Wake up call: The effectiveness of serious games for building awareness within the behavioral change process

By
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Bsc Industrial engineering – TU/e 2013
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In partial fulfillment of the requirements for the degree of

Master of Science
in Innovation Management

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Series Master Theses Innovation Management

Subject headings: organizational change, behavioral change, cognitive learning, serious games
Acknowledgements

Success is not the key to happiness. Happiness is the key to success. If you love what you are doing, you will be successful.

- Albert Schweitzer

While writing down this quote of Albert Schweitzer, I am actually not sure yet whether I can call this master thesis project a success if you would base its success on the final grade. I cannot deny that I value high grades, and that I work hard to accomplish my goals within and outside my education. However, this quote also shows me that success is more than just receiving that high grade. Success is also about being able to say that you enjoyed working on something and that you are proud with the result because it gave you a feeling of satisfaction. Taking this as the definition of success, I can say without a doubt that I was successful in realizing my master thesis. From the beginning until this day I enjoyed working on it, struggling with it, growing with it and finally succeeding with it by handing in this document I have been working on past months. Happiness is the key to success. I found that happiness in the content of my thesis, but also in the people around me that supported me unconditionally.

First of all I would like to thank my supervisor from the university, Theresa Treffers. She gave me the freedom to build my own research in a field of my own interest. Also, her feedback always provided me with the opportunity to get better and make the most out this final chapter of my education. Furthermore, I would like to thank prof. dr. Ed Nijssen (TU/e) and Hans van Tol (The Game Master BV.) for being critical to my work and providing guidelines for improvement.

Outside the educational environment there was also an army of family and friends who never let down their faith in me while I was working on my master thesis project. In specific would like to thank my dad for always taking the time to share thoughts and ideas on my project, my mom, for always being able to put stressful situations in perspective, Laurens, my boyfriend, for helping me taking my mind of the project to relax, and finally my sorority, La Donna e Mobile, because they made my whole student life much more challenging, interesting and most of all a beautiful and great experience.

Muriël Kol, July 2015
Management Summary
The importance of being able to change with or within your organization is confirmed among literature and practice. The main obstacle within change is the people within the organization and their perceptions (Gill, 2009). The behavioral change process, consists of five phases: status quo, build awareness, preparation, action and maintenance (Gill, 2009; Palmer, 2012). Within this master thesis focus is put on phase II; building awareness. Building awareness means processing knowledge and giving meaning to it. Effective awareness building is essential for going through the whole behavioral change process successfully (French, 2012) Processing information is a cognitive learning process, within which focus is put on how people build an understanding of the information they received (Vygotsky, 1978). Based on this introduction, this master thesis examined the effectiveness of a serious game as a cognitive tool trying to answer the following research question:
How to support building awareness within the behavioral change process by making use of a serious game?
In order to investigate the research question, a literature study was conducted to get a better understanding of the behavioral change process and the meaning of cognitive learning. Also, serious gaming as a learning method was further investigated to determine the successful elements of serious games with a specific focus on supporting cognitive learning. In order to structure the further procedures of the master thesis project, the research was split up in two separate studies.

**Study 1**: the main goal was to find out how to design and develop a serious game with as a specific learning goal to build awareness. For this interviews with game developers were conducted as well as an analysis of existing learning games. Study one resulted in a set of learning parameters. This set of parameters served as the input for study 2.

**Study 2**: the main goal was to develop a game based on the findings of study 1 and to test this game for its effectiveness through an experimental setup. In order to be able to draw conclusions on the effectiveness of a game for building awareness for a behavioral change, a serious game called ‘Wake up Call’ was developed in cooperation with The Game Master. The goal of this game was to build awareness among players that it is important to involve the customer in your new product
development processes in order to create successful innovations.

The study was conducted at the Eindhoven University of Technology, with a group of 130 students. These students were split up in three different groups: gaming, listening, or reading. All groups had to participate in three experiments, within which their customer-oriented approach was measured making use of the situational judgment approach. Based on these outputs it was possible to see whether the customer oriented approach of participants changed due to the influence of the game, also in comparison to other learning methods. Measurements were 4 weeks before (T1), directly after (T2) and 1.5 weeks after (T3) the learning intervention.

