het product/dienst voor klanten zo uniek/bijzonder?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Zijn individuele klanten bepaald voor succes in de markt?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Kunnen we met dit product/dienst als eerste op de markt zijn?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Waarin onderscheiden we ons t.o.v. concurrenten?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Volgens welk verdienmodel rekenen we het product/dienst af?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat zijn de geschatte opbrengsten?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Wat is het rendement van het product/dienst? (o.a. spin-off)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is het mogelijk de techniek te patenteren?</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is de juiste interne know-how en know-who betrokken? (competenties en/of mensen)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is de juiste externe know-how en know-who betrokken? (zelfstandig of in samenwerking met partners/onderaannemers?)</td>
<td>Score (0-5)</td>
</tr>
<tr>
<td>Is er intern draagvlak voor het product/dienst?</td>
<td>Score (0-5)</td>
</tr>
</tbody>
</table>

N.B. Wanneer bovenstaande criteria ja scoren, ga dan door naar de should-have criteria. Wanneer één van de bovenstaande criteria nee scoort, wordt er gestopt met het innovatieproject.

De project aantrekkelijkheidsscore wordt bepaald door de ongewogen optelling van de afzonderlijke scores. Een score van <24/60 betekent doorgaans stoppen, een score van 24-36/60 betekent extra huiswerk en een score van >36/60 betekent doorgaans door naar implementatie.

**Figure 14, Final design gate 3 (in Dutch)**
**Review criteria to review NSD progress during the project**

As stated in the elaboration of the focus group meeting, RQ4 is answered after the validation. Hence, an answer is provided to the research question:

**RQ4** Which review criteria can be used to provide insights into new service development performance during development and after introduction in the marketplace?

Figure 9 (Paragraph 4.3.2) presents the selected review criteria to review NSD progress during development. During the validation, these sets of criteria altered. The review criteria that are included in the final design to review NSD progress during the project are presented in Figure 15.

Figure 15 shows that during development different strategic, marketing, financial, and technical criteria are reviewed at the gates. Furthermore, intuition, changed into expert judgment, is used to review concept development and “organizational” criteria (i.e. people involved and internal acceptance) are important to review NSD progress at gate 2 and gate 3. Green colored criteria indicate the must-meet criteria at each gate.

<table>
<thead>
<tr>
<th>Review criteria</th>
<th>Strategic</th>
<th>Marketing</th>
<th>Technical</th>
<th>Financial</th>
<th>Intuition</th>
<th>Organizational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit with firm’s strategy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Strategic renewal &amp; possibility of new markets, new technology(ies)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Value proposition</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chance to be first to market</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Technical feasibility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Potential for profit(s)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Breakeven time</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Return on investment (e.g.; potential spin-off)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Expert judgment (internally and externally)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>People involved in the NSD project (i.e. know-how and know-who)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Internal acceptance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Figure 15. Review criteria in final design to review NSD progress during development**

Figure 10 (Paragraph 4.3.2) presents the selected review measures to review NSD success in the marketplace. NSD success is reviewed on several financial, customer-based, and “internal” measures. Additionally, reviewing the new service on its applicability and its effect on the company’s innovative image are important in the short-term. In the long-term, there also has to be reviewed whether and how the lifecycle of the service can be prolonged.

The next Chapter presents the conclusions of this research and the implementation plan needed to successfully implement the final design at ANL.
6 Conclusions

This final Chapter presents the conclusions of this research. Paragraph 6.1 answers the main research question of this research. Theoretical implications are derived from the main conclusions and are discussed in Paragraph 6.2. Paragraph 6.3 presents the implementation plan. Finally, this Chapter concludes with limitations of this research and directions for future research.

6.1 Conclusions

In order to answer the main research question, six sub questions were defined. The six sub questions guided this research and were answered by performing a literature review, empirical research, and a validation. Answers to the six sub questions were elaborated throughout this report.

The insights gained regarding the sub questions serve as input to address the main question of this research, which is presented hereafter:

*How can new service development projects within ANL be reviewed in order to provide clear insights into development and marketplace performance?*

A) ANL can provide clear insights into NSD performance during development by employing a stage-gate approach.

Stage-gate will assist ANL in both selecting the most promising projects – *doing the rights projects* – and bringing new service offerings to market – *doing the projects right* (Cooper & Edget, 1999).

Each NSD phase will be followed by a review gate. Gates provide managers with focus in development and weed out misfits. Focus in development results in higher NSD performance and the weeding out of misfits results in resources being saved. At gates, the project team will formally receive budget to proceed which leads to a gain of project team confidence because of management support. Furthermore, stage-gate will counter “escalation of commitment” and thus prevents the waste of expensive resources.

B) ANL can provide clear insights into development performance by using review criteria at the gates that reflect the managerial tasks that need to be performed successfully at each stage to warrant NSD success.

NSD progress is reviewed on different aspects throughout the different stages of the NSD process. Following is the distribution of the most important review dimensions for every gate in the NSD process. After concept development, reviewing strategic criteria is most important and this review dimension stays important throughout the whole NSD project. Moreover, a new service concept has to fit the firm’s strategy, otherwise the NSD project is killed.

After the proof of concept stage, technical criteria are crucial in reviewing NSD progress and this review dimension stays important afterwards. When a new service is not technically feasible, there is no proof of concept and the project is killed.

First, technical feasibility has to be met and then, economic feasibility becomes crucial. After business analysis, reviewing financial criteria is most important. Specifically, a new service is expected to be profitable after three years, otherwise no more resources are invested. Marketing criteria are important throughout the whole NSD project and gain importance after business analysis. In reviewing business analysis, a launching-customer is required to test the technique in practice and to proceed to implementation of the new service.

Figure 16 presents the NSD process with review gates and the most important review dimensions per gate.
C) ANL can provide clear insights into marketplace performance by using review measures that reflect the managerial tasks that need to be performed successfully in each timespan to warrant NSD success.

In the short-term, customer-based and internal review measures are most important to review marketplace performance. The number and acceptance of customers are important aspects of NSD performance. Applicability of the new service can be reviewed to expand the volume and the effect on the firm’s image is important as well. Furthermore, investments might be needed as technical applicability turns out to be different than expected. Especially during these times of economic crisis, also short-term revenues are important; eventual short-term investments are reflected in the ROI.

In the long-term, financial and customer-based performance are most important. Mature services should be profitable and should enhance the competitiveness of the firm. Furthermore, whether to prolong the lifetime of the service should be reviewed as well in order to plan for future investments or聘s.

The conclusion serves as input for the formulation of several theoretical and practical implications in the following Paragraphs.

