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The DNA of the fuzzy front end
evaluation of an innovation program

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The DNA of the Fuzzy Front End

Evaluation of an innovation program

by

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Preface

Three years of studying at the University of Technology in Eindhoven have been a great experience for me. The thesis before you is the result of my graduation project that forms the end of the master Innovation Management. I would to thank some people who supported me during my thesis project. These people make this thesis project an enjoyable and great learning experience.

First of all, I would to thank my supervisor Fred Langerak. His lectures in the beginning of the master Innovation Management attracted my attention to new product development. Furthermore, I am also thankful for his valuable insights and guidance during the thesis project. Secondly, my thanks go also to my second supervisor Isabelle Reymen. I really appreciated her valuable input during the last phase of my graduation project. Third, my special attentions go to my two company supervisors Jaco ter Wal & Kristen Wokke. Their practical insights, motivation and guidance where extremely valuable for my. Fourth, I would to thank all the people of Bureau de Bont for giving me the opportunity to do my research. The conversations I had with the people by Bureau de Bont during my thesis project were insightful and enjoyable. Finally, I want to thank all my family and friends for their interests during my study and thesis project. They made my years as student fantastic so that I can look back to a fantastic period of my life.

I hope that you will enjoy reading this thesis!
Management summary

Introduction
The subject of the thesis project is the program ‘Connected Innovation’. This program has as aim to generate for the construction sector feasible innovations in three to four months.

The program starts with an idea generation session. After this session each project team elaborates their idea on feasibility and market aspects. Moreover, two clients were asked to give feedback on the idea. The last step of the program ‘Connected Innovation’ is the idea presentation session. The program is developed by Bureau de Bont and in this setting used for Arcadis. Although Arcadis was satisfied, Bureau de Bont had still the feeling that the program can be improved. Therefore, the research question is as follows:

How can the program ‘Connected Innovation’ be improved based on the best practices of the fuzzy front end?

To answer this research question theoretical insights are gathered by conducting a literature study for the best practices of the fuzzy front end (FFE). The FFE is defined as “activities that take place prior to the formal, well-structured new product and process development or stage-gate®system.” (Koen, et al., 2001).

Theoretical insights
The program ‘Connected Innovation’ is related to the FFE, because the elements and outcome of the program are comparable with the FFE. Moreover, the elements of the program have the same uncertain and iterative nature as the FFE. Based on the FFE literature, the following figure shows the theoretical best practices for each step of the program ‘Connected Innovation’.
These best practices are used to analysis to what extend the program ‘Connected Innovation’ corresponds with the best practices. This analysis is described in the following section.

Analysis
In this section the program ‘Connected Innovation’ is analyzed. The strong/ weaknesses analysis is based on theoretical and empirical insights. The theoretical strong and weak points are based
on the theoretical insights of the previous section. The empirical strong and weak points are gathered by conducting a case study. Four interviews were held with members of the program ‘Connected Innovation’. Five interviews were held with employees of other innovative construction companies and two interviews were held with employees who working in another sector. The figure below shows the results of this analysis. The mean weakness are marked with the following exclamation mark.

**Figure 3 Analysis**

Based on the figure above can be concluded that the mean weakness of the program ‘Connected Innovation’ is the *preparation* phase and the outcome of the program. More specific, the weaknesses of the program ‘Connected Innovation’ are related to the *missing opportunity identification and opportunity analysis, idea generation methods, missing idea selection, selection of members on personality traits, missing gate: go to development, backwards focus and not achieved objectives*. The following chapter will address these weak points by giving improvements for it.
Improvement program ‘Connected Innovation’

Based on the theoretical and empirical weak points, the redesign of the program ‘Connected Innovation’ is shown in the figure below.

In comparison to the origin program ‘Connected Innovation’ the redesign consists of the following additional elements: opportunity identification & analysis, opportunity gate, idea selection gate, gate: go to development and a development & commercialization phase. Beside the additional elements, also other improvements are proposed for the program ‘Connected Innovation. A PICK diagram is used to determine the most promising improvements.

![Figure 4 Redesign program ‘Connected Innovation’](image-url)

![Figure 5 PICK diagram](image-url)
Based on the PICK diagram, it is recommendable to implement the following improvements: 1) opportunity identification and analysis, 6) cross-functional team, 7) idea selection gate, 10) use of standard formats, 12) gate: go to development, 13) multifunctional review team 15) change team composition and 16) involve the responsible department. These improvements scores high on the combination of effect and feasibility. Therefore, these improvements are the most promising. Improvement 14) stay involved and improvement 4 & 9) team composition (leader, originator, motivator, debater and effector) score very high on effect. Therefore is it recommended to implement also these improvements.

**Conclusion**

Based on this research can be concluded that it is more important to do the right things, than to do the things right. The main weaknesses of the program ‘Connected Innovation’ were not related to the existing elements of the program, but to missing elements of the program, such as missing opportunity identification and analysis, gates, etc.

Another conclusion that can be drawn is that people which are involved in the innovation team is the most important factor of the innovation process. This means that not the design and structure of the innovation process is the key factor for a successful product or service, but the selection of the right people.

The last conclusion is that the program ‘Connected Innovation’ is a good manner to generate new ideas. Nevertheless, it seems hard for people to implement and commercialize the idea.

Important to note that this research focuses only on the construction sector. Therefore, the results cannot be generalized outside this setting.
## Table of Content

1 Introduction ............................................................................................................. 1  
   1.1 Theoretical background ...................................................................................... 1  
   1.2 Empirical context ............................................................................................... 1  
   1.3 Problem definition .............................................................................................. 2  
   1.4 Research objective ............................................................................................. 2  
   1.5 Structure of report ............................................................................................... 3  
2 Methodology ........................................................................................................... 4  
   2.1 Literature study .................................................................................................. 4  
   2.2 Case Study ........................................................................................................ 4  
      2.2.1 Unit of analysis: program ‘Connected Innovation’ ..................................... 4  
      2.2.2 Data collection ........................................................................................... 9  
      2.2.3 Data analysis ............................................................................................... 10  
      2.2.4 Quality ....................................................................................................... 10  
   2.3 Improvement program ‘Connected Innovation’ ................................................. 11  
3 Theoretical insights ................................................................................................. 12  
   3.1 Fuzzy front end .................................................................................................. 12  
      3.1.1 Position of the fuzzy front end ................................................................. 12  
      3.1.2 Definition fuzzy front end ......................................................................... 13  
      3.1.3 Characteristics fuzzy front end ................................................................. 13  
      3.1.4 Fuzzy front end model .............................................................................. 14  
   3.2 Influencing factors ............................................................................................. 15  
      3.2.1 Description influencing factors .................................................................. 15  
      3.2.2 Best practices influencing factors ............................................................ 16  
   3.3 The engine (strategy, leadership & culture) ....................................................... 16  
      3.3.1 Description engine ................................................................................... 17  
      3.3.2 Best practices engine ............................................................................... 17  
   3.4 Opportunity identification ............................................................................... 18  
      3.4.1 Description opportunity identification ..................................................... 18  
      3.4.2 Best practices opportunity identification ................................................. 18  
   3.5 Opportunity analysis ......................................................................................... 19  
      3.5.1 Description opportunity analysis .............................................................. 19  
      3.5.2 Best practices opportunity analysis .......................................................... 20  
   3.6 Idea genesis ...................................................................................................... 20  
      3.6.1 Description idea genesis .......................................................................... 20  
      3.6.2 Best practices idea genesis ..................................................................... 21  
   3.7 Idea selection ................................................................................................... 22  
      3.7.1 Description idea selection ...................................................................... 22  
      3.7.2 Best practices idea selection ................................................................. 23  
   3.8 Concept & technology development ................................................................. 23  
      3.8.1 Description concept & technology development .................................... 24  
      3.8.2 Best practices concept & technology development .................................. 24  
   3.9 Gate: go to development ................................................................................. 27  
      3.9.1 Description gate: go to development ....................................................... 27
3.9.2 Best practices gate: go to development ............................................. 27
3.10 Conceptual model ............................................................................ 29
4 Analysis .................................................................................................. 31
4.1 Preparation of the program ‘Connected Innovation’ ....................................... 31
  4.1.1 Theoretical analysis ......................................................................... 31
  4.1.2 Empirical analysis ........................................................................... 32
4.2 Idea generation session of the Program ‘Connected Innovation’ ...................... 33
  4.2.1 Theoretical analysis ......................................................................... 33
  4.2.2 Empirical analysis ........................................................................... 33
4.3 Program ‘Connected Innovation’: Idea elaboration & client involvement .......... 35
  4.3.1 Theoretical analysis ......................................................................... 35
  4.3.2 Empirical analysis ........................................................................... 36
4.4 Program ‘Connected Innovation’: Idea presentation session ......................... 37
  4.4.1 Theoretical analysis ......................................................................... 37
  4.4.2 Empirical analysis ........................................................................... 38
4.5 Program ‘Connected Innovation’: Outcome ............................................ 39
  4.5.1 Theoretical analysis ......................................................................... 39
  4.5.2 Empirical analysis ........................................................................... 39
4.6 Strong/ weaknesses analysis .................................................................... 40
5 Improvement program ‘Connected Innovation’ .............................................. 42
  5.1 Redesign ............................................................................................. 42
    5.1.1 Opportunity identification and analysis ........................................... 42
    5.1.2 Opportunity gate ............................................................................ 43
    5.1.3 Idea generation session ................................................................. 44
    5.1.4 Idea selection gate ........................................................................ 45
    5.1.5 Idea elaboration & client involvement ........................................... 45
    5.1.6 Gate: go to development ............................................................... 46
    5.1.7 Development & commercialization of ideas .................................... 47
  5.2 Change plan ....................................................................................... 48
6 Conclusion .............................................................................................. 51
  6.1 Research objective ............................................................................. 51
  6.2 Theoretical implications ...................................................................... 52
  6.3 Empirical implications ....................................................................... 53
  6.4 Limitations and future research ........................................................... 53
References .................................................................................................. 54
Appendix I ............................................................................................... 57
Appendix II ............................................................................................... 59
Appendix III ............................................................................................... 64
Appendix IV ............................................................................................... 66
Appendix V ............................................................................................... 69

List of figures

Figure 1 Program ‘Connected Innovation’ ..................................................... 4
Figure 2 Theoretical insights ....................................................................... 5
Figure 3 Analysis ....................................................................................... 6
List of tables

Table 1 Idea generation session ................................................................. 7
Table 2 Idea elaboration & client involvement .......................................... 8
Table 3 Idea presentation session ............................................................... 9
Table 4 Overview of empirical analysis ..................................................... 9
Table 5 Quality case study (Yin, 2003) ....................................................... 11
Table 6 Definition fuzzy front end .............................................................. 13
Table 7 Characteristics fuzzy front end (Koen, et al., 2002), (Kim & Wilemon, 2002) ... 14
Table 8 Gate agenda (Polczynski, 2010) ..................................................... 27
Table 9 Strong/weak points preparation .................................................... 32
Table 10 Strong/weak points idea generation session ................................. 35
Table 11 Strong/weak points idea elaboration & client involvement ............. 37
Table 12 Strong/weak points idea presentation session ............................... 38
Table 13 Strong/weak points outcome

Table 14 Redesign - Opportunity identification & analysis

Table 15 Redesign - Opportunity gate

Table 16 Redesign - Opportunity identification & analysis

Table 17 Redesign - Idea selection gate

Table 18 Redesign - Idea elaboration & client involvement

Table 19 Redesign - Gate: go to development

Table 20 Redesign - Development & commercialization of ideas

Table 21 Innovation types (Garcia & Calantone, 2002)
1 Introduction

In this chapter the thesis project is introduced. The subject of the thesis project is the program ‘Connected Innovation’. This program has as aim to generate feasible innovations for the construction sector in three to four months. This chapter is structured as follows. First, the theoretical background of the program ‘Connected Innovation’ is given. Second, the empirical context of the thesis project is described. Third, the problem definition is given. Fourth, the research objective is elaborated. The last section explains the structure of this report.

1.1 Theoretical background

Nowadays, innovative new products are more and more important for companies (Griffin, 1997). Therefore, an effective and efficient innovation process is essential to ensure these innovative new products. As shown in the figure below the innovation process can be divided in the fuzzy front end (FFE) and the development & commercialization phase.

![Innovation process diagram](image)

Figure 6 Innovation process (Osterwalder & Pigneur, 2010)

As shown in the figure above the FFE is more or less an iterative and uncertain process, while the development & commercialization is more or less a linear and certain process. Aken & Nagel (2004) also describe that the FFE can be characterized by no clear beginning, multiple inputs, no well-defined throughput process, high creativity level and participants getting involved and dropping out in unplanned ways. Nevertheless, in the last two decades, the literature underlines more and more the importance of the FFE in new product development (Khurana & Rosenthal, 1998), (Aken & Nagel, 2004). Because in the FFE the product features and product advantage are determined (Hauser, Tellis, & Griffin, 2005). Therefore, the FFE has high potential for cost savings, quality improvements and time reductions. Moreover, in the FFE is it possible to adjust the product with relatively low costs compared to the costs of product adjustments in the development or commercialization phase, because the investments in the FFE are lower than in the development & commercialization phase (Hüsig & Kohn, 2003).

1.2 Empirical context

The case of the thesis project is the program ‘Connected Innovation’. As described above the purpose of this program is to generate feasible innovations for the construction sector in three to four months. In the following figure the program ‘Connected Innovation’ is shown.
How can the program ‘Connected Innovation’ be improved based on the best practices of the fuzzy front end?

The program ‘Connected Innovation’ starts with an idea generation session. The second step is the idea elaboration & client involvement. In this step each project team elaborate their idea and describes: 1) the problem it solves, 2) makes an estimation of the market and 3) develop a reliable and profitable business case. Moreover, potential clients are asked to give feedback on the idea. The third step of the program is the idea presentation step.

1.3 Problem definition

Although Arcadis was satisfied with the program ‘Connected Innovation’, Bureau de Bont had the feeling that there is still room for improvement. Because it was unknown of the program contains all the essential elements. Also it was unknown of the elements were executed in the right manner. Moreover, the feeling that the program can be improved was strengthened by the evaluation session between Bureau de Bont and Arcadis. In this evaluation session are different improvements mentioned, such as better group composition, monitoring of results, etc.

1.4 Research objective

Based on the problem definition the research question is as follows:

Research question:

How can the program ‘Connected Innovation’ be improved based on the best practices of the fuzzy front end?

Sub questions:

1. What is the fuzzy front end?
2. Which best practices are described in the literature for the fuzzy font end?
3. How was the program ‘Connected Innovation’ currently organized by Bureau de Bont?
4. What are the strong and weak points of the program ‘Connected Innovation’?
5. How to address the weak points in the program ‘Connected Innovation’?

Objective:

Improve the program ‘Connected Innovation’ in such a way that it contains all the best practices for the construction sector before 22 August 2012.
1.5 Structure of report

To answer the research question, the remainder of this report is structured in line with Figure 8. First, the methodology is described in chapter 2. Theoretical insights are given in chapter 3. The analysis is discussed in chapter 4. Based on this analysis are in chapter 5 improvements for the program ‘Connected Innovation’ proposed. Chapter 6 ends the report by giving the main conclusions.

Figure 8 Structure of the report
2 Methodology

As shown in Figure 9 this thesis project consists of a theoretical and empirical part. The theoretical part consists of a literature study and the empirical part consists of an analysis of the results of the case study. The literature study and case study deliver the input for the last part of the thesis project, namely the improvement of the program ‘Connected Innovation’. The main conclusions of this research are shown in the last chapter of this report. This chapter is structured as follows. The first section elaborates the methodology which is used for the literature study. In the second section the case study methodology is discussed. The last section describes the methodology for the improvement of the program ‘Connected Innovation’.

2.1 Literature study

Theoretical insights are essential for conducting a case study (Aken, Berends, & Bij, 2006), (Yin, 2003). Although each business problem has its unique context and characteristics, almost always research has been done to similar problems. The insights and results of this research can be used as basis for naming and framing the business problem, exploring the solutions and providing evidence for the solutions (Aken, Berends, & Bij, 2006), (Yin, 2003).

As described in the introduction the program ‘Connected Innovation’ is related to the fuzzy front end (FFE), because the elements and outcome of the program are comparable with the FFE. Moreover, the elements of the program have the same uncertain and iterative nature as the FFE. Therefore, the FFE is the focus of the literature study. The approach that will be followed is first to become familiar with the area of the FFE. Therefore, the first article has to be a review about the FFE. This is way the first article which will be used for the literature study is the overview article of Hüsig & Kohn (2003). The selection of the other articles will be based on the authors, title, abstract and conclusion of the articles. The aim of the literature study is to answer the following sub questions:

1) What is the fuzzy front end?
2) Which best practices are described in the literature for the fuzzy front end?

The result of the literature study is a conceptual model of the FFE. In this conceptual model are the best practices of the FFE for the construction sector described.

2.2 Case Study

According to Yin (2003) a case study is a valuable addition to investigate a business problem in its real-life context. Because the program ‘Connected Innovation’ is performed only once this case study is named a single case study. According to Yin (2003) can this case be described as a representative or typical case, because by a representative or typical case is the objective to capture the conditions of a commonplace situation. Before the methodology of the case study is further elaborated, first the unit of analysis is described in detail.