Results of the study indicated that participants, no matter what learning method they were exposed to, went to a significant improvement in their customer-oriented approach when looking at the process as a whole (from T1 till T3). However, game players experienced the biggest improvement in their approach (table 1). This confirmed the effectiveness of the game for the learning goal, despite the fact that no hard evidence was for the game outperforming the other learning methods in the experimental setup of this master thesis.

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>Total growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>47,62%</td>
<td>55,24%</td>
<td>68,57%</td>
<td>+20,95%</td>
</tr>
<tr>
<td>Listen</td>
<td>49,76%</td>
<td>54,15%</td>
<td>65,37%</td>
<td>+15,61%</td>
</tr>
<tr>
<td>Read</td>
<td>50,21%</td>
<td>53,19%</td>
<td>66,81%</td>
<td>+16,60%</td>
</tr>
</tbody>
</table>

Table 1 Management summary - Overview results experimental setup

Apart from looking at the actual performance of each learning method, the quality of the methods was also examined. This resulted in effective elements of the game that might not directly impact the performance, but did improve the learning experience significantly compared to the other learning methods. Especially the elements variation, challenge and complexity resulted in participants being highly motivated and engaged with the learning task, which was not noticed among readers and listeners.

With this thesis insights were gained on how to effectively build a game for a learning purpose and with that proof was found for the effectiveness of serious games for building awareness. These findings contribute to both science and practice.
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1 Introduction

“Education is the most powerful weapon which you can use to change the world”

Although Nelson Mandela was not referring to organizational change in his speech, this quote represents very well the red line of this master thesis’ philosophy. That is; serious games (education) should be used as a tool (a powerful weapon) to stimulate change processes (change a company’s world).

The importance of being able to change with or within your organization is confirmed among literature and practice. Companies that are more adaptable, flexible, fast, aggressive and innovative are better positioned not only to adjust to dynamic, threats or complex external environment, but also to create change in their competitive environment (Heavy et al., 2009). Companies can only succeed when they continue to learn and adapt to those changes and when they continuously look for opportunities to improve their business (Anderson, 1996). A need for change can be detected as a response to environmental changes (e.g. economic influences, competitive influences, political influences), but also when companies are looking for ways to improve their business proactively. Besides being perceived as important, change is also perceived as one of the most difficult processes to successfully realize within an organization. Change is resisted when it appears to be too major, too risky or too different (Tampsell & Law, 1998; Bovey & Hede, 1986; Piderit, 2000), which lead to the brutal fact that about 70% of change initiatives fail (Nohria & Beer, 2000).

When looking at the change process, the main obstacle is the people within the organization and their perceptions (Gill, 2009). What needs to be changed and how it needs to be changed can be defined based on facts and knowledge. However, having people accept and apply the suggested changes is a lot more difficult (Weeks, 2004; Gill, 2009).

Looking at current change processes, it is believed that these could be improved by realizing engagement among employees with the envisioned change (Marcus et al., 1992). Successful behavioral change starts with building awareness for the need to
transit from the current situation to the new situation (Gill, 2009). Building awareness is a cognitive learning process where information is processed into a certain understanding (Vygotsky, 1978). The conception of this master thesis is that serious games could be a supportive tool for engaging people (Corti, 2006) in a change process by building awareness for the need to change. The purpose of this study is to find out whether a serious game indeed is a beneficial tool for stimulating the behavioral change process. Figure 1 provides an overview of how the different concepts of this study are related to each other.