6.2 Theoretical implications

Several contributions to existing theory have been identified. These implications are discussed below.

First, this study contributes to existing theory as the use of stage-gate in an engineering KIBS was investigated. Existing research in stage-gate has focused largely on product industries (e.g. manufacturing, consumer goods) and several service industries (e.g. financial services, telecommunications). This study shows that review gates can also be used at review moments during NSD projects in engineering. Therefore, this study broadens the research domain of stage-gate by focusing on an engineering KIBS.

Second, this study investigated the use and importance of review criteria during NSD. Despite exploratory studies (i.e. Storey and Kelly (2000), Aas (2011)) in several service industries, the use and importance of review criteria in reviewing NSD performance during development in service industries is not clear.
By focusing on the NSD context of an engineering KIBS, the research domain of review criteria to review development performance is provided with another perspective and expanded beyond the product industries. This study shows that multiple review criteria can be used to review development performance, reflecting the specific goals of each stage. Furthermore, the findings of this study are in line with the patterns of review dimensions during NPD of former studies of Tzokas et al. (2004) and Carbonell-Foulquié et al. (2004). Their findings show that strategic fit criteria are most important at the initial screening, technical feasibility is most important at the concept and development gates, and financial performance and customer acceptance criteria gain importance towards launch of the new product.

This study contradicts the research of Aas (2011). Aas (2011) states that a minimum of review criteria is used in SI, dominated by financial criteria. However, the conclusions of Aas (2011) are not in line with his results; the results of his study suggest the use of also “gut feeling”, strategic fit, and technical performance as review criteria. Hence, this present study adds to the scarce literature about NSD review criteria and suggests that multiple review criteria can be used during development.

Finally, this study provides empirical evidence for a proposed review criterion that can be important during NSD in KIBS, namely reviewing “available expertise” (both internally as well as externally). The review criterion “people involved (i.e. know-how and know-who)” of this study empirically proves the proposition. Apparently, in a projects-based KIBS with no significant R&D department present or specialized R&D workers employed, reviewing whether available expertise is included in the project team during NSD is considered as important while aiming for future NSD success.

### 6.3 Practical implications: key tasks of implementation

This research developed the in-process and post-process measures to review NSD performance (Cooper & Edgett, 1999). Currently, review of NSD progress during development is performed more implicitly at ANL than on the basis of explicit review criteria. This study shows that the type of review criteria that can be considered at the several gates are very similar to the aspects of NSD progress that are currently reviewed implicitly. Table 16 shows the most important current, implicit review criteria and the most important explicit review criteria from this research.

<table>
<thead>
<tr>
<th>NSD gate</th>
<th>Type of criteria</th>
<th>Current, implicit</th>
<th>Research, explicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept development</td>
<td>Strategic renewal</td>
<td>Fit with firm’s strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expert judgment</td>
<td>Strategic renewal</td>
<td></td>
</tr>
<tr>
<td>Proof of concept</td>
<td>Strategic fit</td>
<td>Fit with firm’s strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical feasibility</td>
<td>Technical feasibility</td>
<td></td>
</tr>
<tr>
<td>Business analysis</td>
<td>Strategic fit</td>
<td>Fit with firm’s strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potential revenue</td>
<td>Technical feasibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bringing in time</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Launching customer</td>
<td></td>
</tr>
</tbody>
</table>

The data in Table 16 shows that current, implicit review criteria and the explicit review criteria from this research show the same pattern (i.e. strategic criteria are important after concept development and stay important throughout NSD, technical feasibility is crucial after the proof of concept, and economic feasibility is important after business analysis). A practical implication derived from Table 16 is that the change to explicit review criteria can be managed by consciously using a score form instead of changing the current view on NSD management.
Before one can reap the benefits of the final design of gates and review criteria and the review measures for marketplace performance, the process first has to be implemented. The key tasks of implementation are presented below.

**Define a Process Manager:**
Each process, no matter how excellent its design and nature is, has to be implemented with conscious effort. To prevent bogging down, a process manager should be appointed that ensures that the steps presented below are executed. At ANL, the NBM seems the right person to become the process manager (PM).

**Secure Senior Management Buy-in:**
Generally, senior management agrees with a stage-gate approach (i.e. gates with teeth, fact-based decision making, NSD efforts driven by NSD strategy). However, often senior management does not realize that also their own behavior has to change. Gatekeeper rules carry a certain discipline with them that might be new to senior management. In fact, all NSD projects should be reviewed by the same scrutiny, so even management’s pet projects get assessed.

Senior management buy-in is ensured by involving management in the design of the process. Therefore, a line manager at Environment made part of the focus group panel. Furthermore, early in the implementation, a pilot session can be run (e.g. a mock gate session) with management as participants (Cooper & Edgett, 1999).

In May 2014, the final session of the yearly Innovation contest, Het Ondernemerslab, is held. During the final session, a committee of managers and external people will give feedback on the several NSD initiatives. This final session can be used to experiment with the use of review criteria and gatekeeping behavior.

**Undertake internal marketing:**
In fact, implementing a process looks like developing and launching a new service; also a new process needs marketing and selling. An “announcement event” can be organized to implement the new process. This announcement might coincide with another company event; for example, by making use of the final session of the Ondernemerslab. Furthermore, internal company communication has to be used to inform the rest of the company about progress. The intranet of ANL, Het Portaal, can be used for this. It can happen that there is some time between initial kickoff and actual rollout, so several “press releases” have to be considered all the way along.

**Bring existing NSD projects into the Process:**
First, a list of running projects to be included needs to be created; NSD projects should be picked whose project leaders are willing to pilot-test the stage-gate process. These NSD projects should be typical NSD projects for ANL. These projects should proceed through the gates as NSD is carried out.

**Develop an IT support system:**
An IT system can support the stage-gate process. It is recommended to develop and use a database to store vital characteristics, statistics and actions of new and running NSD projects. This information is used to track progress of projects and indicate performance. Then, useful information is generated and serves as input for gate meetings.

The developed Innovation Website by the Innovation Team member of Environment can be improved to support NSD. This database contains all running NSD initiatives and shows characteristics as organizational members involved, current stage of the NSD process, and planned actions. This database needs to be updated with current NSD projects and actively used and managed.
Furthermore, this database can be expanded by providing access to all gate requirements on beforehand.

6.4 Limitations and directions for future research

This research carries several limitations, which are discussed hereafter.

First, this research focuses on NSD projects in an engineering KIBS in which a technological component has to be developed in an open innovation context. Although the use of Stage-Gate has proven to be useful in several NSD contexts, the resulting sets of review criteria are probably biased towards the specific context.