2.2.1 Unit of analysis: program ‘Connected Innovation’

The unit of analysis is the major entity that is analyzed in a research (Yin, 2003). The unit of analysis is the program ‘Connected Innovation’ which is developed by Bureau de Bont. The
program ‘Connected Innovation’ is executed by Bureau de Bont for Arcadis. The remainder of this subsection describes in detail the context, origin, organizational structure and elements of the program ‘Connected Innovation’.

**Context of the program ‘Connected Innovation’**

This part is divided in four paragraphs. The first paragraph describes the characteristics of the innovation climate in the Netherlands. The second paragraph focuses on the characteristics of the construction sector. The third paragraph describes Bureau de Bont. The last paragraph highlights Arcadis.

**Innovation climate in the Netherlands:** The innovation climate in the Netherlands is described in the ‘Global Competitiveness Report 2011-2012’ of the World Economic Forum. The Netherlands scores high on its institutions and its education system. Furthermore, the Netherlands scores high on their sophisticated nature. Nevertheless, the innovation climate in the Netherlands is constrained by too few BETA students and low investments in R&D projects.

**Construction sector:** According to Harty (2005) the construction sector can be characterized by project-based approach and high inter-organizational collaboration. This results in a fragmented building process. Moreover, due the economic crisis traditional revenue models, products and services are not longer applicable. Therefore, innovation becomes more and more important for the construction sector.

**Bureau de Bont:** The program ‘Connected Innovation’ is developed by Bureau de Bont. Bureau de Bont is a consultancy company which focuses on business- and organization development. Bureau de Bont consists of two departments, namely ‘Construction’, and ‘Healthcare’ (www.bureaudebont.nl). The program ‘Connected Innovation’ is executed by the department ‘Construction’.

**Arcadis:** Arcadis is an international company which provides consultancy, design, engineering and management services in the fields of infrastructure, water, environment and buildings (www.arcadis.com). The program ‘Connected Innovation’ is executed for the department Business Development. It was the first time that the program ‘Connected Innovation’ is executed.

**Origin of the program ‘Connected Innovation’**

The department Business Development of Arcadis wants to solve the declining turnover of Arcadis by municipalities. The declining turnover has to be solved by the generation of new ideas for products or services. This was the origin of the program ‘Connected Innovation’. Moreover, the department Business Development was also looking for an efficient program which obtaining acceptance and support through the whole organization.

**Organizational structure of the program ‘Connected Innovation’**

The organisational structure of the program ‘Connected Innovation’ is depicted in the following figure. This figure also displays the names of the members who participate in the program ‘Connected Innovation’. The bold, underlined names are interviewed during the case study.
**Steering committee:** The steering committee consists of Don Hardy (director Business Development), Toon Strijbosch (manager New Business), Wouter Dreimüller (advisor New Business), Jaco ter Wal (Bureau de Bont) and Kristen Wokke (Bureau de Bont). The manager New Business was also the financier of the program ‘Connected Innovation’. The steering committee had during the program several meetings to monitor the program ‘Connected Innovation’. As shown in the figure above are the members of the steering committee also active project team members.

**Innovation Team (IT) members:** Robert Kroon, Jan van Overeem, Wim Plaisier and Wijnand Susanna where IT members. The IT members are active members of the project teams. Their role in the project team is initiator, connector, guard and motivator of the process. Bureau de Bont had during the executing of the program three meetings with the IT members to evaluate the process of the project teams.

**Project team members:** The members of the project teams are of all departments of Arcadis. The project teams consist of five employees.

**Elements and timeline of the program ‘Connected Innovation’**

The program ‘Connected Innovation’ consists of three elements. In the figure below are the elements and the timeline of the program ‘Connected Innovation’ depicted.
Element 1) Idea generation session: The *idea generation session* was on 24 March 2011. The content of the *idea generation session* is shown in the table below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Explanation</th>
<th>Who</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest speaker</td>
<td>This session starts with a guest speaker who tells something about the development and launch of his own product: the Chick’n'Run. The Chick’n'Run is a spectacular live game with adult size spring riders. In the game players compete with another by riding the spring riders as fast as they can (<a href="http://www.fourcelabs.com">www.fourcelabs.com</a>). The goal of the guest speaker is to motivate people to be innovative and creative.</td>
<td>Guest speaker</td>
<td>15.00-15.30 (30 minutes)</td>
</tr>
<tr>
<td>Explanation program ‘Connected Innovation’</td>
<td>In the second activity Bureau de Bont explains the origin, content, structure, objectives and deadlines of the program.</td>
<td>Bureau de Bont</td>
<td>15.30-16.00 (30 minutes)</td>
</tr>
<tr>
<td>Introduction and project team composition</td>
<td>The third activity is aimed at the introduction of all the members. Everybody gets 5 minutes to introduce himself/herself based on an object. Afterwards, the predetermined team composition is announced.</td>
<td>Individual members</td>
<td>16.00-17.00 (60 minutes)</td>
</tr>
<tr>
<td>Idea generation</td>
<td>The fourth activity is the generation of new ideas. The idea generation session is focused on identifying new opportunities for services during demographic decline and recession by municipalities. All the team members could come up with ideas. The best idea is further elaborated by using a format document. The format document consists of the following elements: 1) description of the idea, 2) the relevant market trends, 3) the problem it solves, 4) target group, 5) advantage of the idea for the target group, 6) SWOT analyzes, 7) objective and 8) an action plan.</td>
<td>Project teams</td>
<td>17.30-18.50 (80 minutes)</td>
</tr>
<tr>
<td>Presentation of ideas</td>
<td>In this step each project team presents their ideas to the other project teams. The purpose of these presentations is to improve the ideas through positive feedback of the other teams.</td>
<td>Project teams</td>
<td>18.50-19.30 (40 minutes)</td>
</tr>
<tr>
<td>Evaluation and finalization</td>
<td>The last activity of this session is the evaluation and finalization of this session.</td>
<td>Bureau de Bont &amp; project teams</td>
<td>19.30-20.00 (30 minutes)</td>
</tr>
</tbody>
</table>

Table 1 Idea generation session

Element 2) Idea elaboration & client involvement: After the first session, the four teams have to elaborate their idea. Moreover, they have to ask clients to give feedback on the idea. In the following table is this element of the program ‘Connected Innovation’ further elaborated.
**Activity**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Explanation</th>
<th>Who</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Idea elaboration</strong></td>
<td>In this phase each project team elaborates their idea. The explanation and elaboration consists of: 1) further development of the idea, 2) description of the problem it solves, 3) estimation of the market and 4) the development of a reliable and profitable business case. In this phase each project team has two meetings under supervision of Bureau de Bont.</td>
<td>Project teams</td>
<td>April, May (2 months)</td>
</tr>
<tr>
<td><strong>Client involvement</strong></td>
<td>A requirement of the program ‘Connected Innovation’ is that each project team should have at least two conversations with potential clients. During these conversations the project team presents their idea to the client and clients are asked for feedback and improvements. Based on the feedback the idea is further developed.</td>
<td>Project teams</td>
<td>June (1 month)</td>
</tr>
</tbody>
</table>

Table 2 Idea elaboration & client involvement

**Element 3) Idea presentation session:** In the second plenary session of the program ‘Connected Innovation’ presents each project team their idea. This session is elaborated in the table below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Explanation</th>
<th>Who</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest speaker</td>
<td>This session starts also with a guest speaker who tells about the development and launch of his own product. The goal of the guest speaker is to motivate the members.</td>
<td>Guest speaker</td>
<td>15.00-15.30  (30 minutes)</td>
</tr>
<tr>
<td>Idea presentation &amp; feedback</td>
<td>Each project team presents their innovative idea to the other project teams and to the director Business Development. The presentation consists of the following elements: 1) explanation of the idea, 2) description of the problem it solves, 3) an estimation of the market and 4) a business case. After the presentation, the other project teams have the opportunity to give feedback on the following points: 1) have the innovation enough potential, 2) what is missed and 3) how can the innovation be improved. The aim of the feedback is to learn from each other and to improve the idea based on the feedback.</td>
<td>Project teams</td>
<td>15.30-17.30  (120 minutes)</td>
</tr>
<tr>
<td>Preparation presentation future</td>
<td>At the dinner, the project teams discussed how their idea should be developed in the future. The main questions were: 1) which information is missing, 2) who will be needed in the future for the development of the idea and 3) what will be the role of the project team in the future.</td>
<td>Project team</td>
<td>17.30-18.30  (60 minutes)</td>
</tr>
<tr>
<td>Presentation future</td>
<td>Each group gives a presentation of 5 minutes on how the idea should be further developed. During this presentation are the missing</td>
<td>Project team</td>
<td>18.30-19.00  (30 minutes)</td>
</tr>
</tbody>
</table>
information, needed actions and role of the project team for the future presented. Finally, the members have the opportunity to vote on the best idea.

Evaluation and finalization

The last activity of this session is the evaluation and finalization of this session and the total program ‘Connected Innovation’.

| Evaluation and finalization | Bureau de Bont & project teams | 19.30-20.00 (30 minutes) |

**Table 3 Idea presentation session**

2.2.2 Data collection

The focus of this thesis project will be on qualitative data. The collection of this data will be carried out by semi-structured interviews. The structure of the interviews is open-ended; this implies that was allowed to discuss other relevant aspects. Nevertheless, an interview guide was used to ensure the global structure of the interviews. The table below shows the name of the interviewees, sectors, companies, etc.

<table>
<thead>
<tr>
<th>#</th>
<th>Interviewee</th>
<th>Sector</th>
<th>Company</th>
<th>Function</th>
<th>Date</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robert Kroon</td>
<td>Construction</td>
<td>Arcadis</td>
<td>Program director</td>
<td>10/5/2012</td>
<td>90 minutes</td>
</tr>
<tr>
<td>2</td>
<td>Arjen Baltus - Naomi Baan Hofman</td>
<td>Construction</td>
<td>Arcadis</td>
<td>-Senior consultant - Public consultant</td>
<td>25/5/2012</td>
<td>75 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Don Hardy</td>
<td>Construction</td>
<td>Arcadis</td>
<td>-Director business development -Member of the innovation team of Arcadis</td>
<td>12/6/2012</td>
<td>60 minutes</td>
</tr>
<tr>
<td>4</td>
<td>Wim Plaisier</td>
<td>Construction</td>
<td>Arcadis</td>
<td>Director In-Situ Technieken</td>
<td>12/6/2012</td>
<td>45 minutes</td>
</tr>
<tr>
<td>5</td>
<td>Ad van der Aa</td>
<td>Construction</td>
<td>Cauberg-Huygen</td>
<td>Technical Director</td>
<td>31/5/2012</td>
<td>45 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Theo Ockhuizen</td>
<td>Construction</td>
<td>UNETO-VNI</td>
<td>Chairman Innovation Platform</td>
<td>1/6/2012</td>
<td>90 minutes</td>
</tr>
<tr>
<td>7</td>
<td>Rik Dikken</td>
<td>Construction</td>
<td>Unica</td>
<td>General director</td>
<td>4/6/2012</td>
<td>60 minutes</td>
</tr>
<tr>
<td>8</td>
<td>Dick van Regteren</td>
<td>Construction</td>
<td>Genap BV</td>
<td>Owner &amp; sales director</td>
<td>5/6/2012</td>
<td>60 minutes</td>
</tr>
<tr>
<td>9</td>
<td>Ad van ‘t Zelfde</td>
<td>Construction</td>
<td>Bam Civiel</td>
<td>Innovation-manager</td>
<td>13/6/2012</td>
<td>60 minutes</td>
</tr>
<tr>
<td>10</td>
<td>Wouter Pijzel</td>
<td>Branch organization</td>
<td>NOVU</td>
<td>Director</td>
<td>29/5/2012</td>
<td>60 minutes</td>
</tr>
<tr>
<td>11</td>
<td>Bert Herweijer - Cynthia Knook</td>
<td>Telecom</td>
<td>KPN</td>
<td>-Management consultant -Master thesis student</td>
<td>30/5/2012</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

**Table 4 Overview of empirical analysis**
As shown in the table above the data will be collected from different sources, namely: from IT members (interviewee 1 & 4), member of the program (interviewee 2), initiator of the program (interviewee 3) and member of the ‘innovation team’ of Arcadis (interviewee 4). Moreover, five interviews were held with employees of innovative companies in the construction sector (interviewees 5-9). Furthermore, two interviews were held with employees who working in another sector (interviewees 10-11). The aim of these interviews is to answer the following sub questions:

3) How is the program ‘Connected Innovation’ currently organized by Bureau de Bont?
4) What are the strong and weak points of the program ‘Connected Innovation’?

Obviously, these sub questions are only relevant for the interviews that were held with members of the program ‘Connected Innovation’ (interviewees 1-4). Therefore, the interviews 5-11 focused on how an innovation process should looks like, what the most critical factors are for innovation and what the most common problems are by innovation. The complete interviews guides are shown in Appendix IV. Beside the interviews, the available information, such as presentations, mailings, documents and the program scripts is also collected and analyzed.

2.2.3 Data analysis
The interviews will be analyzed in parallel with the available documentation, such as presentations, mailings, documents, program scripts, etc. All the interviews are recorded and afterwards transcribed. Thereafter, all the interviews are coded on strong and weak points. These strong and weak points are used as input for the analysis of the program ‘Connected Innovation. This analysis is described in chapter 4. For instance, interviewees Baltus & Baan Hofman (2012) says that members experienced the cross-functional nature very positive, because it results in thinking outside of the box. Therefore, this is seen as a strong point of the program ‘Connected Innovation’. As described above focus interviews 5-11 at how an innovation process should looks like, what the most critical factors are for innovation and what the most common problems are by innovation. This information is also coded on strong and weak points. For instance, according to Theo Ockhuijsen is explicit involvement of clients is important and new for the construction sector. Therefore, this is seen as a strong point of the program ‘Connected Innovation’. In case of contradicting results between interviews and available information an additional analysis will be carried out, such as a call to the interviewee.

2.2.4 Quality
An important aspect by the case study is the quality. According to Yin (2003) are four tests important to taken into account, namely: construct validity, internal validity, external validity and reliability. The table below shows the definition of the tests, the advice, the phase when the advice is relevant and the tactic which is used during this thesis project.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Definition</th>
<th>Advice (phase)</th>
<th>Tactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct validity</td>
<td>Establishing correct operational measures for the concepts being studied.</td>
<td>-Use multiple sources of evidence <em>(data collection)</em>.</td>
<td>-Use of multiple source of evidence, such as interviewees, presentations, mailings, documents, program scripts, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Establish chain of evidence <em>(data collection)</em>.</td>
<td>-References are given</td>
</tr>
</tbody>
</table>
| Internal validity | Establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. | -Do pattern-matching (data analysis).  
-Do explanation-building (data analysis).  
-Address rival explanations (data analysis).  
-Use logic models (data analysis). | -Clear research framework using a well known FFE model.  
-Interviews from different companies, departments and hierarchical levels. |
<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>External validity</td>
<td>Establishing the domain to which a study's findings can be generalized.</td>
<td>-Use theory in single-case studies (research design).</td>
<td>-Theoretical insights are gathered by conducting a case study, before the case study is started.</td>
</tr>
</tbody>
</table>
| Reliability       | Demonstrating that the operations of a study can be repeated, with the same results. | -Use case study protocol (data collection).  
-Develop case study database (data collection). | A specific folder contains all the used data, such as the recorded interviews, presentations, mailings, documents, program scripts, etc. |

| Table 5 Quality case study (Yin, 2003) |

### 2.3 Improvement program ‘Connected Innovation’

The aim of the improvement of the program ‘Connected Innovation’ is to answer the last sub question, namely:

5) **How to address the weak points in the program ‘Connected Innovation’?**

The input for the improvements is the strong and weaknesses analysis, which is described in the previous section. The theoretical improvements are based on the literature study. For instance, the literature argued that an *opportunity identification and analysis* is essential, because this guides the innovation process (Koen, et al., 2002). Therefore, an *opportunity identification and analysis* step is added to the redesign of the program ‘Connected Innovation’. The empirical improvements are based on the interviews of the case study. For example, interviewee Wouter Pijzel (2012) argued that the team composition have to change during the innovation process. In the beginning of the process creative people are needed, while at the end finishers are needed. Therefore, changing team composition is taken into account in the redesign of the program ‘Connected Innovation’.
3 Theoretical insights

As described in the introduction the program ‘Connected Innovation’ is related to the fuzzy front end (FFE). The aim of this chapter is to answer the following sub questions:

1) What is the fuzzy front end?
2) Which best practices are described in the literature for the fuzzy front end?

This chapter is structured as follows. The first section focuses on the general characteristics of the FFE. In the following eight sections the best practices are discussed. Finally, this chapter ends with a conceptual model.

3.1 Fuzzy front end

This section is structured as follows. In the first subsection the position of the FFE in the innovation process is discussed. The second subsection elaborates on the definitions of the FFE. In the third subsection the characteristics of the FFE are described. Finally, the last subsection discusses the FFE model.