![Figure 1 Overview of related concepts](image)

With the above introduction as a base for the structure of this master thesis project, the main research question is defined as:

*How to support building awareness within the behavioral change process by making use of a serious game?*

For clarification, the research question will be further elaborated on. The major obstacle for change within organizations is caused by the human factor; the people that need to make the change happen (Gerkhardt et al., 2008). Therefore, this thesis focuses on the behavioral change process. However, being able to positively stimulate behavioral change might also have a desired impact on organizational change processes in general.
The behavioral change process, as it is explained by Gill (2009), consists of five phases: status quo, build awareness, preparation, action and maintenance. Within this master thesis project, focus is put on phase II; building awareness. Having an understanding for the need to change is crucial for successful behavioral change (Gill, 2009; Palmer, 2012). When awareness is built successfully, risk of failure within the behavioral change is reduced for the rest of the change process (Gill, 2009). People will start to look for ways to change and improve themselves because they believe in the change that is needed (French, 2012; Gill, 2009). Building awareness means processing knowledge and giving a meaning to it so that an understanding about something is reached. Processing information is a cognitive learning process, within which focus is put on how people build an understanding on the received information by themselves (Vygotsky, 1978). Within this thesis it is assumed that for the building awareness, people best can learn in a cognitive manner. It is therefore the intention to build a learning tool that focuses on enabling cognitive learning in such a way that building awareness is best accomplished.

An upcoming method for supporting learning is the serious game (Pourabdollahian et al., 2012; Hainey, 2010; Griffiths, 2002; Guillen Nieto, V. & Aleson Carbonell, M., 2012). Serious games can be used for different learning purposes like developing skills, but also to process and understand provided knowledge (Wouters, 2013). However, there is still a lack of proof for the effectiveness of games within literature (Hainey, 2010). Therefore, this master thesis focuses on examining the effectiveness of a serious game as a cognitive learning tool for supporting the behavioral change process by building awareness.

The following sub-research questions are defined

1) What does the behavioral change process look like?
2) How can the behavioral change process be translated into a learning process?
3) What is the value of serious games, especially those used for learning purposes?
4) What are successful learning parameters for serious games in order to build awareness among players?
5) How can we measure the effectiveness of a serious game in order to evaluate the impact of it on building awareness in the behavioral change process?
Within this master thesis, the new product development process is the context of interest. Within every company this process is relevant. In order to be successful, organizations need to innovate and stay relevant to their customers (Drucker, 1985). Organizations arrange their new product development process in different ways. Most common are the open innovation model, which assumes that firms should use external ideas and internal ideas to successfully innovate (Chesbrough, 2006) and the stage-gate model, which divides the effort into distinct stages separated by management decision gates (Cooper, 2008). Where the open innovation model focuses on innovating with the environment, the stage-gate model develops new product ideas more internally. Within this thesis, the focus is on internally focused new product development processes. It is believed that such processes should transit from internally focused to more externally focused, which takes the environment and especially the customer actively into account. In order to accomplish this goal, a change in behavior is needed, which makes this context relevant to this whole master thesis.

Chapter 2 goes into detail of the scientific background on organizational change, behavioral change and learning processes, so that the foundation for this thesis’ rigorous value is built. Chapter 3 introduces the serious game as the research tool that is on the one hand a learning tool under investigation, but also the research methods used to be able to conduct this study. Further explanations on the procedures within this project will also be provided. Chapter 4 goes into detail for study one, which is an exploratory research in order to find out how you can build a successful game for a certain learning purpose based on practice. Results provide insight in what the development process looks like, but also what elements are essential for cognitive serious games. Study two is a causal research making use of an experimental setup, which focuses on evaluating the effectiveness of the developed game for this master thesis project. Chapter 5 gives all details on this study. Finally, chapter 6 discusses the results and draws the final conclusions of this master thesis.
2 Literature Review

This chapter provides an overview of the literature study conducted for this master thesis project.