Future research to the use and importance of review criteria during NSD in engineering KIBS should focus on NSD of other dimensions of SI (e.g. development of a new revenue model) to investigate differences in sets of review criteria.

Second, this research defines a NSD scenario (i.e. technological component, open innovation context) but does not focus on a certain level of innovativeness (e.g. incremental or radical innovation). Although the use of Stage-Gate has proven to be useful in NSD contexts with different levels of innovativeness, the resulting sets of review criteria might differ for certain levels of innovativeness. It might be that financial criteria are considered as more important for incremental NSD than for radical NSD as a result of less uncertainty regarding future sales.

Future research to the use and importance of review criteria during NSD in engineering KIBS should incorporate a level of innovativeness to investigate differences in sets of review criteria.

Third, the focus group meeting was attended by only four participants. The findings from the focus group are now biased towards the opinion of these four people. The research would have benefitted from a higher number of participants (e.g. eight participants). A higher number of participants would increase the reliability and validity of the focus group findings.

Fourth, the validation of the conceptual design is performed with former NSD projects, two successful ones and one unsuccessful one. Since more well performing NSD projects were validated, the final design is now slightly biased towards the approval of NSD projects. The final design would have been more reliable (e.g. more strict) when a higher number of equally divided (i.e. successful and unsuccessful) NSD projects was validated.

Two former NSD projects were validated by interviewing only one innovator. Furthermore, the innovators had to “score” their own NSD project, in the presence of the researcher. This holds the limitation that the scores of the conceptual design are less reliable, as the innovator might favor the performance of the own project and might act socially desirable (e.g. less critical) in front of the researcher. The scores of the conceptual design would have been more reliable when an innovator and a former project leader scored the project both, without the presence of the researcher.

Finally, the research was conducted within the context of roughly one business line within one organization. This may limit the findings and conclusions to organizations within the same industry or even only organizations or departments with the same characteristics. To increase the generalizability and value for theory, this research should be conducted across several organizations, representing varying service industries.
7 Bibliography


KPMG. (2012). *Kengetallen in de Bouw.*


# Appendices

## 8.1 Appendix A: Organizational chart ANL

### Water

<table>
<thead>
<tr>
<th>Marktgroepen</th>
<th>Adviesgroepen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterbeheer en Groene Ruimte</td>
<td>- Waterbeheer en groene ruimte</td>
</tr>
<tr>
<td>Delta's en Rivieren</td>
<td>- Onderzoek, kennis en innovatie</td>
</tr>
<tr>
<td>Havens en Waterbouw</td>
<td>- Havenbouw</td>
</tr>
</tbody>
</table>

### Mobiliteit

<table>
<thead>
<tr>
<th>Marktgroepen</th>
<th>Adviesgroepen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verkeer en vervoer</td>
<td>- Strategie en beleid</td>
</tr>
<tr>
<td></td>
<td>- LOXIA</td>
</tr>
<tr>
<td>Weginfra en geoinformatie</td>
<td>- Infra consult</td>
</tr>
<tr>
<td></td>
<td>- Wegen</td>
</tr>
<tr>
<td></td>
<td>- Urban transport</td>
</tr>
<tr>
<td>Markgroep Rail</td>
<td>- Baan en spoor</td>
</tr>
<tr>
<td></td>
<td>- Tractie - energievoorziening</td>
</tr>
<tr>
<td></td>
<td>- Railbeveiliging</td>
</tr>
<tr>
<td>Knooppunten</td>
<td>- Architectuur, stations en</td>
</tr>
<tr>
<td></td>
<td>transfer</td>
</tr>
<tr>
<td></td>
<td>- Tunnels en geotechnische</td>
</tr>
<tr>
<td></td>
<td>constructies</td>
</tr>
</tbody>
</table>

### Milieu en Ruimte

<table>
<thead>
<tr>
<th>Marktgroepen</th>
<th>Adviesgroepen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milieu</td>
<td>- Milieuaard en duurzaamheid</td>
</tr>
<tr>
<td></td>
<td>- Milieu en leefomgeving</td>
</tr>
<tr>
<td>Contracting</td>
<td>- New business</td>
</tr>
<tr>
<td></td>
<td>- Design en construct</td>
</tr>
</tbody>
</table>

### Gebouwen

<table>
<thead>
<tr>
<th>Marktgroepen</th>
<th>Adviesgroepen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultancy &amp; Management</td>
<td>- Corporate en publiek vangard</td>
</tr>
<tr>
<td></td>
<td>- Onderwijs en gezondheidszorg</td>
</tr>
<tr>
<td></td>
<td>- Life cycle management</td>
</tr>
<tr>
<td>Technisch Advies en Ontwerp</td>
<td>- Bouwkunde</td>
</tr>
<tr>
<td></td>
<td>- Constructies</td>
</tr>
<tr>
<td></td>
<td>- Binnenmilieu en energie</td>
</tr>
</tbody>
</table>
Appendix B: Interview guide

Interviewvragen innovatieprojecten Milieu en Ruimte

“Goedemiddag …. Bij voorbaat dank voor uw medewerking aan mijn onderzoek. Mijn onderzoek binnen ARCADIS richt zich op evaluatie tijdens en na innovatieprojecten. Ik zal u vragen stellen over wanneer, op basis waarvan en wie geëvalueerd heeft. Graag interview ik u over evaluatie tijdens uw innovatieproject ….”

Algemene vragen over het project
1. Wie bent u en wat is uw functie binnen ARCADIS?
2. Waar gaat [het innovatieproject] over en hoe is het proces globaal gegaan?
3. Wanneer is het project gestart en wanneer is het project gestopt? [wanneer was er sprake van implementatie? in het geval van een succesvolle ontwikkeling]
4. Wie kwam er met het idee?
5. Welke personen waren betrokken bij het project? Wat was hun rol binnen het project?
6. Was er sprake van een projectverantwoordelijke/leider? Zo ja, wat hield deze rol in?
7. Waren er klanten of andere partijen betrokken bij de ontwikkeling?

Vragen over beoordelen tijdens en na het project
8. Op basis waarvan is de waarde van het idee beoordeeld? Wie heeft de waarde van het idee beoordeeld?
9. Op basis waarvan is het project gestart? Moest er iets (project definitie/business case) opgeleverd worden?
10. Wie besliste over de start van het project?
11. Waren er (tussentijdse) doelstellingen gesteld? Waarom wel/niet? Zo ja, wat waren deze doelstellingen en zijn deze geëvalueerd? (Zo ja, hoe?)
12. Waren er evaluatiemomenten gepland? Zo ja, wat werd er besloten (ook GO/NO GO)? Waarom wel/niet?
13. Op basis waarvan is ontwerp/ontwikkeling gecontroleerd of beoordeeld? Moest er iets opgeleverd worden?
14. Wie besliste over voortgang van het project?