3.1.1 Position of the fuzzy front end

Nowadays, introduction of innovative new products is more and more important for companies. According to Griffin (1997) the profit from new products, which are introduced in the past three years, has increased from 15 percent in 1998 to 27 percent in 2007. Moreover, the development time of new products has decreased from on average 18 months to 13 months. Based on these two trends it can be concluded that the development of innovative new products is more and more important for companies to survive. An effective and efficient new product development process is essential to ensure these innovative new products. The most widely used new product development method is the stage-gate® system (Schilling, 2008). In a stage-gate® system project-management methodologies are added to the innovation process. This means that the innovation process is divided in stages and after each stage a quality check or gate ensures the quality of the idea/product (see Appendix II). The general stage-gate® system is illustrated in the figure below.

As shown in the figure above the stage-gate® system consists of three main phases, namely: FFE, development and commercialization. In the last two decades, the literature appointed more and more the importance of the FFE in new product development (Khurana & Rosenthal, 1998), (Aken & Nagel, 2004), because in the FFE the product features and product advantage are determined (Hauser, Tellis, & Griffin, 2005).
3.1.2 Definition fuzzy front end

Now, it can be concluded that the FFE is important during the innovation process. Nevertheless, in the literature a common and broadly accepted definition of the FFE does not exist (Hüsig & Kohn, 2003). The following table contains the four most common definitions of the FFE.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>“Product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning and executive reviews.”</td>
<td>“Individual project strategy formulation, preliminary market &amp; technology assessment and feasibility studies, concept definition, product and business planning, idea generation and selection, opportunity identification &amp; analysis, construction of early prototypes, knowledge and people transferring, field testing and market experiments.”</td>
<td>“FFE exists of the first three stages and gates of the stage-gate® system, namely: ‘discovery stage’, ‘idea screen gate’, ‘scoping stage’, ‘second screen gate’, ‘build business case stage’ and ‘go to development gate’.”</td>
<td>“Activities that take place prior to the formal, well-structured new product and process development or stage-gate® system.”</td>
</tr>
</tbody>
</table>

Table 6 Definition fuzzy front end

In the definition of Khurana & Rosenthal (1998) strategy formulation and communication is an important aspect of the FFE. In addition to this definition, Hüsig & Kohn (2003) argued that early prototyping, field testing and market experiments are also important aspects of the FFE. In contrast to the previous two definitions Cooper (1997) focuses only on the operational aspects and not on the strategic aspects. The last definition of Koen, et al. (2001) does not contain activities, but focuses more on the characteristics of the FFE. For this thesis project the definition of Koen, et al. (2001) is used, because this definition is clear and covers the whole FFE.

3.1.3 Characteristics fuzzy front end

Based on the definition of Koen, et al. (2001) it can be argued that the FFE does not exist of a well-structured process, but exists of a more unpredictable and iterative process. Aken & Nagel (2004) also describe the fuzzy nature of the FFE, which manifest in no clear beginning, multiple inputs, no well-defined throughput process, high creativity level and participants getting involved and dropping out in unplanned ways. The differences between the FFE phase and the development and commercialization phase are elaborated in the table below.

<table>
<thead>
<tr>
<th>Fuzzy front end</th>
<th>Development &amp; commercialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of work</td>
<td>Experimental, often chaotic, difficult to plan, eureka moments.</td>
</tr>
<tr>
<td>Information for decision making</td>
<td>Qualitative, informal and approximate.</td>
</tr>
<tr>
<td>Outcome</td>
<td>A blueprint.</td>
</tr>
<tr>
<td>Width and dept</td>
<td>Broad but thin.</td>
</tr>
<tr>
<td>Budget</td>
<td>Small and variable.</td>
</tr>
</tbody>
</table>
Management methods | Unstructured, experimental, creativity needed. | Structured, systematic.
--- | --- | ---
Damage if abandoned | Small. | Substantial.

Table 7 Characteristics fuzzy front end (Koen, et al., 2002), (Kim & Wilemon, 2002)

As shown in the previous table the FFE is more or less an unpredictable and iterative process, while the development & commercialization is more or less a predictable and linear process. Despite the fuzzy nature the FFE, it still has high potential for cost savings, quality improvements and time reductions, because in the FFE the product features and product advantage are determined (Hauser, Tellis, & Griffin, 2005). According to the meta-study of Henard & Szymanski (2001), Pattikawa, Verwaal, & Commandeur (2006) and Montoya-Weiss & Calantone (1994) is product advantage one of the most important determinants of new product success. Moreover, in the FFE it is possible to adjust the product with relatively low costs compared to the costs of product adjustments in the development or commercialization phase (Hüsig & Kohn, 2003).

3.1.4 Fuzzy front end model

In the literature are different FFE models described. The model of Koen, et al. (2001) fits best with the elements and the uncertain and iterative nature of the FFE, because the circular shape of the model implies that the activities of the framework can iterate across the five steps. Nevertheless, a weakness of the model of Koen, et al. (2001) is the screening of concepts, because the model contains only one idea selection step and not a gate afterwards. According to Cooper & Edgett (2008) is it recommendable to add a gate, because a gate serve as quality–control check point. Moreover, Cooper (2008) argued that especially the gate: go to development is important, because this is the last possibility where an idea can be killed before the expensive development phase start. Therefore, to the model of Koen, et al. (2001) the gate: go to development is added. The adjusted FFE model of Koen, et al. (2001) is shown in the figure below.

![Figure 13 Adjusted fuzzy front end model of Koen, et al. (2001)](image)

Generally, the model consists of an engine, influencing factors and the steps opportunity identification, opportunity analysis, idea genesis, idea selection and concept & technology
As described earlier, iterations are possible due to the circular shape. The engine of the model represents the senior- and executive managers who develop a strategy, gives leadership and creates a culture. The FFE process is affected by influencing factors. Actors in this environment are corporation’s organizational capabilities, clients, competitors, the outside world’s influences, etc. (Koen, et al., 2001).

Highlight 1: Fuzzy front end
Based on this section can be said that innovation is the lifeblood of an organization. An effective and efficient new product development process is essential to ensure innovative new products. An important aspect of the new product development process is the FFE. According to Koen, et al. (2001) the FFE is defined as “activities that take place prior to the formalized, well-structured new product and process development or stage-gate” system”. Based on this definition can be argued that the FFE does not exist as a well-structured process, but exists as a more unpredictable and iterative process. Nevertheless, the FFE has high potential for cost savings, quality improvements and time reductions, because in the FFE the product features and advantage are determined (Hauser, Tellis, & Griffin, 2005). The model of Koen, et al. (2001) is the best model for the FFE, because the most important FFE elements and the fuzzy nature of the FFE are taken into account. However, one weakness of this model is the inadequate screening of ideas, because the model contains only an idea selection step. Therefore, the gate: go to development is added.

The best practices for the model of Koen et al. (2002) are discussed in the following sections.

3.2 Influencing factors
Based on the previous section can be argued that the model of Koen, et al. (2001) is the best model for the FFE. In this section the first element of the model is elaborated, namely the influencing factors. This section is structured as follows. First, the influencing factors are described. Second, the best practices for the influencing factors are discussed.

3.2.1 Description influencing factors
The influencing factors are the first element of the model of Koen, et al. (2001). According to Hüsig & Kohn (2003) these environmental factors are ignored in most FFE models and FFE research. Koen, et al. (2001) argued that the FFE is influenced by corporation’s organizational capabilities. The organization capabilities determine how opportunities, ideas and concepts are treated. Another influencing factor in the FFE is the involvement of clients during the FFE process. Furthermore, the FFE is affected by actions, products and services of competitors. The FFE is also influenced by government policy, environmental regulations, laws concerning patents and socioeconomic trends. The last influencing factor is the depth and strength of enabling sciences and technology. Science and technology are called enable when they can be used in a product or service. In addition, Hüsig & Kohn (2003) argued that the size and growth of the market, the stage of the industry life cycle, the length of product and technology life cycles, the technological change rate and the level of industry innovation also affect the FFE. The following subsection describes how to deal with the influencing factors.
3.2.2 Best practices influencing factors

In this subsection the best practices are described for the influencing factors. In general, the influencing factors which are described in the previous section are almost uncontrollable by construction companies. Nevertheless, companies can respond to the influencing factors by changing their strategy and developing new capabilities. The model of Henderson & Venkatraman (1999) shows how companies can maintain fit between influencing factors and the strategy and capabilities of the organization. The model is shown in the figure below.

The model shows that the strategy and capabilities of the organization have to fit with the influencing factors. Moreover, the senior management should maintain a strategic fit between strategy and capabilities of an organization. Furthermore, there should also be a functional fit between the business and the FFE. According to Khurana & Rosenthal (1998) and Frishammar & Florén, (2008) this is crucial for new product success. Mostly, the functional fit is the responsibility of the innovation manager. Important to mentioned that this model is dynamic, because the influencing factors are changing over time. Therefore, it is important for organizations to maintain a fit between the influencing factors and the strategy and capabilities (Henderson & Venkatraman, 1999). In addition, Koen, et al. (2002) emphasize that organizations should act efficient and quickly when influencing factors are changing.

**Highlight 2: Best practices influencing factors**
- Maintain alignment between the influencing factors, strategy and capabilities.
- Act quickly and efficient during changing influencing factors.

The following section explains how organizations should maintain a fit between the influencing actors and the strategy.

3.3 The engine (strategy, leadership & culture)

The previous section has described the factors which influenced the FFE. In this section the engine of the FFE is elaborated. According to Koen, et al. (2001) the engine consists of the strategy of the organization, leadership of the management and culture of the company. This section is structured as follows. In the first subsection a description is given of the engine. In the second subsection the best practices are described for the engine.
3.3.1 Description engine

According to Koen, et al. (2002) and Kim & Wilemon (2002) the engine is the steering mechanism of the FFE. The engine consists of the (senior) management of the company. The management influences the FFE. First by providing a strategic vision. This vision helps employees to channel their efforts to the right projects (Hülsheger, Anderson, & Salgado, 2009). Second by showing leadership. Especially in the FFE the leadership of management is important for the prioritizing of projects, allocating of resources, managing organizational cooperation and providing commitment (Koen, et al., 2002). Finally, the management is responsible for creating an innovative culture (Koen, et al., 2002). In the meta-study of Pattikawa, Verwaal, & Commandeur (2006) management skills are one of the most important determinants of new product performance. In the following subsection the best practices for the engine are elaborated.

3.3.2 Best practices engine

This subsection divides three categories for the best practices, namely: strategy, leadership and culture. As mentioned earlier, the best practices are intended for the (senior) management, because strategy, leadership and creating an innovative culture are the responsibility of the (senior) management.

**Strategy**

According to Frishammar & Florén (2008) and Schilling (2008) the business strategy of a company is an important determinant of successful innovation. The aim of a strategy is to identify, develop and nurture resources and capabilities which are: 1) crucial for the long-term competitive position of the company and 2) have value for their customers. Schilling (2008) argues that a proper business strategy contains a challenging gap between the existing companies resources and capabilities and the ones that are needed to fulfill the strategy. Khurana & Rosenthal (1998) argued that most companies fail to translate the business strategy into an innovation strategy, which results in many off-strategy ideas during the FFE.

**Leadership**

Koen, et al. (2002) emphasize that leadership is important during the FFE, because the FFE often contains boundaries of responsibility and expertise (Khurana & Rosenthal, 1998). Successful leadership results in employees who are motivated to work on innovative projects (Boeddrich, 2004). Moreover, senior management should demonstrate in their decisions and actions that innovation is important for their company. For instance by giving employees time to try new things. Leadership is also important for developing a close relationship between technical people and marketing (Koen, et al., 2002). Henard & Szymanski (2001) found in their meta-study that involvement of marketing during product development has significant advantages, because the voice of customers is taken into account during the innovation process.

**Culture**

The culture in the FFE should be different in comparison with the development and commercialization phases. As described earlier the FFE is experimental, ambiguous and chaotic, while the development and commercialization phases are more disciplined, goal-oriented and follow a clearly defined process. Hülsheger Anderson, & Salgado (2009) argued in their meta-
study that an environment where innovation is supported can be described as: active support of innovative behavior, articulated and enacted norms for innovation and risk and that unsuccessful innovations are tolerated.

**Highlight 3: Best practices engine**

**Strategy:** Articulate and link the business strategy with the innovation strategy, resources and capabilities.

**Leadership:** Senior management should demonstrate leadership by making decisions. Also they have to take actions to show that innovation is important.

**Culture:** Active support of innovation behavior articulated and enacted norms for innovation. Moreover, risky and unsuccessful innovations are tolerated.

### 3.4 Opportunity identification

In the previous sections the *influencing factors* and the *engine* are described. This section focuses on the first step of the model, namely the *opportunity identification*. The first subsection describes the *opportunity identification* step. The second subsection discusses the best practices for the *opportunity identification* process.

#### 3.4.1 Description opportunity identification

An opportunity is defined as “a business or technology gap, that a company or individual realizes, that exists between the current situation and an envisioned future in order to capture competitive advantage, respond to a threat, solve a problem, or ameliorate a difficulty” (Koen, et al., 2002). In the *opportunity identification* step organizations identify potential business and technological opportunities. These new opportunities can result in new markets, market grows, operating effectiveness and operating efficiency (Koen, et al., 2001). Mostly, the identification of new opportunities is driven by the business and the innovation strategy (Khurana & Rosenthal, 1998). The identification of opportunities happens by different methods and sources. On one hand organization can identify opportunities in a formal way, such as creativity techniques. On the other hand, organization can also identify new opportunities in an informal way, such as ad hoc sessions, lunch discussions and individual insights (Koen, et al., 2001). The results of the opportunity identification are a well-defined market and/or technology arena. In the following subsection the best practices to identify new opportunities are described.

#### 3.4.2 Best practices opportunity identification

This subsection of best practices is divided in two parts, namely: type of people and methods.

**Type of people**

In the *opportunity identification* different type of people has to involve. Based on the entrepreneurial literature people with creativity and optimism traits should be selected for the identification of new opportunities (Koen, et al., 2002). Moreover, people should have knowledge of market and clients problems. Finally, people should be alert in identifying new opportunities (Ardichvili, Cardozo, & Ray, 2003). Now the type of people is described, the methods for identifying new opportunities can be elaborated.
Methods
The most suitable methods for the opportunity identification are as follows:

Roadmapping: According to Kappel (2001) is a roadmap a plan that combines short-term and long-term goals with specific technology solutions. The strength of roadmapping is that the driving forces of the business are shown in a graphical form. The graphical form enhances the communication and sharing of insights (Koen, et al., 2002).

Trend analysis: By trend analysis is information collected to identify a pattern or trend. Trend analysis can be used for forecasting technology, market and client characteristics (Koen, et al., 2002).

Scenario planning: By scenario planning different scenarios are elaborated. Organizations should create multiple views of the future, such as worst case scenario, most likely case scenario and best case scenario, because a diverse set of scenarios helps organization to determine in which situation which opportunities have potential (Koen, et al., 2002).

Highlight 4: Best practices opportunity identification
Type of people: Involve for the identification of new opportunities creative people with optimism traits.
Methods: Use roadmapping, trend analysis and scenario planning during the opportunity identification.

3.5 Opportunity analysis
In the previous section the step opportunity identification is elaborated. In this section the next step of the model is elaborated, namely the opportunity analysis. This section is structured as follows. In the first subsection the opportunity analysis is described. This section is followed by the subsection which contains the best practices.

3.5.1 Description opportunity analysis
The opportunities that are identifying in the previous step are in this step analyzed. Koen, et al. (2002) argue that additional information is needed before the opportunities of the previous stage can be assessed and translated into specific business and technology opportunities. The purpose of additional information is to reduce the uncertainty of technology and market (Cooper, 2008). The amount of additional information depends on the uncertainty of the opportunity, the expected size of development, fit with the business strategy, fit with the business culture and the risk tolerance of the business (Koen, et al., 2001). In contrast to the previous stage, during the opportunity analysis also the appropriateness and attractiveness of the opportunity is investigated. According to Koen, et al, (2002) an analysis of the opportunity includes the following elements:

Strategic framing: During strategic framing is determined of the opportunity fits within the company’s market, technology strengths, gaps and threats.

Market segment assessment. An important part of the opportunity analysis is a market segment assessment. Elements of the market segment assessment are market size analysis, growth rates and market share of competitors. Moreover, economic, cultural, demographic, technological and regulatory factors are also investigated.
**Competitor analysis.** In this element the strategy, capabilities and recent patents of competitors are analyzed, because this is needed to determine which type of new product is needed to achieve competitive advantage.

**Client assessment.** During the assessment of clients the most important client’s needs, which are not fulfilled with current products, are determined.

### 3.5.2 Best practices opportunity analysis

The best practices of the *opportunity analysis* are almost the same of the best practices during the *opportunity identification*, namely: roadmapping, trend analysis and scenario planning. Nevertheless, for the *opportunity analysis* two additional best practices exist, namely: opportunity analysis team and opportunity analysis gate.

**Opportunity analysis team**

The *opportunity analysis* is more extensive than the *opportunity identification*. Therefore, in general this activity is carried out by a multifunctional team. The size and composition of the team depends on the size, scope and complexity of the opportunity. Nevertheless, Koen, et al. (2002) gives some rules of thumps, namely: teams typically consists of three to five people and usually contain one person of R&D and one person of marketing. Pattikawa, Verwaal, & Commandeur (2006) also argue that involvement of marketing has significant positive influence on new product development performance, because the voice of customers is better taken into account.