[Bij gestopte projecten]
15. Op basis waarvan is het project gestopt?
16. Wie besliste over wel/niet stoppen van het project?

[Bij succesvolle projecten]
17. Is het project na implementatie nog beoordeeld? Op basis waarvan?

Afsluitende algemene vragen

18. Is de zojuist bevraagde controle tijdens innovatieprojecten representatief voor Milieu en Ruimte?

19. Bent u tevreden met de huidige manier van controle tijdens innovatieprojecten? Wat zou er verbeterd kunnen worden in uw ogen?

Vragen na het interview

Is er documentatie behorende bij het project die ik kan inzien? (notulen, voortgangsrapporten, technische documenten)

Ook ga ik een enquête houden onder enkele eerdere innovatoren en studenten om te onderzoeken wanneer en op basis waarvan er tijdens/na een innovatieproject het beste geëvalueerd zou kunnen worden. Zou u deze enquête willen maken?
8.3 Appendix C: Survey

Enquête afstudeerproject Louis Essers

Beste respondent,

Mijn naam is Louis Essers, Innovatie Management student aan de Technische Universiteit te Eindhoven. Ik loop stage bij ARCADIS en mijn afstudeeronderzoek binnen de divisie Milieu en Ruimte richt zich op het optimaliseren van evaluatiemomenten en toetsingscriteria binnen innovatieprojecten. Oftewel: op welke momenten en op basis van welke criteria zouden bedrijven moeten besluiten om een innovatief idee verder te ontwikkelen en te vermarkten, of juist niet?

Om dit inzichtelijk te maken, wil ik de mening van innovatie-experts weten. Ik heb besloten een enquête uit te zetten, waarin ik middels een fictieve casus wil bekijken wat de beste manier is om innovatieprojecten te beoordelen. Graag wil ik jou uitnodigen om mijn enquête in te vullen. Na het verwerken van resultaten zal ik met enkele respondenten middels een “round table” discussie tot overeenstemming proberen te komen.

Het invullen zal niet meer dan 15 minuten tijd in beslag nemen en je antwoorden worden uiteraard vertrouwelijk behandeld. Let op: er zijn geen goede of foute antwoorden, het is jouw mening die telt. Alvast bedankt voor je medewerking!

Louis Essers
l.j.e.essers@gmail.com / louis.essers@arcadis.nl
06-51065645 / 06-50240252
Ik ben:

Functie:

Leeftijd:

jaar

De afgelopen 3 jaar bij innovatieprojecten betrokken geweest

Stel: jij werkt binnen een toonaangevende advies-, ontwerp-, projectmanagement en ingenieursorganisatie die diensten levert op de gebieden infrastructuur, water, milieu en gebouwen. Jij beslist over het opstarten en/of de voortgang van innovatieprojecten. Innovaties omvatten veelal ontwikkeling van tools en technieken die bestaande dienstverlening verbeteren, uitbreiden of bundelen; bij innovatie worden vaak klanten, overheidsinstanties en collega’s van verschillende disciplines betrokken. Om de kwaliteit van het “eindproduct” zo goed mogelijk te bewaken én de focus op succes in het project scherp te houden is het belangrijk dat innovatieprojecten worden geëvalueerd. In deze enquête is het jouw taak te bedenken op basis van welke toetsingscriteria je wilt dat er geëvalueerd moet worden tijdens het ontwikkelen van een innovatie en nadat de innovatie op de markt is gebracht. Ook bepaal je of evaluatie wel/niet plaats vindt tijdens vooraf afgesproken beslismomenten (”gates”), waar formeel beslist wordt tot GO/NO GO/HOLD/RECYCLE van het project.

In Figuur 1 zie je een algemeen innovatieproces afgebeeld met drie evaluatiemomenten (EM); bedenk bij ieder evaluatiemoment welke toetsingscriteria gebruikt moeten worden die het beste inzicht verschaffen in potentieel succes van een concept. Dit kun je aangeven in Tabel 1. Je mag óf één, óf twee, drie, vier, óf vijf categorieën van criteria selecteren per EM. Geef eenvoudigweg iedere categorie het percentage tot op welke hoogte je deze zou gebruiken als toetsingscriterium. Geef de meest bruikbare categorie het hoogste percentage en de minst bruikbare categorie het laagste percentage. Controleer na toedeling van de percentages dat de totale som van percentages in iedere kolom 100% is.

Nadat je bedacht hebt welke toetsingscriteria je wilt gebruiken, moet je nog bedenken of bij dat evalueren een formele gate hoort. Oftewel: zou je een project formeel met een GO of NO GO beoordelen?

Hieronder volgen enkele definities van gebruikte concepten in de enquête:

_Evalueren:_
Observeren wat er gebeurt, inzichten in (potentiële) prestatie vergelijken met (impliciete) doelstellingen en eventueel corrigerende acties initiëren.

_Toetsingscriterium:_
Criterium dat aspecten van het idee/concept representeert, zoals financiële of technische aspecten.

_Formele gate:_
Vooraf gepland en uitgesproken beslismoment binnen een innovatieproject. Op dit moment wordt besloten of er verder wordt gegaan met het project (GO), definitief wordt gestopt met een project (NO GO), het project in de wacht wordt gezet (HOLD) of dat bepaalde aspecten van het idee/concept nog eens herzien moeten worden (RECYCLE).

Figuur 1, Algemeen innovatieproces met evaluatiemomenten
### Tabel 1, Toetsingscriteria tijdens service ontwikkeling

<table>
<thead>
<tr>
<th>Toetsingscriteria\Evaluatiemomenten (EM)</th>
<th>EM 1</th>
<th>EM 2</th>
<th>EM 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financiële criteria</strong>&lt;br&gt;“Ik zou het project beoordelen op het behalen van omzet doelstellingen, winst doelstellingen, break-even tijd en binnen het beoogde budget blijven.”</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Marketing criteria</strong>&lt;br&gt;“Ik zou het project beoordelen op aanvaarding door de klant, kans op “eerste op de markt” en synergie met bestaande marketing capaciteiten.”</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Technische criteria</strong>&lt;br&gt;“Ik zou het project beoordelen op technische haalbaarheid, beoogde productkwaliteit (m.b.t. wet- en regelgeving), synergie met bestaande technische capaciteiten en potentie voor een patent.”</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Intuïtie</strong>&lt;br&gt;“Ik zou het project beoordelen op gevoel.”</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Strategische criteria</strong>&lt;br&gt;“Ik zou het project beoordelen op fit met bedrijfsstrategie, fit met productportfolio, innovatief imago en strategische vernieuwing (kans op nieuwe markt, nieuw product platform, nieuwe technologie).”</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>TOTAAL:</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Ik zou hier een formele GO/NO GO beslissing maken</td>
<td>☐ ja</td>
<td>☐ ja</td>
<td>☐ ja</td>
</tr>
<tr>
<td></td>
<td>☐ nee</td>
<td>☐ nee</td>
<td>☐ nee</td>
</tr>
</tbody>
</table>

**Toelichting:**

Beschrijf kort waarom je voor EM1 deze keuzes maakte:

Beschrijf kort waarom je voor EM2 deze keuzes maakte:

Beschrijf kort waarom je voor EM3 deze keuzes maakte:
In Figuur 2 zie je een zogenaamde “levenscyclus” van een vermarkte innovatie van de ingenieursorganisatie. Bedenk welke toetsingscriteria gebruikt moeten worden die het beste inzicht verschaffen in korte en lange termijn prestatie van de gelanceerde dienst. De opdracht is exact hetzelfde als hierboven, maar nu moet je percentages verdelen over vier categorieën van toetsingscriteria.

![Levenscyclus vermarkte service](image)

**Figuur 2, Levenscyclus vermarkte service**

Bovenstaande levenscyclus schetst de groei en uiteindelijk achteruitgang van een service; dit kan in termen zijn van omzet of naambekendheid. De tijd behorende bij de verschillende fases kan per service en per markt verschillen.

Tabel 2, Toetsingscriteria tijdens vermarkten service

<table>
<thead>
<tr>
<th>Toetsingscriteria/Evaluatiemomenten (EM)</th>
<th>Korte termijn prestatie</th>
<th>Lange termijn prestatie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financiële prestatie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Ik zou prestatie beoordelen op winstdoelstelling behaald, omzetdoelstelling behaald en return on investment (ROI)”</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Klant-gebaseerde prestatie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Ik zou prestatie beoordelen op aanvaarding door de klant, aantal nieuwe klanten, (verbeterde) concurrentiepositie en feedback van medewerkers in contact met de klant”</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Technische prestatie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Ik zou prestatie beoordelen op beoogde technische functionaliteit behaald, ontwikkeltijd, beoogde productkwaliteit (m.b.t. wet-en regelgeving) behaald”</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Interne prestatie</td>
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<td></td>
</tr>
<tr>
<td>“Ik zou prestatie beoordelen op toekomstpotentieel, efficiëntie, strategische fit en mate van innovativiteit”</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>TOTAAL:</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Toelichting:
Beschrijf kort waarom je voor korte termijn prestatie deze keuzes maakte:

Beschrijf kort waarom je voor lange termijn prestatie deze keuzes maakte:
### 8.4 Appendix D: Project-level success measures of Griffin and Page (1996)

Project-level success measures: average utility of success measures for each project strategy (Griffin & Page, 1996).

#### Table 5B. Project-Level Success Measures: Average Utility of Success Measures for Each Project Strategy

<table>
<thead>
<tr>
<th>Project-Level Measure</th>
<th>New-to-the World</th>
<th>New-to-the Company</th>
<th>Product Improvement</th>
<th>Line Extensions</th>
<th>Repositionings</th>
<th>Cost Reductions</th>
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<tbody>
<tr>
<td>Customer-based success</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Customer satisfaction</td>
<td>0.12</td>
<td>0.10</td>
<td>0.16</td>
<td>0.08</td>
<td>0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>Customer acceptance</td>
<td>0.16</td>
<td>0.06</td>
<td>0.04</td>
<td>0.08</td>
<td>0.14</td>
<td>0.16</td>
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<td>Market share goals</td>
<td>0.03</td>
<td>0.19</td>
<td>0.11</td>
<td>0.11</td>
<td>0.10</td>
<td>0.03</td>
</tr>
<tr>
<td>Revenue goals</td>
<td>0.06</td>
<td>0.08</td>
<td>0.04</td>
<td>0.07</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Revenue growth goals</td>
<td>0.03</td>
<td>0.04</td>
<td>0.10</td>
<td>0.09</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Unit volume goals</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>0.06</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td># of customers</td>
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<td>0.02</td>
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<td>0.01</td>
<td>0.02</td>
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</tbody>
</table>

*Note: The numbers in this table are the average fraction of the chips apportioned to this measure for each project strategy. Within each dimension of measures, the measures are listed in order of descending utility across all six project types. Measures in bold indicate the measures with statistically significantly higher utility than the next most useful measure within each strategy (t-test, p < .05).*

8.5 Appendix E: Innovation project performance model

Innovation project performance model (Blindenbach-Driessen et al., 2010).


Notes: Covariance, ML estimation, SAS program. Significant relationships (p ≤ 0.05) in bold (N = 219).
8.6 Appendix F: Importance of review dimensions during the NPD process

Variation in relative importance of review dimensions during the NPD process (Carbonell-Foulquié et al., 2004).

![Graph showing variation in relative importance of review dimensions during the NPD process.](Image)

8.7 Appendix G: Management control during service innovation (Aas, 2011)

Management control during service innovation (Aas, 2011).

<table>
<thead>
<tr>
<th>Firm no</th>
<th>Ex-ante</th>
<th>Development</th>
<th>Ex-post</th>
<th>Strategic</th>
<th>Personnel and culture</th>
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<td>None</td>
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<tr>
<td>C</td>
<td>Strategic fit, financial</td>
<td>Technical performance, time, cost</td>
<td>Technical performance, customer satisfaction</td>
<td>None</td>
<td>Competency mapping</td>
</tr>
<tr>
<td>D</td>
<td>Financial</td>
<td>Technical performance, time, cost</td>
<td>Technical performance, customer satisfaction</td>
<td>None</td>
<td>Competency mapping</td>
</tr>
<tr>
<td>E</td>
<td>Varies</td>
<td>Varies</td>
<td>Customer satisfaction (not always)</td>
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<td>Risk, financial, strategic fit</td>
<td>Technical performance</td>
<td>Financial, technical performance</td>
<td>Financial (sales)</td>
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<td>Time, cost, customer satisfaction</td>
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<td>Competency mapping</td>
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<tr>
<td>H</td>
<td>Financial, gut feeling</td>
<td>Market situation</td>
<td>Financial</td>
<td>Financial</td>
<td>Employee well-being, competency</td>
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<td>Financial</td>
<td>None</td>
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<tr>
<td>J</td>
<td>Varies</td>
<td>Varies</td>
<td>Financial</td>
<td>Varies</td>
<td>Competency, personality mapping</td>
</tr>
</tbody>
</table>

8.8 Appendix H: Detailed description PFOS

In spring 2011, a senior advisor (SA) of the market group Environment contacted Dutch airport Schiphol in order to discuss opportunities to do business together. It became clear that during an operation at Schiphol much fire fighting foams were released; fire fighting foams contain PFOS, a chemical that is harmful for the natural environment and causes much pollution. At that moment, there was no commercial technique available that was able to break down PFOS.