**Opportunity analysis gate**

An opportunity analysis gate receives almost no attention in the FFE literature. Nevertheless, based on Cooper & Edgett (2008) a gate serves as quality–control check point. In this gate, the opportunities have to be assessed on strategic framing, market segment, competitor analysis and client assessment (Koen, et al., 2002). The selection of the right opportunities should be carried out by the senior management and innovation managers, because the selection of the right opportunities is highly related to the strategy of the company.

**Highlight 5: Best practices opportunity analysis**

*Opportunity analysis team:* In general, the team consists of three to five people and usually contains one person of R&D and one person of marketing.

*Gate opportunity analysis:* The senior management should assess the opportunities on strategic framing, market segment, competitor analysis and client assessment.

### 3.6 Idea genesis

In the previous section the focus was on identifying and analyzing new opportunities. In this section the focus is on the generation of ideas. The first subsection of this section describes the *idea genesis*. The second subsection describes the related best practices of the *idea genesis*.

#### 3.6.1 Description idea genesis

The stage *idea genesis* concerns the birth, development and maturation of an idea. Especially, in this stage the iterative nature of the FFE is visible, because ideas are built up, torn down, combined, reshaped, modified or upgraded when it is examined, studied, discussed and
developed. The ideas which are generated are based on the defined opportunities. However, new ideas might also feed the opportunity identification stage. This also demonstrates that the FFE is an iterative process (Koen, et al., 2001). The idea genesis can be carried out in a formal and informal way. Examples of formal idea genesis are brainstorm sessions and internal capture of ideas. Examples of informal idea genesis are unusual user request, new material offered by supplier, anyone with a passion for a particular need, etc. In the following subsection the best practices for the generation of new ideas are described.

3.6.2 Best practices idea genesis

This subsection investigates methods that can be used to generate new innovative ideas. The method which is used depends on the environmental circumstances, strategy, and culture of the organization.

Cross-functional team
A cross-functional team should be used for the idea generation (Wulffen, 2006). Moreover, R&D and marketing as well as other functions (e.g., production, client service) should cooperate in the idea generation process. Because the cross-functional nature of the group ensures that client needs and technological capabilities are better taken into account (Herstatt, Verworn, & Nagahira, 2004).

Type of people
Similar to the opportunity identification people with creativity and optimism traits should be selected for the generation of new ideas (Koen, et al., 2002). Moreover, people should have knowledge of market and clients problems (Ardichvili, Cardozo, & Ray, 2003).

Methods
The idea generation methods can be divided in four categories; these four categories are as follows:

Thinking inside the box methods: Hauser, Tellis, & Griffin (2005) argued that most new ideas come from ‘thinking inside the box’ by transforming existing solutions into new solutions. They argued that a template and a consumption chain analysis are two thinking inside the box methods. A template is a systematic way for changing an existing solution into a new solution due exclusion, inclusion, unlinking, linking, splitting and joining a new function to an existing product (Goldenberg, Mazursky, & Solomon, 1999). In the consumption chain analysis are what, where, who when and how question asked during the birth, use, disposing, etc. of the product (MacMillan & McGrath, 1997).

Thinking outside the box methods: Thinking ‘outside the box’ results in really new or radical innovation (see Appendix I). A characteristic of this type of innovation is that it results in a major change in the technology and/or market (Garcia & Calantone, 2002). By the method peripheral vision are the big trends and threats of the external world are identified (Cooper & Edgett, 2008). The challenge for companies with this approach is to really act on the identified trends and threats. Another method is brainstorming. According to Wulffen (2006) brainstorming is suitable for the generation of new radical ideas. Brainstorm sessions are executed with 10-15 persons. A session starts with a divergent thinking part and ends with a convergent thinking part.
Thinking inside the company methods: According to Cooper & Edgett (2008) employees are a major source of new product ideas. The most used thinking ‘inside the company’ method is internal idea capture. By this method a formal system is used for collecting new product ideas of the employees, such as a suggestion box (Kim & Wilemon, 2002). Other indirect methods are giving employees free time, which they should spend on new ideas (Koen, et al., 2002).

Thinking outside the company methods: Koen, et al. (2002) argued that client involvement improves the quality of the ideas. External submission of ideas is one of the thinking outside the company methods. By this approach clients, suppliers, vendors and users and others in the external world are invited to share their new product ideas. Another method is client visit teams. By this approach, the team interviews clients to uncover user problems, needs and wants for new products (Mullins, 2007). A similar method is client focus groups. The purpose of a focus groups session is to identify needs, wants, problems and new product suggestions. The last method is the lead user method. According to Von Hippel (1986) lead users face needs that will be general in the marketplace. However, lead users face these needs months or years before the bulk of that marketplace encounters them. Moreover, lead users benefits significant by obtaining a solution for those needs.

Highlight 6: Best practices idea genesis

Cross-functional team: The team should include people from R&D and marketing as well as other functions (e.g., production, client service).

Type of people: Select people with creativity and optimism traits. Furthermore, people should have knowledge of market and clients problems.

Methods: Use thinking inside the box methods for transforming existing solutions into new solutions. Use thinking outside the box methods for really-new or radical innovation. Use thinking inside the company methods to collect idea from own employees, because own employees are important sources of new ideas. Use thinking outside the company methods by products where client input is important.

3.7 Idea selection

In this section the fourth step of the model of Koen et al. (2001) is described, namely the selection of the generated ideas. In the first subsection a description of the idea selection is given. In the second subsection the best practices are described.

3.7.1 Description idea selection

The idea selection is a critical step for the competitive position of companies (Frishammar & Florén, 2008). Nevertheless, a single process that guarantees the right selection of idea does not exist (Schilling, 2008). Selection of ideas varies from an individual’s choice among different self generated options to a formalized portfolio management method. However, in comparison with the development phase is in the FFE a formalized decision process difficult due an uncertain and limited amount of information. Moreover, financial analyses and estimates for ideas are in the FFE often wild guesses (Cooper, 1997). Furthermore, in comparison with the development phase the selection of ideas is less rigorous, because ideas must have the opportunity to grow and improve (Koen, et al., 2002). Nevertheless, the selection of ideas usually starts with a personal judgment of the person who generates the idea. This personal judgment is made at an intuitive level, because there is not more than the idea itself to consider (Koen, et al., 2002). For a good
initial decision it is important that persons who generate ideas are familiar with the strategy of the organization (Khurana & Rosenthal, 1998). For the formal selection of ideas quantitative and qualitative criteria’s can be used.

3.7.2 Best practices idea selection

In this subsection the best practices are described for the composition of the review team, quantitative criteria’s and qualitative criteria’s.

**Review team composition**

In general, the review team consists of senior people who own the resources of the project team. Because the project team is multifunctional, the review team is also multifunctional. This multifunctional view of the review team leads to better decision. Koen, et al. (2002) argued that the review team should consists of people with preferences for intuition and thinking, because research has shown that these people will make better decisions. Important to note that during the decision process the review team needs to adopt a positive attitude. The review team should have as aim how an idea can be modified to make it more attractive instead of how to determine which ideas to kill. In other words, the selection of ideas should encourage creativity and not stifle new ideas (Koen, et al., 2002).

**Quantitative criteria’s**

Cooper (1997) argued that the focus during the *idea selection* should not be on financial aspects. Nevertheless, especially for incremental innovations quantitative criteria’s are suitable, such as discounted cash flow calculations, net present value or internal rate of return (Koen, et al., 2002).

**Qualitative criteria’s**

According to Cooper (1997) qualitative methods are more suitable than quantitative methods during the *idea selection*, especially by radical innovation. Important qualitative methods are screening questions, mix of innovation and Q-sort.

**Highlight 7: Best practices idea selection**

**Review team composition:** The review team should consist of a multidisciplinary team of senior people, with preferences for intuition and thinking. Moreover, the review team should own the resources of the project team.

**Quantitative criteria’s:** Use this type of criteria’s, such as discount cash flow methods, for incremental new ideas.

**Qualitative criteria’s:** Use this type of criteria’s, such as screening questions, mix of innovation and Q-sort for radical innovation.

3.8 Concept & technology development

After the *idea selection* starts the development of concepts & technologies. This is described in this section. The first subsection gives a description of this step. The second subsection discusses the best practices.
3.8.1 Description concept & technology development

The concept & technology development consists of the development of a business case. According to Osterwalder & Pigneur (2010) a business case consists of the elements which are depicted in the figure below:

![Figure 15 Business Case (Osterwalder & Pigneur, 2010)](image)

**Value Proposition:** The value proposition offers the company one kind of product or services that’s fulfill the needs of the customers. According to Osterwalder & Pigneur (2010) a company should distinguishes itself from its competitors by the value proposition.

**Key Activities:** These are the most important activities to achieve the value proposition of the new product or services.

**Key Resources:** Human, financial, physical and intellectual resources are needed to achieve the value proposition.

**Key Partners:** The key partners, such as suppliers, optimize the project and reduce the risk.

**Customer Segments:** The company has to identify which customer segments are targeted.

**Channels:** The company has to determine by which channels the value proposition is offered. Effective channels are fast, efficient and cost effective.

**Customer Relationship:** The company must determine the type of relationship with the customer segments.

**Cost Structure:** In this part of the business case the most important monetary costs are described.

**Revenue Streams:** In this part of the business case is described how a company makes money (Osterwalder & Pigneur, 2010).

In addition, Koen, et al. (2001) argued that competitor assessments, technology unknowns and overall project risks should be taken into account. Important to note is that the depth of the business case depends on the type of innovation, level of resources, organization requirements and the business culture.

3.8.2 Best practices concept & technology development

Before a good business case can be developed the best practices which are described below are important.
**Product champion**

The literature discussed that product champions play an important role during the FFE (Markham & Aiman-Smith, 2001), (Frishammar & Florén, 2008), (Koen, et al., 2002). The role of a product champion is to ensure that the idea survives the barriers (Koen, et al., 2002). The main barriers are organization inertia and resistance to new ideas and new technologies (Markham & Aiman-Smith, 2001). In general, product champions are persons with a drive, assertiveness, political astuteness, technical competence and market knowledge (Kim & Wilemon, 2002). However, Markham & Aiman-Smith (2001) argued that there does not exist a relation between product champions and market success, but only between product champions and new product projects. The underlying reason is that product champion support both market failures as well as market successes.

**Cross-functional project team**

The literature discussed the role of project teams on the innovativeness of new product. Different researchers argued that the FFE should be carried out by a cross-functional team (Frishammar & Florén, 2008), (Kim & Wilemon, 2002). Persons in a cross-functional team can differ in function, profession, education, tenure, knowledge, skills, or expertise (Hülsheger, Anderson, & Salgado, 2009). Frishammar & Florén (2008) argued that the main benefit of cross-functional teams is that ideas can be improved, because the idea is reviewed by knowledgeable individuals from all related functions and departments. Furthermore, cross-functional project teams facilitate mutual understanding, communication, create or improve relationships and decrease ambiguity by early understanding of other functions (Kim & Wilemon, 2002). The functions which should be included in the cross-functional team depend on the type of product and level of innovativeness. However, it is highly recommended to include people from research & development and marketing, because marketing involvement in new product development improves the performances (Henard & Szymanski, 2001), (Pattikawa, Verwaal, & Commandeur, 2006).

**Personality**

Although the effect of personality on team performance is not well investigated, research suggests that personality plays an important role in the performance of teams. According to Reilly, Lynn, & Aronson (2002) personality variables are especially important for new product development teams, because activities in these teams are highly coordinated and mostly carried out by cross-functional members. Singh (2011) argued that a new product development team consists of four personality types and a leader. These personality types are depicted in the following figure.
Originator: Persons in the first quadrant are originators or creative persons. These types of persons are not comfortable with rigidity. Originators have the ability to think outside the box. The disadvantage of originators is that they easily lose the bigger picture and generate many irrelevant ideas. According to Singh (2011) originators are important during the idea genesis of the FFE.

Motivator: This personality has the ability to think in a more structured manner than originators. These persons inject energy to the idea and boost the idea forward by removing all obstacles. This type of personality is important during the concept & technology development stage of the FFE (Singh, 2011).

Debater: Quadrant three presents the debater or the devil’s advocate personality. Although this personality is very creative in his or her tough, the behavior is not individualistic, but conforming. Debaters form a bridge between a creative idea and the feasibility of the idea in the real world. Singh (2011) mentioned that this type of personality is important during the concept & technology development stage of the FFE.

Effector: Persons in this quadrant enjoy implementation. The strength of an effector is a crisp execution. This type of personality is important in the development phases after the FFE (Singh, 2011).

Leader: A leader or facilitator is needed to coordinate all of the functions above. A leader is responsible for effective and efficient teamwork. Important to note that this does not imply that a new product development team should consists of 5 persons, because persons can possess more than one personality type.

Client involvement
Many researchers emphasizes the influence of client involvement during the FFE (Koen, et al., 2002), (Frishammar & Florén, 2008), (Kim & Wilemon, 2002). Moreover, Henard & Szymanski (2001) found in their meta-study that the extent to which the products meets client needs is one of the most important determinants of new product performance. An advantage of client involvement is that the project team receives new information from another point of view. This result in a better understanding of clients needs, probable market size and market growth (Kim & Wilemon, 2002). Different methods for client involvement exist, such as focus group interviews, direct contact with clients, lead users and concept testing (see section 3.6).
external clients, the project team also has to deal with internal clients, such as production, sales, etc.

**Highlight 8: Best practices concept & technology development**
The *concept & technology development* consists of the development of a business case. The corresponding best practices are as follows:

- **Product champion:** Use product champions to ensure that the ideas survive the barriers.
- **Cross-functional team:** Use for diverge insights during the *concept & technology development* a cross-functional team.
- **Personality:** Compose a team which consists of a leader, originator, motivator, debater and effector.
- **Client involvement:** Involve clients to ensure that the product meets client needs.

### 3.9 Gate: go to development

As described in section 3.1 the mean weakness of the model of Koen, et al. (2001) is that it does not contain a gate before the *development and commercialization phase* starts. Therefore, the *gate: go to development* is added to the model of Koen, et al. (2001). This section has the same structure as the previous sections, namely first the description is given, followed by the best practices.

#### 3.9.1 Description gate: go to development

In the *gate: go to development* the outcome of the *concept & technology development step* is reviewed. The *gate: go to development* has as objective to determine of the business case is profitable enough to start the development phase. Furthermore, it is the last possibility where the project can be killed before the expensive developing stage starts. In the table below a typical gate agenda is given.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Who</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 minutes</td>
<td>Presentation and recommendation of the project team.</td>
<td>Project team</td>
<td>Silent listening to presentation. No discussion, but clarifying questions are allowed.</td>
</tr>
<tr>
<td>15 minutes</td>
<td>General discussion</td>
<td>All participants</td>
<td>Led by non-voting facilitator</td>
</tr>
<tr>
<td>15 minutes</td>
<td>Voter deliberation</td>
<td>Voters</td>
<td>Led by non-voting facilitator</td>
</tr>
<tr>
<td>10 minutes</td>
<td>Team briefing on decision and action items</td>
<td>All participants</td>
<td>Led by non-voting facilitator</td>
</tr>
</tbody>
</table>

*Table 8 Gate agenda (Polczynski, 2010)*

As shown in the table above takes a gate review about one hour. In the following subsection are the best practices described to ensure a good gate decision.

#### 3.9.2 Best practices gate: go to development

According to Cooper (2008) the *gate: go to development* consists of a review team, deliverables, criteria’s and outputs. The best practices for these elements are described below.
Review team composition

In general, the review team consists of a non-voting facilitator and senior people who allocate the resources of the project team. Because the project team is multifunctional, the review team is also multifunctional. This multifunctional view of the review team leads to better decision. The senior level of the review team depends on the type and importance of the idea. In general, for incremental ideas the review team should consist of mid management of a company. For important radical ideas the review team should consist of the senior management (Cooper, 2008). In addition, Polczynski (2010) advice to add suppliers (or Chief Technology Officer), investors (or Chief Financial Officer) and customers to the review team. A common mistake of companies is having too many people in the review team, because every senior manager feels that he or she is important enough to influence the final decision. Another mistake is that the project team members are also voting member of the review team (Cooper, 2008).

Deliverables

The deliverables are what the project team brings to the gate. In other words, the deliverables are the results of a set of completed activities. Cooper (2008) argued that the deliverables have to be well-known and based on a standard format for the gate. For this gate are the deliverables the business case of the concept & technology step. As described in the previous section a business case consists of the following elements: value proposition, key activities, key resources, key partners, customer segments, channels, customer relationship, cost structure and revenue streams (Osterwalder & Pigneur, 2010). In additional, Koen, et al. (2001) argued that competitor assessments, technology unknowns and overall project risks have to be taken into account.

Criteria’s

The criteria’s for this gate can be compared with the criteria’s of the idea selection, as described in subsection 3.7.2. This subsection makes a distinction between quantitative and qualitative criteria’s. Examples of quantitative criteria’s are discounted cash flow methods and real options. Examples of qualitative criteria’s are screening questions, mapping of process and Q-sort. Decisions are improved when different types of quantitative and qualitative criteria’s are used (Schilling, 2008). In addition, Hart, Hultink, Tzokas, & Commandeur (2003) investigate which criteria’s companies used during the gate: go to development. In the table below the results in percentage are given for the gate: go to development.