The SA knew that ARCADIS in England (AENG) had developed a technique that is able to break down PFOS, so he told that ANL is able to break down PFOS. Schiphol informed the SA that another engineering firm could break down PFOS in a period of 40 years. If ANL could do this significantly faster and cheaper, ANL was allowed to perform the soil remediation. After this, the SA found out that the technique of AENG works but is too expensive. Then, he contacted the research laboratory of ANL; together with a multi-disciplinary team of four people – including one technical specialist (TS) - they investigated whether the technique could be made commercially applicable.

After thorough desk research and tests, the team came to a commercially viable solution. End 2011, ANL discussed with Schiphol about possible next steps. Many parties had stakes in this specific soil pollution problem and eventually a water board became ARCADIS’ client in this. ANL had to change the approach of the specific project to fit the needs of the water board and together with a contractor, it enrolled in a market consultation. The fact that ANL had to offer its’ services in competition with other parties hindered further development and implementation.

During 2011, the team got the impression that co-operation with Schiphol would be postponed indefinitely. Therefore, the team performed market research to identify the scope and stakeholders of the PFOS problem. While doing market research, the team found out that several organizations (e.g. airports and petrochemical complexes) might be interested and that the PFOS problem is not limited to only the Netherlands but occurs in many other countries. Therefore, an international team, consisting of employees from OpCos of ARCADIS, was composed in the summer of 2011 to investigate the size of the PFOS problem and to market this technique as quickly as possible. The initial team was the driving force. To offer a full-scale remedial method, more tests on laboratory scale and in-field were necessary. During market research, the several OpCos realized several concrete leads, mainly for the investigation of PFOS contamination.

In June 2011, a marketing plan was written and sent to Environmental management of the respective OpCos in order to increase awareness and to gain commitment. Reactions from the U.S., England and Germany were positive. In order to protect the technique and to serve as marketing-instrument, BD (of ANL) advised the team to apply for a patent. BD financed and the patent was finally granted in September 2013. However, the team felt that the marketing plan was read moderately. To generate more commitment and sponsorship, the team participated in the summer of 2012 in the yearly, global innovation contest of ARCADIS, Imagine. The team won and received budget.

Feedback of BD stated that an independent in-field proof of the technique was necessary. Because of fear of copying, the team hesitated to discuss pilot projects with potential customers. Yet, the team decided to aim for a launching-customer with a “serious” PFOS problem. The rationale was that ARCADIS would finance the pilot project and if successful, ARCADIS would get the main contract. The won budget was not sufficient enough. Hence, the team presented the marketing plan and their ideas about the pilot project for European management of ARCADIS and asked for corresponding budget, which was granted.

Begin 2012, the team contacted a petrochemical company. This company indicated that it has a major PFOS problem and together they discussed possible next steps. The company noticed that if it would co-operate with the pilot project, it would acknowledge its PFOS problem and should tackle it on all its global petrochemical sites. Therefore, it became reluctant to co-operate. Meanwhile, the team continued its work that consisted of discussions with potential launching-customers, discussions with both an external agency for the patent application and a chemical supplier, and development of marketing and communication material.

Project work became too complicated and because of lack of control and mandate, the team asked for management that is allowed to assign resources and budget. In January 2013, the program director
(PD) of the In-Situ soil remediation team became project leader (PL) and the commercialization of the technique became more structured.

In autumn 2013, a marketing campaign was launched consisting of several press releases and an interview in a newspaper. January 2014, ARCADIS and a German airport agreed to perform a pilot project and are finalizing matters to start the project.
Appendix I: Detailed description Blue Water Program

In 2008, the University of Amsterdam (UvA) found out that hydrogen peroxide (HP) has a much stronger inhibitory effect on photosynthesis of blue algae (algae) than of green algae. In June 2008, the Dutch government organized a meeting for several organizations interested in a European guideline prescribing certain quality of European waters (Water guideline). During this meeting, a researcher of the UvA briefly explained his idea of solving the algae problem in bathing water with the use of HP. A SA of ANL, together with an employee of water board Hunze en Aa’s, agreed with the researcher to work on this idea; the SA started to search for suitable partners but he progressed slowly.

One year later, the tender\(^5\) of the Innovation program for the Water guideline started. Therefore, the head of an advisory group (HAG) and an account manager (AM) within the Water business line (Water) contacted the researcher. Then, Hunze en Aa’s introduced the municipality of Veendam (Veendam) as a potential interested party to test the concept. The concept of the UvA served as basis for the Water guideline grant application. Hereupon, diverse potential parties were invited (e.g. water boards, municipalities) and a large consortium was formed. ANL, as consultancy firm, was member of a subproject to reduce algae with HP. The rationale was that development costs would either be paid by Veendam or partially funded by the grant of the Water guideline.

In June 2009, Veendam had to cope with a lake with an algae problem. Because of the algae, there was a bathing prohibition and a water ski track threatened to be closed. A local bank urged Veendam to find a solution. Therefore, Veendam chose to test the concept of the UvA.

A small-scale experiment in the lake was performed with the aim of achieving safe, durable bathing water. The UvA performed the tests and ANL, Hunze en Aa’s and Veendam were closely involved in the execution. The tests were successful and the HAG went looking for an organization that could reduce the whole lake of algae. Via the internal network of ANL the HAG found remediation company ARCADIS In-Situ Technieken (In-Situ), specialized in building dosing systems for HP. The expertise of In-Situ suited the research well, but treatment of surface water would be a new challenge. Under time pressure, the experiment proceeded. The biggest challenge was that the experiment had to be executed in one day.

In July 2009, this full-scale experiment succeeded and the bathing prohibition was abolished. The experiment was performed by a boat with a specially designed frame. The frame was designed by In-Situ and directly patented. Unfortunately, the grant for the Water guideline was not assigned. Later in 2009, two more experiments in other lakes (i.e. Born and Haarlem) were carried out in a similar manner.

At the end of the bathing season the three experiments were evaluated; technical feasibility was demonstrated, but limits of applicability had to be more clear. ANL concluded that one more bathing season was necessary to draw definite conclusions. Also, it was not clear how the concept would benefit existing business of ANL.

In winter 2009, the team realized new projects and further elaborated the concept; many ideas and possibilities came up, which also increased the amount of (scarce) time spent. The team consisted primarily of the AM of Water and a technical specialist (TS) from In-Situ. During their efforts, the couple would get feedback and assistance from other SAs, management of both Water and Environment, and BD.

In January 2010, the team wrote a business case to get an overview of all possible product concepts and to create commitment from management. Eventually, the team focused NSD on a concept that offers a fixed “bathing warranty” to customers (Blue Water Program).

After consultation with management, a decision was made not to invest in resources needed (e.g. boat, frame) because it was not clear what market potential was. To generate more commitment and sponsorship, the team participated in the summer of 2010 in the yearly, global innovation contest of ARCADIS, Imagine. The jury was not convinced but the team continued to believe in the value of the concept. Hereafter, ANL treated the same lake in Veendam in 2010 one more time, a lake in

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5 A tender is a procedure in which a client organization announces an assignment and asks providers of the product/service for a project proposal.
Hardenberg in 2011, and a creek in Ouwerkerk in 2012. Every treatment of algae was a single treatment, with no fixed bathing warranty for a longer time in place.

Over the years, demand seemed to be less than expected and the team lowered its efforts. In 2012, the TS wrote an investment plan to get sponsorship for a boat; because of too much uncertainty regarding sales volume, management did not want to invest in the boat. Also, the Blue Water Program finished third in the yearly, national innovation contest of ANL, Ondernemerslab. The team was rewarded with explicit support from BD. However, in the meantime the team had lowered its NSD efforts to a minimum.

In 2013, a student performed market research. The market research was not performed well; the student hardly investigated potential customer’s view on the Blue Water Program. However, the overall conclusion was clear; potential revenues of the Blue Water Program are too low. Therefore, the project was put on hold. Since the full-scale method with HP works effectively, ANL is still willing to perform single treatments.
8.10 Appendix J: Detailed description MUDTRAP

In 2007, a project leader (PL) had an innovative idea about dredging of waterways. Dredging of waterways is performed regularly, which leads to high operation costs and destruction of the soil. The PL started thinking about a system that would make that dredging is history. By broadening a location in a waterway, water with silt particles comes to rest so that the silt is allowed to settle. In order to let the settling be done in a manageable way the PL was thinking about a tank construction.

In April 2008, the PL wrote an investment proposal in which the concept was elaborated and in which he mentioned potential customers, a patent application and concrete next steps. Management granted the required budget and the PL continued his work. In 2008, the PL contacted potential customers (e.g. municipalities and water boards) to test their view on the concept. Then, the PL was told that another company also was working on something similar. He decided to contact the company to discuss matters. Both parties noticed that their chances of success should raise when they would cooperate. Therefore, a consortium was created consisting of the following parties: ANL, a builder, and two freelancers.

By creating a consortium the four parties were able to position themselves in varying ways, ranging from both consultancy as installation work related to the dredging concept, named “Mudtrap”. The consortium was addressed to the development, marketing, installation, and exploitation of the Mudtrap. The members of the consortium applied for a patent, which was granted in 2011.

In September 2009, the four parties signed a cooperation contract in which duties and responsibilities were made explicit per consecutive phase. Especially during and after the development phase, several “go/no go” moments were planned. In the meantime, the PL continued contacting potential customers. In this way, he created awareness about the MUDTRAP and aimed for a launching-customer.

In 2010, the team recreated a waterway in a shed in Werkendam and a student performed tests to investigate the efficiency (i.e. technical feasibility and operation costs) of the MUDTRAP. After the tests of the student the team discussed matters and was satisfied with the efficiency. The team concluded that a MUDTRAP can be commercially viable but noticed also that natural factors (for example, water flow or leaves) might hamper efficiency. In 2010, the PL came in touch with the municipality of Darmstadt (Darmstadt). Darmstadt was interested in the MUDTRAP so ANL performed a consultancy project. Eventually, because of vague communication and budget constraints, no MUDTRAP was installed.

Late 2010, the PL lowered his efforts to approach potential launching-customers, mostly because of reserved reactions. A few weeks later, in 2011, water board Vallei en Eem (V&E) approached the PL because it was interested in the MUDTRAP concept. The team started discussions with V&E and it found out that V&E was mostly interested because of their need to raise water quality concerning phosphates and nitrates. Therefore, the head of an advisory group (HAG) first performed a consultancy project for V&E to explain the efficiency of the MUDTRAP and the operation of dredging silt on phosphates. Hereafter, V&E was convinced and the MUDTRAP could be installed and exploited by the consortium. It was agreed to evaluate the MUDTRAP one year later on efficiency, in autumn 2013.
8.11 Appendix K: Detailed description AppStore

In 2012, a SA was told that many small and medium enterprises (SMEs) have difficulties with risk of dust explosions. To control these risks, firms must satisfy certain guidelines (i.e. compliancy). Firms have to demonstrate that they are compliant and ANL consults firms about compliancy. Furthermore, some incidents with dust explosions were present in the news.

In general, ANL performs projects for corporate firms and because of the economic crisis many organizations lower the amount of work they bring to the market. The SA combined the recent dust explosions with ANL’s market position and felt the need to reach new customer groups. Therefore, she developed a new service concept; an online platform for SMEs having difficulties with compliancy.

The AppStore should be a platform with access to tools and applications (apps) developed by ANL, offering quick compliancy scans to SMEs. Furthermore, the AppStore concept could be an improvement of internal knowledge management for ANL. The SA wrote an innovation proposal to the director of Environment. In the proposal she extensively explains the concept, the target market, the revenue model (i.e. free access to specific knowledge), and activities to undertake.

In autumn 2012, a specific innovation program was started within Environment to both look carefully to the way innovation projects are organized and managed, and give certain innovators the possibility to develop their innovative concept. The AppStore concept was given the opportunity to be developed and the SA received budget to proceed the project. The innovation program consisted of seven innovation projects. At the start of the program, every innovator had to pitch the project to the other innovators, the Innovation team member of Environment (I-member), and the director of Environment.

Because ANL had developed a huge volume and diversity of ICT apps, the SA did not worry about technical feasibility of the AppStore. In December 2012, the SA initiated market research to test the view on the concept of potential customers. A market research agency started calling the potential SMEs. Because of the upcoming Holidays, not much response was generated.