![Figure 17 Criteria’s adjusted from Hart, Hultink, Tzokas, & Commandeur (2003)]

As shown in the table above organizations use most customer acceptance, product performance, and technical feasibility during the gate: go to development. The other criteria’s are less important during this gate.
**Outputs**

The output of the gate is a Go/ Kill/ Hold/ Recycle decision, an approved action plan for the next stage and a list of deliverables, criteria’s and dates for the next gate. Important to note is that a Go decision also means that budget and resources should be available for the next gate (Cooper, 2008).

**Highlight 9: Best practices gate: go to development**

The gate: go to development is the last possibility where the project can be killed before the expensive developing phase starts. The review team investigates both the qualitative and quantitative information of the project team. It can be concluded that the following best practices are essential for the gate: go to development:

**Review team composition:** Involve the right mix of seniority in the review team. Moreover, does not involve the project team members in the review team.

**Deliverables:** The deliverable for this gate is the business case, which is developed during the concept & technology step of the model of Koen, et al. (2001).

**Criteria’s:** The criteria’s for this gate can be compared with the criteria’s of the idea selection step. Moreover, Hart, Hotlink, Tokays, & Commandeer (2003) found in their study that customer acceptance, product performance, and technical feasibility are the most important criteria’s.

**Outcome:** The output of the gates is a Go/ Kill/ Hold/ Recycle decision, an approved action plan for the next stage and a list of deliverables, criteria’s and dates for the next gate.

The development and commercialization phases start after the FFE. In Appendix II is, by means of the stage-gate® system, elaborated how these phases should be carried out.

**3.10 Conceptual model**

In the previous sections the best practices are described for all the elements of the model of Koen et al. (2001). In this section, the model of Koen (2001) is translated to the program ‘Connected Innovation’. The best practices of the opportunity identification and opportunity analysis have to be executed before the idea generation session. Therefore, these best practices are placed for the idea generation session. The step idea genesis is related to the idea generation session of the program ‘Connected Innovation’. The idea selection was not part of the program ‘Connected Innovation’, but could be executed between the idea generation session and idea elaboration & client involvement. The concept and technology development has similarities with the idea elaboration & client involvement of the program ‘Connected Innovation’. The gate: go to development fits best with the idea presentation session. The main focus of the research was not the engine and influencing factors. Therefore, these best practices are placed in the left corner.
In the following chapter inter alia an analysis is made to what extent the program ‘Connected Innovation’ corresponds with the best practices of the literature.
4 Analysis

In this chapter an analysis will be given on the program ‘Connected Innovation’. The aim of this chapter is to answer the following two research questions:
3) How is the program ‘Connected Innovation’ currently organized by Bureau de Bont?
4) What are the strong and weak points of the program ‘Connected Innovation’?
The strong/weakness analysis of this chapter is based on theoretical and empirical insights. As shown in Figure 19 the theoretical insights are gathered by conducting a literature study. Based on the best practices of the literature study is analyzed of the program ‘Connected Innovation’ takes into account all these best practices. The empirical insights are gathered by conducting a case study. As described in chapter 2 four interviews were held with members of the program ‘Connected Innovation’. Five interviews were held with employees of other innovative construction companies and two interviews were held with employees who work in another sector. The aim of the case study is to evaluate the program ‘Connected Innovation’, which is executed by Arcadis. This chapter is structured as follows. The first five sections discuss for each element of the program ‘Connected Innovation’ the strong and weak points. This chapter ends up with a figure that contains the whole analysis.

4.1 Preparation of the program ‘Connected Innovation’

This section discusses the aspects which are related to the preparation of the program ‘Connected Innovation’. During the preparation, the delineation for the idea generation session is determined. Moreover, the objective of the program is also specified.

4.1.1 Theoretical analysis

As described above the program ‘Connected Innovation’ is compared with the best practices of the fuzzy front end (FFE). Based on these best practices, the following points of the program ‘Connected Innovation’ are noteworthy.

Opportunity identification step: A weakness of the program ‘Connected Innovation’ is that it does not have an opportunity identification step. According to Koen, et al. (2002) organizations identify in the opportunity identification step potential business and technological opportunities. The result of this step is a well-defined market and/or technology arena. This step is essential, because it guides the innovation process and reduces the likelihood of off-strategy ideas (Koen, et al., 2002).

Opportunity analysis step: Because the program ‘Connected Innovation’ does not have an opportunity identification step, it also does not have an opportunity analysis step. In the opportunity analysis step the opportunities that are identifying in the opportunity identification are analyzed. Koen, et al. (2002) argued that additional information is needed before the opportunities of the previous stage can be assessed and translated into specific business and technology opportunities. The purpose of additional information is to reduce the uncertainty of technology and market (Cooper, 2008).
Opportunity gate: It is obviously that without an opportunity identification and analysis the program does not contains an opportunity gate. Without gates poor ideas are not killed in an early stage, with as results that too much time and money is spend on it (Cooper, 2008).

4.1.2 Empirical analysis
Based on the interviews, the strong and weak points of the executed program ‘Connected Innovation’ are determined. The following points of the program ‘Connected Innovation’ are significant.

Delineation: The ideas which are generated during the idea generation session have to fit within demographic decline and recession by municipalities. The underlying reason for this delineation is that the turnover of Arcadis decreases by municipalities (Interviewee: Plaisier, 2012), (Interviewee: Hardy, 2012). According to interviewee: Hardy (2012) delineation gives a better focus during the idea generations and less off-strategy ideas. This is a benefit and seen as a strong empirical point.

Objective: The objective of the program ‘Connected Innovation’ was to generate four ‘out of the box’ innovations (Interviewee: Hardy, 2012). In a short period of time, all the ideas have to result in business. One idea has to result in a product or services that can be compared in terms of turnover with Xeiz (www.xeiz.nl). Furthermore, one idea has to generate business within 2 years. It can be concluded that the objective was not SMART formulated, because the objective was not specific, measurable and timely. Moreover, members of the program ‘Connected Innovation’ argued that it was not clear that the objective of the program was to commercialized the ideas, instead of to generate new ideas (Interviewee: Hardy, 2012), (Interviewee: Plaisier, 2012).

<table>
<thead>
<tr>
<th>Theoretical strong points</th>
<th>Empirical strong points</th>
<th>Theoretical weak points</th>
<th>Empirical weak points</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Delineation during the idea generation session.</td>
<td>✓ Does not contain an opportunity identification step.</td>
<td>❌ Does not contain an opportunity analysis step.</td>
<td>❌ Objectives were not SMART formulated.</td>
</tr>
<tr>
<td></td>
<td>❌ Does not contain an opportunity gate.</td>
<td></td>
<td>❌ Members realize insufficient that the objective was to commercialize the ideas.</td>
</tr>
</tbody>
</table>

Table 9 Strong/weak points preparation

Two theoretical weaknesses of the program are that it does not contain an opportunity identification and an opportunity analysis step. In this context, it seems contradictory that delineation is seen as an empirical strong point. Because delineation has matches with the opportunity identification and analysis. The reason that delineation is seen as a strong point is that it results in a better focus during the idea generation and less off-strategy ideas. Nevertheless, the fact remains that the delineation should be determined based on a well executed opportunity identification and analysis, instead of an instinctive choice. Based on the article of Koen, et al. (2002) it can be concluded that the mean weakness of the preparation are the missing opportunity identification, opportunity analysis and opportunity gate. Also the interviews show that these missing elements are the cause of different problems in the sequel of the program ‘Connected Innovation’. For example, the delineation (demographic decline and...
recession by municipalities) was not relevant enough for all the team members (Interviewee: Kroon, 2012), with as result a lowering in motivation (Interviewee: Hardy, 2012).

4.2 Idea generation session of the Program ‘Connected Innovation’

The first session of the program is the idea generation session. As described in the case description of chapter 2 this session consists of a guest speaker, explanation of the program & deadlines, introduction and team composition, idea generation part and a presentation of the ideas.

4.2.1 Theoretical analysis

Based on the best practices of the literature the following points during the idea generation session are noteworthy.

Type of people: Based on the article of Koen, et al. (2002) it can be argued that the selection of members of the program ‘Connected Innovation’ corresponds with the best practices. Because the division directors of Arcadis selected their most creative and optimistic people to participate in the program ‘Connected Innovation’ (Interviewee: Kroon, 2012), (Interviewee: Baltus & Baan Hofman, 2012).

Cross-functional team: The literature argues that a cross-functional team is beneficial during the idea generation, because the cross-functional nature of a team ensures that client needs and technological capabilities are taken into account (Herstatt, Verworn, & Nagahira, 2004). The program ‘Connected Innovation’ makes use of a cross-functional team, because the members of the program are from all the divisions of Arcadis (Interviewee: Kroon, 2012).

Idea generation methods: For the idea generation, different methods are described in section 3.6. The program ‘Connected Innovation’ mostly makes use of ‘thinking inside the company’ methods and ‘thinking inside the box’ methods. These methods are suitable for incremental innovation. However, the objective of the program ‘Connected Innovation’ was for ‘out of the box’ innovations. Therefore, ‘thinking outside the box’ methods and ‘thinking outside the company’ methods are more suitable methods. Therefore, the used methods are seen as a weak point of the program ‘Connected Innovation’

Idea selection: Another weakness of the program ‘Connected Innovation’ is that the idea generation session is not followed by an idea selection step. Moreover, the program ‘Connected Innovation’ does not makes use of an external review team. The ideas were only judged by the members of the project teams. According to Frishhammer & Florén (2008) the idea selection is a critical step for the competitive position of companies, because it is a possibility to kill bad ideas in a premature stadium, before much time and money is spend on it.

4.2.2 Empirical analysis

The following empirical strong and weak points for the idea generation session are mentioned by the interviewees.

Type of people: The interviewees emphasize that the selection of the right team members is extremely important for a successful execution of an innovation process (Interviewee: Herweijer & Knook, 2012), (Interviewee: Pijzel, 2012), (Interviewee: Hardy, 2012). As described in the previous section are the members of the program ‘Connected Innovation’ only selected on their creative and optimistic traits (Interviewee: Kroon, 2012), (Interviewee: Baltus & Baan Hofman, 2012). According to interviewees: Baltus & Baan Hofman (2012) the downside of this is that
creative and optimistic people are in general not critical enough for a thorough self-evaluation of their ideas.

**Team composition:** The project teams were cross-functional to ensure that the whole organization is involved with the innovation process (Interviewee: Hardy, 2012). This means that the employees from all the five divisions of Arcadis were selected to participate in the program ‘Connected Innovation’. Members experienced the cross-functional nature very positive, because it results in ‘thinking outside of the box’ (Interviewee: Plaisier, 2012), (Interviewee: Kroon, 2012). Moreover, cross-functional teams enlarge the networks of the members (Interviewee: Baltus & Baan Hofman, 2012). Nevertheless, a comment had to be made. The project teams were only cross-functional on division level and not on department or function level (Interviewee: Kroon, 2012), (Interviewee: Hardy, 2012). With as result that almost only engineers were involved and not the people from marketing, sales, etc. Moreover, because of the cross-functional nature of the teams, not all the members had enough context of the idea (Interviewee: Baltus & Baan Hofman, 2012), (Interviewee: Kroon, 2012). With result that the problem owners of the idea become very active and people with less context become too passive (Interviewee: Kroon, 2012). According to interviewee: van der Aa (2012) are active team members crucial for a successful innovation process.

**Clarity:** According to interviewee: Kroon (2012) the structure of the program ‘Connected Innovation’ was clear. Moreover, interviewee: Plaisier (2012) also argued that setting deadlines was a strong point of the program ‘Connected Innovation’. Because this ensures that the process does not disappear into a sluggish project. Also interviewees van der Aa (2012) and Herweijer & Knook (2012) argued that clarity and setting deadlines is important in an innovation process.

**Idea generation:** The idea generation session focuses on the generation of new ideas for services during demographic decline and recession by municipalities. For different members was this delineation not concrete and relevant enough. During the idea generation, all the team members could come up with ideas. The best idea is during this session further elaborated by using a format. Nevertheless, not the best idea was chosen, but the idea from whom shouted the loudest (Interviewee: Baltus & Baan Hofman, 2012). After the idea generation the ideas are presented. After the presentation other project teams can give feedback. The members experienced the learning rate very positive, because based on this feedback the idea could quickly be improved (Interviewee: Baltus & Baan Hofman, 2012).

<table>
<thead>
<tr>
<th>Theoretical strong points</th>
<th>Empirical strong points</th>
<th>Theoretical weak points</th>
<th>Empirical weak points</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅ Involvement of creative and optimistic people.</td>
<td>✅ Cross-functional teams.</td>
<td>✗ Teams do not use ‘thinking outside the box’ methods for radical innovation.</td>
<td>✗ Members were only selected on optimistic and creativity traits.</td>
</tr>
<tr>
<td>✅ Use of a cross-functional team.</td>
<td>✅ The structure and deadlines were clear.</td>
<td>✗ Teams do not use ‘thinking outside the box’ methods during the idea generation.</td>
<td>✗ Teams were not cross-functional on department level.</td>
</tr>
<tr>
<td></td>
<td>✅ Members enlarge their network.</td>
<td>✗ Does not contain an idea selection gate.</td>
<td>✗ The delineation was not concrete and relevant enough for the team members.</td>
</tr>
<tr>
<td></td>
<td>✅ Use of a standard format.</td>
<td></td>
<td>✗ Not all members</td>
</tr>
</tbody>
</table>
The ideas were only judged by the members of the project teams. has enough context about the delineation

Not the best idea was chosen, but the idea which was shouted the loudest.

<table>
<thead>
<tr>
<th>Table 10 Strong/weak points idea generation session</th>
</tr>
</thead>
</table>

The table above contains some remarkable points. The theoretical strong point involvement of creative and optimistic people is also an empirical weak point. The program ‘Connected Innovation’ shows that a team of only creative and optimistic people is not critical enough to self-evaluate the idea (Interviewee: Bultus & Baan Hofman, 2012). The second interesting point is that the teams looks cross-functional, however the teams are only cross-functional on division level and not on department or function level. Another remarkable point is that the delineation, which is determined during the preparation, causes in this phase for problems. For instance, the delineation was not concrete and relevant enough. The last interesting point is that the program does not contain an idea selection gate. This theoretical weak point results also in an empirical weak point, because members of the program ‘Connected Innovation’ argued that without an idea selection gate, not the best idea was chosen, but the idea which was shouted the loudest. In this section are similar to the previous section also the most important weak points determined. The mean weak point of the idea generation session is that it does not contain an idea selection gate. According to the literature is an idea selection extremely important, because bad ideas can be killed in a premature stadium (Frishammar & Florén, 2008), (Koen, et al., 2002). As described above, the lack of an idea selection gate results also that not the best idea was chosen, but the idea which was shouted the loudest. The second main weaknesses of this session are the idea generation methods. The used methods were ‘thinking inside the company’ methods and ‘thinking inside the box’. According to the literature are these methods more suitable for incremental innovation (Hauser, Tellis, & Griffin, 2005), (Cooper & Edgett, 2008).

4.3 Program ‘Connected Innovation’: Idea elaboration & client involvement

In this phase each project team elaborates their idea and asks two clients for feedback. The elaboration consists of a further development of the idea, a description of the problem it solves, an estimation of the market and a reliable and profitable business case.

4.3.1 Theoretical analysis

The theoretical best practices of the literature study results in the following strong and weak points.

Product champion: The role of a product champion is to ensure that the idea survives the barriers (Koen, et al., 2002). A strong point of the program ‘Connected Innovation’ is that it pays attention to the concept of product champions. The role of the product champion in the program ‘Connected Innovation’ is fulfilled by the innovation team (IT) member (see case description in chapter 2). The IT members have to be initiator, connector, guard and motivator of the team during the program ‘Connected Innovation’.
Cross-functional project team: Researchers argued that the FFE should be carried out by a cross-functional team (Frishammar & Florén, 2008), (Kim & Wilemon, 2002). As described in the previous section the program ‘Connected Innovation’ makes use of a cross-functional team.

Personality: Personality plays an important role in the performance of teams. According to Reilly, Lynn, & Aronson (2002) personality variables are especially important for new product development teams, because activities in these teams are highly coordinated and carried out by cross-functional members. To determine the personality type, the program ‘Connected Innovation’ asked all the selected members to send their curriculum vitae. However, only two of twenty members have sent their curriculum vitae. Therefore, the selection of the members on personality was a thumb approximation of Bureau de Bont. With as result that teams does not exists of a right mix of personality types.

Client involvement: A strong point of the program ‘Connected Innovation’ is the involvement of clients during the program. Each team has two clients conversations to ask feedback on the idea. Many researchers emphasize the positive influence of client involvement during the FFE (Koen, et al., 2002), (Frishammar & Florén, 2008), (Kim & Wilemon, 2002). Moreover, Henard & Szymanski (2001) found in their meta-study that the extent to which the products meet client needs is one of the most important determinants of new product performance.

4.3.2 Empirical analysis
Based on the interviews, the following strong and weak points can be made for the program ‘Connected Innovation’.

Unclear: For project teams it was unclear which elements they have to elaborate on (Interviewee: Kroon, 2012), (Interviewee: Baltus & Baan Hofman, 2012). The results of this uncertainty is that the motivation and priority decreases by some team members (Interviewee: Hardy, 2012), (Interviewee: Baltus & Baan Hofman, 2012), (Interviewee: Kroon, 2012). Moreover, team members found it difficult to reprimand other members by insufficient motivation (Interviewee: Hardy, 2012).