It became clear that SMEs were not interested in the service concept. Furthermore, branche associations already provide such information. Meanwhile, the SA also participated in sessions of the Ondernemerslab. This participation was difficult because this contest is focused at concrete value propositions and expected revenue. Furthermore, Environment decided to focus its efforts more on multinationals clients and less on small projects. Therefore, in February 2013, the SA decided with management to kill the project.
8.12 Appendix L: Detailed description Steenmeel

End 2008, an innovation initiative started at market group Environment. Several employees gathered to investigate the use of the mineral olivine in several applications; quickly was agreed to investigate the use of olivine in soil improvement. Furthermore, an advisory group was performing a client project concerning the use of olivine in agriculture. However, research revealed that the use of olivine would deteriorate the soil, because it contains too many heavy metals. Therefore, it was decided to stop both the client project and the research direction of olivine.

Because of sympathy with the initiative, two technical specialists (TSs) continued innovation efforts and brainstormed about other minerals to improve the soil. The two TSs thought of the mineral rock dust. Scientific research showed that rock dust captures carbon dioxide and works as a nutrient supplier. The TSs found out that rock dust combined with fungi would restore soil quality. Therefore, the need for fertilizer would be reduced, making agriculture more sustainable. The TSs saw possible market potential and got offered time to continue research (i.e. performing internal presentations and small experiments).

In 2009, several activities were performed in parallel. The NBM and a financial engineer of BD joined to assist in developing a business case. For ANL, rock dust could yield business opportunities as consultancy for farmers and the food industry, or even selling rock dust to farmers. Begin 2009, the team applied for a patent, which was granted in 2010. In order to investigate practical applicability, a pilot project started, subsidized by the Province of Utrecht. Furthermore, the team contacted the market (e.g. governments, universities, news media, potential partners) to create awareness and discuss business opportunities. Therefore, ANL agreed with Norwegian Nordic Mining about supply of certain minerals and cooperation on the “project”; no financial commitments were made.

End 2009, discussions started with Ankerpoort, another minerals supplier; in December 2010, ANL and Ankerpoort signed a cooperation contract in which both parties aimed to cooperate in further investigating practical and economic feasibility. Despite slow progress, both parties decided “go” in August 2011 and continued the cooperation.

In 2010 and 2011, several research projects were performed in which the practical feasibility of the rock dust concept was further elaborated. In November 2011, a large research project started, named SUPERSOILS. Researchers from several universities and one TS (ANL) further investigated the rock dust concept, supported by the government and several companies.

Begin 2012, disagreements about future directions made that the cooperation between ANL and Ankerpoort ended. Despite growing interest, few revenues were made on all development efforts. Therefore, management of Environment decided in Summer 2012 to kill its share in all initiatives concerning rock dust.
8.13 Appendix M: Poster of EM1 for focus group meeting

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**N.B. Vier kruisjes in de “toetsenvakjes” voor de belangrijkste criteria; nog additionele criteria?**

<table>
<thead>
<tr>
<th>Strategische criteria</th>
<th>Toetsen</th>
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</thead>
<tbody>
<tr>
<td>Toets op basis van strategie</td>
<td>Toets op basis van inzet strategie</td>
</tr>
<tr>
<td>Innovatietracker</td>
<td>Toets op basis van inzet strategie</td>
</tr>
<tr>
<td>Strategische implementatie (kan op nieuwe markt, nieuw product platform, nieuwe technologieën)</td>
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<table>
<thead>
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<th>Marketing criteria</th>
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</tr>
<tr>
<td>Kans op “eerste” in de markt</td>
<td>Toets op basis van inzet strategie</td>
</tr>
<tr>
<td>Synergie met bestaande markttrends, marketing capaciteiten</td>
<td>Toets op basis van inzet strategie</td>
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</table>

<table>
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<tr>
<td>Verhogen fonds</td>
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<tr>
<td>Break even tijd</td>
<td>Toets op basis van inzet strategie</td>
</tr>
<tr>
<td>Binnen het beoogde budget blijven</td>
<td>Toets op basis van inzet strategie</td>
</tr>
</tbody>
</table>

*Belangrijk om te weten of het in de strategiek past en/of de klant er op zit te wonen.*

*De eerste fase heeft sterk nadruk op de *bestaande business nieuwe ideeën* in genereren voor (nieuwe) klanten. Daarom leg ik sterk nadruk op *marketing & strategie*; gewoonlijk komt daarbij ook kijken. In deze fase vind ik *hard* maatstaven; *strategische criteria, techniek* een niet van belang; het kan een doekdoener zijn voor creativiteit en concept uitwerking.*

*Grootste belang is, wat er als *bedrijf wil in deze markt steken*? Daarnaast is belangrijk of er wel een *klant* voor is en een *goed* van *deze manier* of *achtbaar* is. Technische haalbaarheid is nu niet zo belangrijk; als het moet wel heel erg buiten onze normale logen liggen. In deze fase kan *intuïtie* een rol spelen. Later niet meer.*

<table>
<thead>
<tr>
<th>Additionele criteria?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technische haalbaarheid</td>
</tr>
<tr>
<td>Beoordeel productiviteit (inkl. wet. en nepgewich)</td>
</tr>
<tr>
<td>Synergie met bestaande technische capaciteiten</td>
</tr>
<tr>
<td>Potentie voor een patent</td>
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---

**N.B. Kies jaren voor een formele gate, wie/hoor binnen ANL?**

<table>
<thead>
<tr>
<th>Formele gate?</th>
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<tr>
<td>Nee (33,33%)</td>
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**Wie/hoe toetsen binnen ANL?**

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*Round-table, afstudeerproject Louis Essens, 3 december 2013, Arnhem*
Appendix N: Poster of EM4 for focus group meeting

N.B. Korte termijn prestatie. Vier kruisjes in de “toetsenvakjes” voor de belangrijkste criteria; nog additionele criteria?

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<tr>
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<tr>
<td>Innovatie</td>
<td>Toetsen</td>
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<tr>
<td>Feedback van medewerkers</td>
<td>Toetsen</td>
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N.B. Lange termijn prestatie. Vier kruisjes in de “toetsenvakjes” voor de belangrijkste criteria; nog additionele criteria?

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<th>Lange termijn prestatie</th>
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</thead>
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</tr>
<tr>
<td>Omzetdoelstelling behaald</td>
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<tr>
<td>Return on Investment (ROI)</td>
<td>Toetsen</td>
</tr>
</tbody>
</table>

Additionele criteria?

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8.14 Appendix N: Poster of EM4 for focus group meeting

Round-table, afstudeerproject Louisa Esser, 3 december 2013, Arnhem