Support: During this phase each project team has two meetings under supervision of Bureau de Bont. However, two meeting was not enough to remove the unclarity by the teams (Interviewee: Kroon, 2012), (Interviewee: Baltus & Baan Hofman, 2012). Moreover, two meetings in roughly three months was not enough for Bureau de Bont to determine the progress of the project teams.

Client involvement: A requirement of this step is that each project team should have at least two conversations with potential clients. According to interviewee: Ockhuijsen (2012) explicit involvement of clients is new for the construction sector. During these conversations with clients the project team presents their idea to the client and clients are asked for feedback and improvements of the idea. Based on the feedback the idea is further developed. All the teams experienced the involvement of clients as positive, because it delivers new insights (Interviewee: Kroon, 2012), (Interviewee: Baltus & Baan Hofman, 2012), (Interviewee: Plaisier, 2012). Therefore, interviewees Baltus & Baan Hofman (2012) and Kroon (2012) argued that more than two clients should be involved by a next program ‘Connected Innovation’. 
### Theoretical strong points

- IT members functioned as product champion.
- A cross-functional project team is used for diverge insight.
- Clients were involved to ensure that the products meet the client needs.

### Empirical strong points

- Client involvement was a positive experience for team members.

### Theoretical weak points

- Teams do not consist of the right mix of personality types (originator, motivator, debater, effector and a leader).

### Empirical weak points

- Unclear which elements have to be elaborated.
- Motivation and priority decreases by some members.
- Team members found it difficult to reprimand other members.
- Difficult to measure the progress of the teams.
- Two client conversations is to less.

<table>
<thead>
<tr>
<th>Table 11 Strong/weak points idea elaboration &amp; client involvement</th>
</tr>
</thead>
</table>
| This phase consists mainly of team work. Therefore, the selection of the right team members is important during the idea elaboration & client involvement. A theoretical weakness of the program was that the selection of members was only based on creativity traits and not on the right mix of personalities (originator, motivator, debater, effector and a leader). This results also in an empirical weakness, because the motivation and priority decrease by some team members. Another reason why the motivation and priority decrease is that it was unclear to the team members which elements they have to elaborate. The mean weakness of the idea elaboration & client involvement is that the personality types are not taken into account. According to Reilly, Lynn, & Aronson (2002) personality traits are especially important for new product development teams, because activities in these teams are highly coordinated. Also the interviewees emphasize that the selection of the right team members is extremely important for a successful execution of an innovation process (Interviewee: Herweijer & Knook, 2012), (Interviewee: Pijzel, 2012) and (Interviewee: Hardy, 2012).

### 4.4 Program ‘Connected Innovation’: Idea presentation session

The second plenary session of the program is the idea presentation session. As described in the case description this session consists of a guest speaker, presentation & feedback, preparation and a presentation about the future of the idea.

#### 4.4.1 Theoretical analysis

As described earlier, the idea presentation session can partially be compared with the gate: go to development, because teams present their ideas and people can give feedback. **Gate: go to development**: The idea presentation session is not a real gate with predetermined deliverables, criteria’s and output. The lack of a gate with predetermined deliverables, criteria’s and output is seen as a weak point of the program ‘Connected Innovation’, because the gate: go to development is the last possibility where the project can be killed before the expensive developing stage starts.
Review team: The program ‘Connected Innovation’ does also not contain an external review team. The feedback on the ideas came only from the other team members, instead of an external review team. According to Cooper (2008) it is a common mistake of companies that the project team members are also member of the review team.

4.4.2 Empirical analysis

The empirical strong and weak points of the program ‘Connected Innovation’ are described below.

Presentation: Each team presents their innovative idea to the other teams. The presentation consists of the following elements: 1) explanation of the idea, 2) description of the problem it solves, 3) an estimation of the market and 4) a reliable and profitable business case. Nevertheless, for the teams was it unclear what they have to present (Interviewee: Kroon, 2012). After the presentation, the other project teams have the opportunity to give feedback on the following points: 1) Have the innovation potential, 2) What is missed, 3) How the innovation can be improved. The aim of the feedback is to learn from each other and to improve the idea. The feedback is bundled and with voting devices all the team members determine or the feedback is realistic and important. The members experienced this as very positive, because based on this feedback the idea can quickly be improved (Interviewee: Baltus & Baan Hofman, 2012). According to interviewee: Hardy (2012) is it better in the future to use an extern review team, because an external review team has a fresh look.

Not future oriented: At the dinner, the project teams discuss how the idea should be developed in the future. Three questions are central, namely: 1) which information is missing, 2) who is needed in the future for the development of the innovation, 3) what is our role in the future of the innovation. Each group gives a presentation of 5 minutes on how the idea should further be developed. It can be concluded that the time to think about the future was too short. In other words, the focus of the program was too much backwards looking instead of future oriented (Interviewee: Kroon, 2012).

<table>
<thead>
<tr>
<th>Theoretical strong points</th>
<th>Empirical strong points</th>
<th>Theoretical weak points</th>
<th>Empirical weak points</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Members experienced the learning rate very positive.</td>
<td>✗ Does not contain a gate: go to development.</td>
<td>✗ There was not an external review team.</td>
<td>✗ Focus of the session was on looking back instead of the future.</td>
</tr>
</tbody>
</table>

Table 12 Strong/weak points idea presentation session

The following points in the table above are remarkable. First, although the members experience the learning rate as very positive, it was better to use an external review team. The mean weakness of the idea presentation session is the lack of a real gate: go to development. According to Cooper (2008) the gate: go to development has as objective to determine of the business case is profitable enough to start the development phase. Furthermore, it is the last possibility where the project can be killed before the expensive developing stage starts. Another important weakness is that the focus was not future oriented, but backwards oriented. As described in the following section results a backwards focus in a low success rate.
4.5 Program ‘Connected Innovation’: Outcome

The outcome of the program ‘Connected Innovation’ is aimed at the formulation of four ideas. As described in the previous section the ideas are elaborated on the following elements: description of the problem it solves, an estimation of the market and a reliable and profitable business case. In Appendix III the four ideas are described.

4.5.1 Theoretical analysis

Based on the best practices of the literature study, the following theoretical weak point can be drawn.

Business case: According to the literature the output of the program ‘Connected Innovation’ has to contain the same elements as a business case. As described earlier, a business case consists of the following elements: value proposition, key activities, key resources, key partners, customer segments, channels, customer relationship, cost structure and revenue streams (Osterwalder & Pigneur, 2010). In additional, Koen, et al. (2001) argued that competitor assessments, unknown technology and overall project risks have to be taken into account. Based on these elements it can be concluded that the program ‘Connected Innovation’ does not take into account all the needed elements, because the program focuses only on a description of the problem it solves, an estimation of the market and the development of a reliable and profitable financial analysis.

4.5.2 Empirical analysis

The empirical strong and weak points for the outcome of the program ‘Connected Innovation’ are described below.

Duration: The program ‘Connected Innovation’ has as a positive outcome that in practice is proven that this process can be executed in the construction sector within three months (Interviewee: Hardy, 2012). Also interviewees Herweijer & Knook (2012) of KPN said that a duration of 3 months for the FFE is feasible.

Client involvement: The involvement of clients was a positive learning point, because it provides valuable insights. (Interviewee: Baltus & Baan Hofman, 2012), (Interviewee: Kroon, 2012). Especially, it was a strong point because it was relative new for the construction sector (Interviewee: Ockhuijsen, 2012).

Objective not reach: Followed from the objective the aim was not only to generate ideas, but to generate ideas that can be commercialized. It can be concluded that at June 2012 only the idea ‘Innovative connecting: the entrepreneurial corporation’ is ready for commercialization (Interviewee: Hardy, 2012). This idea is in short-term the most promising and concrete idea. The other three ideas are not commercialized (Interviewee: Kroon, 2012), (Interviewee: Plaisier, 2012), (Interviewee: Baltus & Baan Hofman, 2012). Reason why the ideas are not commercialized: 1) the teams disintegrated after the program ‘Connected Innovation’ was ended, because there was not an organized continuation session (Interviewee: Plaisier, 2012), 2) members get a new job (Interviewee: Kroon, 2012), 3) creative peoples are not implementers of the innovations (Interviewee: Baltus & Baan Hofman, 2012), 4) creative people are busy people and therefore not finishers of projects (Interviewee: Baltus & Baan Hofman, 2012) and 5) the department Business Development does not communicate about the progress.
Theoretical strong points | Empirical strong points | Theoretical weak points | Empirical weak points
---|---|---|---
✔ One innovation that can be commercialized. ✔ Short duration of three months. ✔ Involvement of clients was a positive learning point. | ✗ It does not contains all the elements of a business case. | ✗ Objective is not achieved. ✗ Teams disintegrate after the program ‘Connected Innovation’ was ended. ✗ Creative peoples are not implementers of the innovations. ✗ Creative peoples are busy people. ✗ The department Business Development does not communicate about the progress. | 

Table 13 Strong/weak points outcome

A main criticism of the outcome of the program ‘Connected Innovation’ is that only one idea is ready for commercialization. The other three ideas are ended, because: 1) the teams disintegrate, 2) members get a new job, 3) creative peoples are not implementers of the innovations, 4) creative people are busy people and therefore not finishers of projects and 5) the department Business Development does not communicate about the progress. No communication decreases the motivation of the members to participate in the future in an innovation program.

### 4.6 Strong/ weaknesses analysis

Based on the empirical insights of the previous sections the figure below can be drawn. This figure gives a summary of the strong and weak points of the preparation, idea generation session, idea elaboration & client involvement, idea presentation session and outcome phases. In the figure the mean weakness are marked with the an exclamation mark mark.
In general, the elements of the program ‘Connected Innovation’ correspond relatively high with the best practices of the literature. Moreover, the interviews also indicate that the elements of the program ‘Connected Innovation’ are executed pretty good. The mean weaknesses come from not presented elements. Based on the figure above it can be concluded that the main weaknesses are during the preparation phase and the outcome of the program. More specific, the weaknesses of the program ‘Connected Innovation’ are related to the missing opportunity identification and opportunity analysis, idea generation methods, missing idea selection, selection of members on personality traits, missing gate: go to development, backwards focus and not achieved objectives. The following chapter will address these weak points by giving improvements for it.
5 Improvement program ‘Connected Innovation’

The sub question: How to address the weak points in the program ‘Connected Innovation’? is the focus of this chapter. In this chapter improvements are proposed for the weak points of the program ‘Connected Innovation’. The improvements are based on the theoretical and empirical insights of the previous chapter. This chapter is structured as follows. The first section discusses the redesign. The second section describes the change plan.

5.1 Redesign

As described in the previous chapter, the main weaknesses of the program ‘Connected Innovation’ are related to the missing opportunity identification and analysis, idea generation methods, missing idea selection, selection of members on personality traits, missing go to development, backwards focus and not achieved objectives. Before in detail the redesign is described, first an overview of the redesign is given in the following figure.

Beside the idea generation session and idea elaboration & client involvement the redesign consists of the following additional elements: opportunity identification & analysis, opportunity gate, idea selection gate, gate: go to development and a development & commercialization of ideas. In the following subsections the redesign is further elaborated.

5.1.1 Opportunity identification and analysis

This subsection elaborates the first element of the redesign. The table below starts with the weaknesses which are identified in the previous chapter. The most important weaknesses are underlined. Based on these weaknesses improvement are proposed. Furthermore, for each phase the theoretical best practices are given. Moreover, the last row shows which people should be involved during each element.

<table>
<thead>
<tr>
<th>Weaknesses</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not contain an opportunity identification step.</td>
<td>✓</td>
</tr>
<tr>
<td>Does not contain an opportunity analysis step.</td>
<td>✓</td>
</tr>
<tr>
<td>Objective was not SMART formulated.</td>
<td>✓</td>
</tr>
</tbody>
</table>
Members realize insufficient that the objective was to commercialize the ideas.

**Improvement**

Add the *opportunity identification and analysis* phase to the program ‘Connected Innovation’. An opportunity is defined as “a business or technology gap, that a company or individual realizes, that exists between the current situation and an envisioned future in order to capture competitive advantage, respond to a threat, solve a problem, or ameliorate a difficulty” (Koen, et al., 2002). In the *opportunity identification* step organizations identify potential business and technological opportunities. These new opportunities can result in new markets, market grows, operating effectiveness and operating efficiency (Koen, et al., 2001). Beside the identification of opportunities, Koen, et al. (2002) argued that additional information is needed before the opportunities of the previous stage can be assessed and translated into specific business and technology opportunities. The purpose of additional information is to reduce the uncertainty of technology and market (Cooper, 2008). According to Koen, et al, (2002) an analysis for the importance and potential of the opportunity includes the following elements: strategic framing, market segment assessment and competitor analysis. In addition, interviewee: Regteren (2012) argued that not the technical, but market aspects are essencial during the *opportunity identification and analysis*.

Formulate objectives which are Specific, Measureable, Attainable, Relevant and Timely. The advantage of SMART formulated objectives is that it real aim of the program is clear for the members of the program ‘Connected Innovation’. In addition, interviewees: Herweijer & Knook (2012) argued that projects can be easily controlled on basis of SMART objectives.

**Best practices**

Use roadmapping, trend analysis, competitive intelligence analysis and scenario planning during the *opportunity identification and analysis*.

**Who**

Use an opportunity analysis team that consists of three to five people and usually one person of R&D and one person of marketing.

---

Table 14 Redesign - Opportunity identification & analysis

5.1.2 Opportunity gate

The second element of the redesign which is elaborated is the *opportunity gate*.

2) Opportunity gate

| Weaknesses | ✓ Does not contain an opportunity gate. |
| Improvement | ✓ Add to the program ‘Connected Innovation’ an opportunity gate. An opportunity gate receives almost no attention in the literature of the fuzzy front end (FFE). However, based on Cooper & Edgett (2008) a gate serves as quality–control check point and is therefore recommended. |
| Best practices | ✓ Assess the opportunities on strategic framing, market segment, competitor analysis and client assessment. |
| Who | ✓ Senior management and innovation managers, because the selection of the right opportunities is highly related to the strategy of a company. |

Table 15 Redesign - Opportunity gate
### 5.1.3 Idea generation session

The third element of the redesign is the *idea generation session*. The *idea generation session* was also part of the original program ‘Connected Innovation’. Nevertheless, based on the theoretical and empirical weak points the following changes are proposed.

<table>
<thead>
<tr>
<th>3) Idea generation session</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>✗ During the program ‘Connected Innovation’ the selection of members was not good enough, because members were only selected on their creativity traits (Interviewee: Hardy, 2012).</td>
</tr>
<tr>
<td>✗ Teams do not use ‘thinking outside the box’ methods for radical innovation.</td>
</tr>
<tr>
<td>✗ Teams do not use ‘thinking outside the company’ methods for radical innovation.</td>
</tr>
<tr>
<td>✗ The teams need be cross-functional on department-level, instead of cross-functional on division level.</td>
</tr>
<tr>
<td>✗ The delineation was not concrete and relevant enough for the team members. For instance, in the executed program the demographic decline and recession by municipalities was not relevant for employees of the division ‘water’.</td>
</tr>
<tr>
<td>✗ Not all members have enough context about the delineation.</td>
</tr>
<tr>
<td><strong>Improvement</strong></td>
</tr>
<tr>
<td>✓ Team members should not only be selected on creativity. A team has to consist of a leader, originator, motivator, debater and effector. Especially during the idea generation are originators important (Singh, 2011). Interviewee: Baltus &amp; Baan Hofman (2012) also argued that debaters are important, because this enhanced a critical self-evaluation of the idea. According to interviewee: Aa (2012) and interviewee: Ockhuijsen (2012) a leader should focusses more on the team and innovation process, than on the content. To ensure the right mix of personality, it is recommended to compose teams on basis of a personality test.</td>
</tr>
<tr>
<td>✓ To ensure radical innovation, Bureau de Bont have to used ‘thinking outside the box’ and ‘thinking outside the company’ methods for the idea generation, such as templates, consumption chain analyze, client visit teams and client focus groups.</td>
</tr>
<tr>
<td>✓ A cross-functional team should be used for the idea generation (Wulfen, 2006). R&amp;D and marketing as well as other functions (e.g., production, client service) should cooperate in the idea generation process, because the cross-functional nature of the group ensures that client needs and technological capabilities are taken into account (Herstatt, Verworn, &amp; Nagahira, 2004).</td>
</tr>
<tr>
<td><strong>Best practices</strong></td>
</tr>
<tr>
<td>✓ Use ‘thinking outside the box’ for radical innovation.</td>
</tr>
<tr>
<td>✓ Use ‘thinking outside the company’ methods for collecting ideas from customers.</td>
</tr>
<tr>
<td><strong>Who</strong></td>
</tr>
<tr>
<td>✓ Use a cross-functional team that includes different personalities and people from R&amp;D and marketing as well as other functions (e.g., production, client service). Moreover, people should have knowledge of market and client problems (Ardichvili, Cardozo, &amp; Ray, 2003).</td>
</tr>
</tbody>
</table>

*Table 16 Redesign - Opportunity identification & analysis*
The two weaknesses: 1) the delineation was not concrete and relevant enough for the team members and 2) not all members has enough context about the delineation are solved by a well executed opportunity identification and analysis.

5.1.4 Idea selection gate

The idea selection gate was not part of the original program. Nevertheless, based on weaknesses described in chapter 4 it is recommend to add the idea selection gate.

4) Idea selection gate

<table>
<thead>
<tr>
<th>Weaknesses</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗ Does not contain an idea selection gate.</td>
<td>✓ Add the idea selection gate to the program ‘Connected Innovation’.</td>
</tr>
<tr>
<td>✗ Not the best idea was chosen, but the idea which was shouted the loudest.</td>
<td>According to interviewee: Regteren (2012) ensure a gate a conscious choice which ideas get priority or are killed.</td>
</tr>
<tr>
<td>✗ The program ‘Connected Innovation’ does not makes use of an external review team.</td>
<td>Also according to the literature the idea selection is a critical step for the competitive position of companies (Frishammar &amp; Florén, 2008). Nevertheless, a single process that guarantees the right selection of idea does not exist (Schilling, 2008). Therefore, different methods should be used for the selection of ideas, such as discounted cash flow calculations, net present value or internal rate of return. Moreover, screening questions, mix of innovation and Q-sort are also suitable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Add the idea selection gate to the program ‘Connected Innovation’.</td>
</tr>
<tr>
<td>According to interviewee: Regteren (2012) ensure a gate a conscious choice which ideas get priority or are killed.</td>
</tr>
<tr>
<td>Also according to the literature the idea selection is a critical step for the competitive position of companies (Frishammar &amp; Florén, 2008). Nevertheless, a single process that guarantees the right selection of idea does not exist (Schilling, 2008). Therefore, different methods should be used for the selection of ideas, such as discounted cash flow calculations, net present value or internal rate of return. Moreover, screening questions, mix of innovation and Q-sort are also suitable.</td>
</tr>
<tr>
<td>✗ Use an extern review team. According to Cooper (2008) is a common mistake that the project team members are also member of the review team. In the last row of this table the composition of the review team is described.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Use quantitative criteria’s especially for incremental new ideas.</td>
</tr>
<tr>
<td>✗ Use qualitative criteria’s especially for radical innovation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ The review team composition should consist of a cross-functional team of senior people, with preferences for intuition and thinking. The senior level of the review team depends on the type and importance of the idea. In general, for incremental ideas, the review team should consist of the mid management of a company. For important radical ideas the review team should consist of the senior management (Cooper, 2008).</td>
</tr>
</tbody>
</table>

Table 17 Redesign - idea selection gate

5.1.5 Idea elaboration & client involvement

The element idea elaboration & client involvement was part of the origin program ‘Connected Innovation’. Nevertheless, based on the weaknesses are the following improvements proposed.

5) Idea elaboration & client involvement

<table>
<thead>
<tr>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗ Teams do not consist of the right mix of personality (originator, motivator, debater, effector and a leader).</td>
</tr>
<tr>
<td>✗ During the idea elaboration &amp; client involvement and idea presentation it was unclear to the project teams what they have to elaborate on.</td>
</tr>
<tr>
<td>✗ Motivation and priority decreases.</td>
</tr>
<tr>
<td>✗ Team members found it difficult to reprimand other members.</td>
</tr>
</tbody>
</table>

Table 17 Redesign - idea selection gate
Involvement of two clients is not enough.

**Improvement**

- Similar to the *idea generation session* a team should consist of a leader, originator, motivator, debater and effector. During this phase is especially the role of motivator and debater important (Singh, 2011). Therefore, it is recommended to compose teams on basis of a personality test. An additional advantage of a better selection and team composition are more motivated team members. Therefore, reprimanding other team members is less needed.
- The program ‘Connected Innovation’ has to use standard formats for each step. The step *idea elaboration & client involvement* have to use a business case as format. This business case should consist of the following elements: value proposition, key activities, key resources, key partners, customer segments, channels, customer relationship, cost structure and revenue streams (Osterwalder & Pigneur, 2010). In additional, Koen, et al. (2001) argued that competitor assessments, unknown technology and overall project risks should also be taken into account.
- Depending on time pressure, is it recommendable to involve more than two clients during this phase.

**Best practices**

- Use a product champion to ensure that the idea survive the barriers.
- Involve clients to ensure that the products meets the client needs.

**Who**

- Use a cross-functional team for diverge insights during the *concept & technology development*. Moreover, compose a team which consists of a leader, originator, motivator, debater and effector.

<table>
<thead>
<tr>
<th>Table 18 Redesign - Idea elaboration &amp; client involvement</th>
</tr>
</thead>
</table>

### 5.1.6 Gate: go to development

The *gate: go to development* does not form a part of the original program ‘Connected Innovation’. However, as shown in the table below this gate has additional value for the program ‘Connected Innovation’.

<table>
<thead>
<tr>
<th>6) Gate: go to development</th>
</tr>
</thead>
</table>

#### Weaknesses

- Does not contain a gate ‘go to development’.
- There was not a review team; ideas are only judged by the members of the program.
- Difficult to measure the progress of the teams.

#### Improvement

- Add the *gate: go to development* to the program ‘Connected Innovation’. In the *gate: go to development* the outcome of the *idea elaboration & client involvement* is reviewed. The *gate: go to development* has as objective to determine of the business case is profitable enough to start the development phase. Furthermore, it is the last possibility where the project can be killed before the expensive developing stage starts. An additional benefit of a gate is that it is easier to measure the progress of teams, because in the gate each team presents their results.
- Use an external review team during this gate. The review team consists of a non-voting facilitator and senior people who allocate the resources of the project team. The senior level of the review team depends on the type and importance of the idea. In general, for incremental ideas the review team should consist of the mid management of a company. For important radical ideas the review team should consist of the senior management (Cooper, 2008). In addition, Polczynski (2010) advice to add Chief
Technology Officer, Chief Financial Officer and customers to the review team.

<table>
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<th>Best practices</th>
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<tr>
<td>✔️ A gate consists of input, criteria, output and a review team. The most important criteria’s for this gate are customer acceptance, product performance, and technical feasibility. The output of the gate is a Go/ Kill/ Hold/ Recycle decision, an approved action plan for the next stage and a list of deliverables, criteria’s and dates for the next gate.</td>
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<tr>
<td>✔️ Use a business gate as format for the <em>idea presentation session</em></td>
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<tr>
<td>✔️ The review team composition should consist of a cross-functional team of senior people. Moreover, do not involve the project team members in the review team.</td>
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Table 19 Redesign - Gate: go to development

5.1.7 Development & commercialization of ideas

In comparison to the original program ‘Connected Innovation’ this element is added to the redesign of the program ‘Connected Innovation’. According to interviewee: Zelfde (2012) is the *development & commercialization of ideas* the moment where it usually goes wrong.

<table>
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<th>7) Development &amp; commercialization of ideas</th>
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<td>Weaknesses</td>
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| Improvement | ✔️ Bureau de Bont still has to be involved during this phase to ensure that the ideas do not disappear into nothingness. The aim of Bureau de Bont is to organize meetings, support project teams, communicate about the progress and to ensure that the teams do not disintegrate. |
| | ✔️ During the innovation process other types of people are needed (Interviewee: Pijzel, 2012). During the *idea generation session* creative people are needed, who think out-of-the-box (originator) (Singh, 2011), (Interviewee: Pijzel, 2012), (Interviewee: Ockhuijsen, 2012). However, during the *development and commercialization phase* more precise and detail oriented persons are needed (effector). Therefore, the team composition has to change during the innovation process. |
| | ✔️ Another improvement is to involve the department whose is finally responsible for the new product or services (Interviewee: Plaisier, 2012). Because this department is most affected by the idea and has to embraces the idea (Interviewee: Kroon, 2012). |

| Best practices | ✔️ Use a product champion to ensure that the idea survives the barriers. |
| | ✔️ Join or retire people during the innovation process. |

| Who | ✔️ Use a cross-functional team for diverge insights during the concept & technology development. Moreover, compose a team which consists of a leader, originator, motivator, debater and effector. |

Table 20 Redesign - Development & commercialization of ideas
As shown in the table above the main changes focus on the opportunity identification and analysis, gates and the development & commercialization phase.

### 5.2 Change plan

As shown in the previous section the redesign consists of quite a few improvements. Some improvements are more promising than other improvements. In this section a PICK diagram is used to determine the most promising improvements for the program ‘Connected Innovation’. A PICK diagram shows the effect on the horizontal axis and the feasibility on the vertical axis. Given the two axes on which a high or a low score can be achieved, four categories can be distinguished. The category with a high score on effect and feasibility is called Implement, the category with high score on feasibility, but low on effect is called Possible, the category with high score on effect, but low on feasibility is called Challenge, and the category with the lowest score on both effect and feasibility is called Kill. The writer of this report has determined the scores in the PICK with the aim of the Kesselring method. By this method, the improvements are assessed against each other. The complete Kesselring method is shown in Appendix V. The criteria’s which are taken into account for effect are: quality improvement, costs, etc. The criteria’s which are taken into account by feasibility are: the acceptance of the improvement by Bureau de Bont, clients, financiers and members of the program ‘Connected Innovation’.

**Figure 22 PICK diagram**

Based on the PICK diagram, the following points are remarkably. First of all, only the improvement 16) involve the responsible department is in the Implement quadrant of the PICK diagram. The other improvements are almost covered by the Challenge quadrant and the Possible quadrant. The most promising improvement of the Possible quadrant are: 10) use of standard formats, 6) cross-functional team, 13) multifunctional review team and an 7) idea selection gate. These improvements scores relative high on effect, therefore these improvements are the most promising. In the Challenge quadrant scores 12) gate: go to
development, 15) change team composition and 1) opportunity identification and analysis relative good on the combination of effect and feasibility. Therefore, these improvements are the most promising. Another remarkable point is that the improvement 14) stay involved scores very high on effect, but low on feasibility. The underlying reason why stay involved scores low on feasibility is that clients of Bureau de Bont does not realize that the ‘development and commercialization phase’ is the most difficult phase. Moreover, clients are less willing to pay Bureau de Bont also for this phase. Nevertheless, these improvements have big effect, therefore is it recommended to enter these improvements to the program ‘Connected Innovation’. The last remarkable point is that the 4 and 9) team composition (leader, originator, motivator, debater and effector) scores very high on effect, but low on feasibility. The underlying reason is that it is difficult to determine exactly the personality traits. Nevertheless, these improvements have big effect, therefore is it recommended to enter these improvements to the program ‘Connected Innovation’. Especially because these improvements solve the mean weaknesses of the program ‘Connected Innovation’. Therefore, to convince people of the importance of these improvements, the change process of Kotter (1997) is recommended. This change program is depicted in the figure below.

![Eight Steps To Successful Change - John Kotter](www.samsari.se)

**Figure 23 Change program of Kotter (www.samsari.se)**

**Establish a sense of urgency:** The first step of the change program is creating a sense of urgency around the need to change. In case of the program ‘Connected Innovation’ the step has to be carried out during the acquisition talk of Bureau de Bont by potential clients.

**Create a guiding coalition:** The second step is to create a coalition of leaders who guides or leads the change. The power of the leaders can come from job title, status, expertise and political importance. The guiding coalition can be in the case of the program ‘Connected Innovation’ the steering committee, IT members and Bureau de Bont. The steering committee, IT members and Bureau de Bont has to lead the change to implement the improvements.

**Develop a clear shared vision:** The third step is to create a clear vision. A vision is important, because with an vision it is easier for everyone to understand why he or she is asked to change.

**Communicate the vision:** The fourth step is to communicate the vision. Important is not only to talk about the vision, but also ‘walk your talk’.

**Empower people to act on the vision:** To realize change, barriers have to be removed and people who should realize the change have to be empowered. This is the responsibility of the steering committee, IT members and Bureau de Bont.
Create short term wins: The best way to change is success. Therefore, celebrate the victory of a quick win. Because quick wins counter critics and negative people. Bureau de Bont has determine quick wins and had to organize the communication and celebration around it.

Consolidate & build on the gains: Kotter (1997) argues that many change projects fail because the change program is stopped to early. Therefore, the change program has to be consolidate and have to build on the gains, because real change runs deep.

Institutionalize the change: In the last step the change have to be embedded in the organization, culture and day-to-day work. It is important that the leaders of the company continue to support the change(Kotter, 1997).
6 Conclusion
This chapter presents the conclusions of the thesis project. The chapter is structured as follows. First, the research question is answered. Second, the theoretical implications are discussed. Third, the empirical implications are elaborated. Finally, limitations and directions for future research are described.

6.1 Research objective
The subject of the thesis project was the program ‘Connected Innovation’. This program has as aim to generate new innovative products or services for the construction sector in three to four months. The program ‘Connected Innovation’ is developed by Bureau de Bont and in this setting used for Arcadis. Although Arcadis was satisfied with the program ‘Connected Innovation’ Bureau de Bont had the feeling that there is still room for improvement. Therefore, the research question is as follows:

How can the program ‘Connected Innovation’ be improved based on the best practices of the fuzzy front end?

To answer this research question, the thesis project starts with a literature study to determine the best practices of the FFE. The model of Koen, et al. (2001) is used for framing the best practices. This model consists of influencing factors, engine and the steps opportunity identification, opportunity analysis, idea genesis, idea selection and concept & technology development. The engine of this model represents the senior- and executive managers which develop a strategy, gives leadership and creates an innovative culture. Moreover, this process is affected by influencing factors. One of the most important characteristics of the model is its iterative nature. Based on the described best practices it can be concluded that the program ‘Connected Innovation’ scores bad on the following points: opportunity identification, opportunity analysis, idea generation methods, idea selection, team composition and the gate: go to development. The underlying reason for the bad score is that these elements were not part of the program ‘Connected Innovation’.

Beside the theoretical insights, the program ‘Connected Innovation’ is also investigated by a case study. Interviews were held with the initiator of the program, IT members and members of the program. Moreover, five interviews were held with employees of other innovative companies in the construction. Also two interviews were held with employees who work in another sector. Based on these interviews, the most important weaknesses of the program ‘Connected Innovation’ is the backwards focus and not achieved objective. The weak points of the program ‘Connected Innovation’ are addressed in the redesign. An overview of the redesign is given in the following figure.
To address these weaknesses, the redesign of the program ‘Connected Innovation’ consists of an opportunity identification and analysis, a gate after this phase, a gate after the idea generation and the gate: go to development after the concept & technology phase. Finally, the program should not be stopped after this gate, but Bureau de Bont had to be still involved during the development & commercialization phase.

6.2 Theoretical implications

This thesis project results in the following theoretical implications. First, to the model of Koen, et al. (2001) is the gate: go to development added. The gate: go to development has as objective to determine of the business case is profitable enough to start the development phase. According to Cooper (2008) the gate: go to development consists of a review team, deliverables, criteria’s and outputs. In general, the review team consists of a non-voting facilitator and senior people who allocate the resources of the project team. The deliverables are what the project team brings to the gate. The most important criteria’s for this gate are customer acceptance, product performance, and technical feasibility (Hart, Hultink, Tzokas, & Commandeur, 2003). The output of the gates is a Go/ Kill/ Hold/ Recycle decision, an approved action plan for the next stage and a list of deliverables, criteria’s and dates for the next gate. The gate: go to development is added to the model of Koen, et al. (2001), because the weakness of this model is the screening of ideas. The model contains only one idea selection step and after the last step is not a gate added. According to Cooper & Edgett (2008) is it recommendable to add a gate, because a gate serve as a gate serve as quality–control check point. Moreover, Cooper (2008) argued that especially the gate: go to development is important, because this is the last possibility where an idea can be killed before the expensive development phase starts.

Another theoretical implication is that the best practices to involve people with creativity and optimism traits for the generation of new ideas (Koen, et al., 2002) is in practices not recommended. Because the practice shows that a team of only creative and optimistic people is not critical enough to self-evaluate the idea (Interviewee: Baltus & Baan Hofman, 2012). Therefore, it is recommended to compose also for the idea generation a team which consists of creative, but also critical members.
6.3 Empirical implications

The first empirical implication of this research is that by an innovation process, such as the program ‘Connected Innovation’ it more important is to do the right things, than to do the things right. Based on the analysis, it can be concluded that the mean weaknesses of the program ‘Connected Innovation’ where related to the elements which are not part of the program ‘Connected Innovation’, such as: opportunity identification, opportunity analysis, idea selection and the gate: go to development. These missing elements result in different problems. For instance, the missing opportunity identification and analysis results in a delineation which was not concrete and relevant enough. Moreover, without an idea selection gate, not the best idea was chosen, but the idea which was shouted the loudest. Also, the fact that the program ‘Connected Innovation’ does not contains gates results in the fact that bad ideas are not killed in an early stage of the program ‘Connected Innovation’.

The second empirical implication is that it can be concluded that the most important factor of an innovation process are the people which are involved in the process (Interviewee: Herweijer & Knook, 2012), (Interviewee: Kroon, 2012), (Interviewee: Pijzel, 2012). This implies that not the design and structure of the FFE is the key factor for a successful outcome, but the selection of the right people is the most important factor for a successful innovation process. Important to note that there does not exist one type of people which had to involved in the FFE. The best way is to involve a balanced mix between people. For instance, a team should consist of a leader, originator, motivator, debater and effector (Singh, 2011).

The third empirical implication is that not the generation of ideas, but the development and commercialization is the hardest part of innovation. The underlying reason is that creative people are mostly not the most appropriate people for the development and commercialization of ideas. Moreover, during the development and commercialization has also the department be involved whose is finally responsible for the new product or services (Interviewee: Plaisier, 2012). Because this department is most affected by the idea and has to embrace the idea (Interviewee: Kroon, 2012).

6.4 Limitations and future research

This thesis project has the following limitations. The main limitation is that this research focuses only on one case in the construction sector in the Netherlands. This limits the generalization of the results of this thesis project. Moreover, the results cannot be generalized outside this setting. Another weakness is that the model of Koen et al. (2001) is not empirically tested. Therefore, the results of this these thesis should be threaded carefully. Based on these limitations, the following recommendations have to be made. The model of Koen et al. (2001) should be empirically tested by means of qualitative and quantitative research. For qualitative research a case study of other innovation projects is recommendable. Quantitative research can be carried out by using data of innovation projects. Based on these data can be determined which best practices are most important for the quality, speed, costs, etc. of the FFE. Furthermore, future research in other settings has to investigate of the recommendations for the program ‘Connected Innovation’ are also applicable in another context. This can be done by executing a case study of the FFE in different sectors.


Appendix I

Innovation

Innovation is more and more investigated in the literature of product development, technology management, marketing, strategic management, economics, etc. The downside of this growth is that the term innovation becomes more or less ambiguous (Garcia & Calantone, 2002). Another issue is that the literature distinguishes a lot of innovation types, such as radical, incremental, new to the market, new to the firm, really new and discontinuous, innovations. These types of innovation have more or less overlap with each other. Therefore, the aim of this appendix is to define innovation and distinguish three different innovation types.

Definition Innovation

The literature used a wide range of definition for innovations. According to (Garcia & Calantone, 2002) is a technological innovation defined as:

“Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention.”

(Garcia & Calantone, 2002) argued that a product will evolve on a predictable manner. The initial emphasis will be on product performance. Then on product variety and finally on product standardization and costs. The evolution of products results in an iterative innovation process with a variety of different innovation types, such as radical innovations for products at the initial stage of the product and incremental innovations at the later stages of the product. In addition, (Garcia & Calantone, 2002) also distinguish a third type of innovation, namely: really new innovation. Table 21 makes a distinction between radical, really new and incremental innovation. These innovation types are based on the distinction between macro and micro level and the distinction between marketing and technology. Macro level is related to the level of respectively the world, the market, or the industry. While micro level is related to the level of firms and individual customers. The distinction between marketing and technology depends on the requirements of the innovation. The evolution of marketplace (macro level), marketing skills (micro level) is related to marketing. While a shift in the state of science of the technology (macro level), new R&D resources (micro level) is related to technology.

Table 21 Innovation types (Garcia & Calantone, 2002)
Radical Innovation
As shown in Table 21 is radical innovation defined as an innovation which require changes on macro-marketing, macro-technology, micro-marketing and micro-technology. The result of a radical innovation is the development of a new product in a new market and the envelopment and suppression of the existing market. In other words, the result of radical innovation is a discontinue on current marketing and technology for both macro and micro level. This type of innovation does not exist frequently, roughly 10% of the innovation can be classified as radical (Garcia & Calantone, 2002). Examples of radical innovation are the steam engine, internet, and tablet. A characteristic of radical innovation is that it creates a demand which was unrecognized by the customers.

Really New Innovation
Based on Table 21 requires really new innovation a change on either marketing or technology. Furthermore, it requires a micro level change on marketing or technology. Really new innovation is on the one hand new technologies to existing markets, such as product line extensions and new product lines. On the other hand is this type of innovation existing technologies to new markets, for instance product lines. Most innovations are covered by this type. Research shows that roughly 40% of the innovations are really new innovation (Garcia & Calantone, 2002).

Incremental Innovation
Table 21 shows that incremental innovation a change require at the micro level of marketing and/or technology and no changes at the macro level. Incremental innovations are described as product improvements using existing technologies in existing markets. For companies is incremental innovation important because it is a competitive weapon in a technologically mature product and it reduces the change that a new radical innovation compete the current product and market. About 50% of the innovation belongs to incremental innovation (Garcia & Calantone, 2002).
Appendix II

General stage-gate system
The stage-gate system is a blueprint for effective and efficient managing of the new product development process from idea to launch (Cooper, 2008). The basic assumption is that the stage-gate system recognizes innovation as a manageable process. In a stage-gate system are project-management methodologies added to the innovation process. This means that the innovation process is divided in stages, and after each stage is a gate or quality checks. In the stages is the work down through a cross-functional project team. A cross-functional project team means that the project members are from different functions, such as research and development, engineering, production and marketing. This indicates also that the stage-gate system is not a functional process, but a cross-functional process. The works what is been done in the stages is judged in the gate through the stage-gate review team, which is another team than the project team. A gate consists of deliverables, criteria’s and outputs. Deliverables are the result of the gates which the project teams bring to the gate. The output of the gates is a Go/ Kill/ Hold/ Recycle decision, an approved action plan for the next stage and a list of deliverables, criteria’s and dates for the next gate. Important to note is that a Go decision also means that budget and resources should be available for the next gate (Cooper, 2008).

Method general stage-gate system
The general stage-gate system is depicted in the figure below.

![Figure 25 Stage-gate system (Cooper, 2008)]

The following description of the stage-gate system is based on (Cooper, 1990), (Cooper, 1997) and (Cooper, 2008).

Initial stage - Discovery: The initial stage is the discovery stage. In this stage are the ideas discovered.

Gate 1 - Idea Screen: The first gate is the screening of the ideas. The criteria’s which are used at this gate are related to strategic alignment, project feasibility, magnitude of opportunity, differential advantage, synergy with the firm’s core business and resources, and market attractiveness. The focus in the first gate is less on financial aspects.

Stage 1 - Scoping: The first phase is an inexpensive stage to determine the technical and marketplace potentials of the idea. Steps which should be done in this stage are a library search, contacts with key users, focus groups, and even a quick concept test with a handful of potential users for the market aspects and a simple in-house appraisal of the idea. The aim of this stage is
to determine global the market size, market potential, market acceptance, manufacturing feasibility, and possible costs and production time.

Gate 2 - Second Screen: The second screen is a re-evaluation of the project based on the new information which is gathered in the first stage. Beside the criteria’s of gate 1 are also financial criteria’s included.

Stage 2 - Build Business Case: This stage has as aim to investigate the attractiveness of the new product before the expensive development starts. Activities of this stage are a market research, competitive analysis, concept testing, preliminary design or laboratory work, manufacturing proposal. Additionally, legal, patent or copyright issues can be a part of this stage. Furthermore, a financial analysis is a part of this phase. Important to note that the cost of the new product are mainly determined in the first and second stage (Hauser, Tellis, & Griffin, 2005).

Gate 3 - Go to development: This gate is the last possibility where the project can be killed before the expensive developing stage start. The review team investigates the target market definition, product positioning strategy, product concept definition, product features, product attributes, and product specifications. An important aspects of this review are the financial aspects.

Stage 3 - Development: Stage 3 has as purpose to develop the product, marketing plan and production plan. Based on the new information is the business case of the previous stage updated. Moreover, a proposal is prepared for the next stage.

Gate 4 - Go to testing: Gate 4 is a check on the progress of the new product. The steps of the development stage are reviewed and checked on completeness and quality. At this review are financial criteria’s very important for the Go/ Kill/ Hold/ Recycle decision.

Stage 4 - Testing & Validation: This stage tests the viability of the product, production process, client reactions and finance. The activities which are undertaken in this stage are an in-house product tests, field trials of the product, pilot production and a market pre-test. Finally, the financial analysis is updated to check the economic viability of the new product.

Gate 5 - Go to launch: This final gate makes the decision between commercialize the project or killing the project. In this gate is the quality of the previous stage is checked. Finance plays a key role in the gate decision of the gate review team.

Stage 5 - Launch: The last stage is the product commercialized. Post-launch review following at some time the commercialization. The last step is a product and process review. This review looks at the innovation project’s strengths and weaknesses, what can be learned from this project. Hereafter, the project team is disbanded and the new product becomes a standard product of the firm.

Stage-gate system with flexible amount of gates

According to (Cooper, 2008) is the greatest change in the original stage-gate system a stage-gate system with a flexible amount of stages and gates. The amount of gates depends on the expected risk of the new product. For instance, radical innovation has a higher risk and need therefore also more gates in comparison with incremental innovations. The first advantage of a flexible amount of gates is that it accelerates the development speed. The second advantage of a flexible amount of gates is that it decreases resources, because less stages and gates have to be completed.
Method stage-gate system with flexible amount of gates

An example of a stage-gate system with a flexible amount of gates is depicted in the figure below.

In addition to the regular gate decision determine the review team in gate 1 also the routing of the new product in the stage-gate system. In general, high risk is related with radical innovations, moderated risk is related with really-new innovations and low risk is related with incremental innovations. The products with the highest risk following the regular stage-gate system. For products with moderate risk are stage 1 and 2 combined. The same applies to stage 3 and 4. The stage-gate system consists of 2 gates for products with low risks. The first stage consists of the original gate 1 and 2. The second stage consist out a combination of stage 3, 4 and 5.

Spiral stage-gate system

Another method for new product development is a spiral or agile stage-gate system (Cooper, 2008). The aim of spiral development processes is to close the gap between the need for early sharp and fact-based product definition before the development begins and the need to be flexible in the development stage to new information and changing market conditions. By spiral stage-gate system is the processes accelerated due build-test-feedback-and-revise iterations with the potential users. In other words, the new product development team is forced to get market and engineering feedback quickly and often. Spiral stage-gate system seems in favor for products in fast evolving markets.

Method spiral stage-gate system

The method of spiral or agile stage-gate system is shown in the figure below.
As shown in the figure above is spiral stage-gate system close connected in stage 2, stage 3 and stage 4 with the potential users.

**First spiral:** The first spiral investigates the user’s needs and wants. The project members visit clients to understand the unmet needs, problem and benefits.

**Second spiral:** By the second spiral present the project team a representation of the product, such as a computer-generated virtual prototype, very crude prototype to the potential user. The aim of this spiral is to investigate the interest, preference and getting feedback of the product.

**Third spiral:** The aim of the third spiral is to test the rapid prototype. In contrast to the previous step is the test carried out with a physical prototype.

**Fourth & fifth spiral:** These spirals are the second and third spiral of stage three. The aim of this spiral is to test the adapted prototype.

**Sixth spiral** The last spiral belongs by the testing and validation stage. This spiral is an extensive test of the final product in the market. This is done due, for instance, field tests and beta tests.

**Overlapping stage-gate system**
Another extension of stage-gate system are overlapping stages (Cooper, 2008). In overlapping stage-gate systems is it allowed to start with stage 3 before stage 2 is finished and stage 4 might starts before stage 3 is completed. The aim of overlapping stage-gate systems is greater speed and more rapid feedback. The drawback of this method is that overlapping can result in rework which required extra time, resources and budget.

**Method overlapping stage-gate system**
The method of overlapping stage-gate systems is shows in the figure below.
A major benefit of overlapping of gates is the potential time reduction. It is important to note that overlapping can also result in rework. A tradeoff between time reduction and rework should be made. For instance rework occurs when information in the overlapping part of stage 2 required changes in the just started activities of gate 3. When stages are very dependent on the activities of the previous stage is overlapping not recommended. When stages are independent could overlapping be an option.
Appendix III

Innovative connecting: the entrepreneurial corporation

**Problem:** The government will improve the quality of licensing and enforcement. This is done by scaling up the licensing and enforcement. However, due demographic decline and recession the government will reduce the budget of licensing and enforcement.

**Idea:** Outsource work to the specialist of Arcadis, because the specialist of Arcadis has up to date information about the specialty.

![Figure 29 Innovative connecting: the entrepreneurial corporation](image)

**Revenue model:** The revenue model for Arcadis is traditional, namely: at hourly rates.

**Market:** The target market for this idea are small municipals, because small municipals have as first to deal with scaling up the licensing and enforcement.

Shrinkage in living is space for businesses

**Problem:** Different factories are located in a residential. This results in complains about nuisance, safety, etc. of residents of the factories. Furthermore, because the residential, the factories are restricted in expansion options.

**Idea:** By this idea the houses around the factory are demolished. The new space can be used for expansion of the factory and for a park environment. The factory has to pay for the demolition of the houses and the creation of the park. The costs of this are lower than the moving costs of the factory. The benefits of this idea are expansion possibilities of the company; the quality of the residential improves due the park environment.

![Figure 30 Idea: Shrinkage in living is space for businesses](image)

**Revenue model:** The revenue model for Arcadis is traditional, namely: at hourly rates.

**Market:** In a quick scan are about twenty sites founded where the location of factories is problematic. Such as Voskuilenweg in Heerlen, Kerkdennen in Ermelo, Middenstraat in Hoogezaand, etc.
**Largest municipality of the Netherlands**

**Problem:** A problem for the government is the aging of the civil servants. Another problem is that the government focuses less on the effectiveness of their own organization during an economic crisis, because it is difficult to change the routines of the employees.

**Idea:** Create a community (NV, foundation, association) between Arcadis and the municipalities.

In this community are people of Arcadis and the municipalities employable for municipal tasks at less money. Moreover, the community should develop a training program for employees to guarantee a high quality.

**Revenue model:** The revenue model for Arcadis is traditional, namely at hourly rates

**Market:** The focuses of this idea is on medium municipals.

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**Together improves efficiency**

**Problem:** The municipal properties have a value of approximately € 25 milliard. Nevertheless, the costs, revenue and value of the municipal properties are often not clear. Especially, during economic recession is it important to known the costs, revenue and value of the municipal properties, because this makes savings opportunities also visible.

**Idea:** Connect different services of Arcadis to determine costs, revenue and value of the municipal properties.

The first step is an analyze of the municipal properties. In the second step the municipal properties are benchmarked. Based on this benchmark is a business case developed for municipals how to cut in municipal properties costs. In additional, municipals can ask Arcadis to execute the ideas of the business case.

**Revenue model:** The revenue model for Arcadis is traditional, namely at hourly rates.

**Market:** The market for this idea are all municipals.
Appendix IV

Semi structured interviews Arcadis

Introduction

1. Introduction Alex de Gast
2. Objective of the interview
3. Structure of the interview
4. Function of respondent
5. Function description of respondent

Personal experiences with innovation

6. Which innovation projects were you involved?
7. Which functions did you have in these projects?
8. Which result was achieved?

Innovation by Arcadis

9. How is innovation organized by Arcadis?
10. In comparison with previous companies, is innovation priority by Arcadis?

Program ‘Connected Innovation’

11. In your opinion, how does the program ‘Connected Innovation’ looks like?
12. What was your function during the program ‘Connected Innovation’?
13. What was the result of the program ‘Connected Innovation’?
14. What are the strong points of program ‘Connected Innovation’?
15. What are the weak points of the program ‘Connected Innovation’?
16. Are there elements what are missed in the program ‘Connected Innovation’?

Best practices innovation

17. What are in your opinion the three most important aspects for a successful innovation?
18. What goes in your opinion most wrong by innovation process?
19. What do you think about a short duration for the innovation process?
20. What do you think about many contact moments?
21. How important are the right people (people who think in opportunities)?
22. How should a team (size, composition, type of people) look like by an innovation process?
23. What do you think about a cross-functional character of the project team?
24. How important is support of the (senior) management?
25. How important is leadership of the (senior) management?
26. Is involvement of clients important?
27. Influence culture innovation?
28. Are go/no go moments or gates meaningful?
Finalization

29. How did you experience the interview?
30. Do you have additions, tips?
31. Have you interest in the results of the research?

Semi structured interviews other companies

Introduction

1. Introduction Alex de Gast
2. Objective of the interview
3. Structure of the interview
4. Function of respondent
5. Function description of respondent

Personal experiences with innovation

6. Which innovation projects were you involved?
7. Which functions did you have in these projects?
8. Which result was achieved?

Innovation in the company (focus on FFE)

9. How is the innovation process designed?
10. What are the strong points of this process?
11. What are the weak points of this process?
12. Are there elements what are missed in this process?

Best practices innovation

13. What are in your opinion the three most important aspects for a successful innovation?
14. What goes in your opinion most wrong by innovation process?
15. What do you think about a short duration for the innovation process?
16. What do you think about many contact moments?
17. How important are the right people (people who think in opportunities)?
18. How should a team (size, composition, type of people) look like by an innovation process?
19. What do you think about a cross-functional character of the project team?
20. How important is support of the (senior) management?
21. How important is leadership of the (senior) management?
22. Is involvement of clients important?
23. Influence culture innovation?
24. Are go/no go moments or gates meaningful?

Model Fuzzy Front End of Koen (2001)

25. Explanation model.
26. Did you have additions of other issues on the model?

Finalization

27. How did you experience the interview?
28. Do you have additions, tips?
29. Have you interest in the results of the research?
Appendix V

Kesselring method for effect

<table>
<thead>
<tr>
<th>Opportunity Identification and Analysis</th>
<th>Opportunity gate</th>
<th>Idea generation session</th>
<th>Idea selection</th>
<th>Idea elaboration &amp; client involvement</th>
<th>Gate go to development</th>
<th>Development and implementation</th>
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<td>4. Team composition (leader, engineer, etc.)</td>
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<td>15. Involve the responsible department</td>
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Figure 31 Kesselring method for effect
Kesselring method for feasibility

![Table and Diagram]

**Figure 32** Kesselring method for feasibility