2.1 Change processes

Change is comprised of those processes that break down existing structures and create new structures; new organizations, cultures, and ways of working (Hutchison, 2001). Successful organizations continually anticipate and manage a variety of change venues: economic changes, technological changes, market changes, political changes, social changes, and competitive intensity (Weeks et. al., 2004). Change initiatives for the purpose of performance improvement and achieving competitive advantage have experienced a number of problems (Denton 1996; Galpin and Robinson 1997; Geisler 1996; Harari 1997; Lawson 2003). One long-known explanation for unsuccessful change initiatives is the tendency of management to seek a quick fix instead of taking a longer-term perspective (Kilman, 1984). Another long-known reason for lack of change success is the propensity of organizations to implement piecemeal solutions rather than taking a systems perspective (Ackoff, 1974). Other possibilities are the pervasive culture of the organization and the operating climate (McNabb and Sepic, 1995). Those two characteristics combined determine the organizational readiness for change (Weeks, 2004). Culture is the deep-rooted set of values and beliefs that provide norms of behavior. Climate is the way organizations operationalize routine behaviors and the actions that are supported, expected and rewarded.

Within this master thesis, changing an organization’s culture or values will not be the issue at hand. Focus will be put on the change that an organization goes through when changing its climate; in specific when changing processes and with that the necessary behavior. Organizations often have a hard time changing their internal processes effectively (Stark, 2000). Taking a closer look at change and how to make it happen, the main obstacle is the people that need to change their behavior in order to make it work (Gill, 2009). The factor “people” within change processes is therefore the most relevant issue to analyze; in other words the concept of human-behavioral change (Weeks, 2004; Gill, 2009; Thomas & Hardy, 2011).
One of the first to analyze the process of change was Kurt Lewin. His work dominated the theory and practice of change management for over 40 years (Burnes, 2004). A successful change project, according to Lewin (1947), consists of three stages:

1. Unfreezing - the current situation needs to be destabilized before old behavior can be discarded and new behavior successfully adopted.
2. Moving - investigate new options and move from a less acceptable set of behaviors to a more acceptable set of behaviors
3. Refreezing - stabilize the group at a new quasi-stationary equilibrium in order to ensure that the new behaviors are part of the environment (Burnes, 2007).

With his psychological background, Lewin (1947) focuses his model on changing behavior within a certain change process. He claims that in order to be successful with a certain change project, a person needs to go through all three phases. With the focus on behavioral change, the model Lewin presents seems relevant to this master thesis. The fact that his work is still used in current literature and practice on behavioral change (Burnes, 2004; Coghlan and Brannick, 2003; Coghlan and Jacobs, 2005) also confirms the successful impact of the model that Lewin developed. Although Lewin laid the foundation for organizational and in specific behavioral change, his model is not considered as the ‘Holy Grail’ anymore. Other researchers also examined the behavioral change process, and further developed the three-stage model to a more detailed five-stage model (Gill, 2009; Palmer, 2012).

### 2.1.1 5-stage behavioral change model

When tackling change, leaders focus on communicating the vision and behavioral change they need to deliver for the new organization. They focus resources and support on designing new processes, structures and systems (LaClair and Rao, 2002). However, change can be managed more effectively by predicting the type and flow of interventions required to ensure that behavioral change is lasting and engaging, not temporary and disruptive (Gill, 2009). In her research, Gill describes a five-stage model of changing behavior by introducing effective and appropriate interventions to manage organizational change. Figure 2 displays the behavioral change model as a five-stage process.
The first stage, status quo, defines the current and future state. Stage two is about building awareness for the necessary change, and is the stage that is of interest within this research. Next is preparation, understanding what needs to happen for the change to take place. The next and fourth stage is action. This is all about developing skills and celebrating successful change of behavior. The last stage is maintenance to recognize the change and to engage others in mentoring the change and continuing it. With this more detailed view of the behavioral change process, it is easier to distinguish the different processes a person goes through when changing his/her behavior. This more detailed view on the different stages enables us to develop ideas on how to support or influence each step effectively.

This master thesis will focus on the building awareness phase. Creating awareness on the personal level is the first step in achieving successful organizational change. It is from this moment the actual behavioral change process can begin. If this is done the right way the risk of failure will be minimized for the rest of the behavioral change process (Gill, 2009; Palmer, 2012).
2.1.2 Building awareness

*Awareness: having knowledge or an understanding of something* (English dictionary, (n.d.)). The definition of awareness explains that it is not about learning how to behave differently, but to develop an understanding of the meaning of information that has been provided and to get understanding of the need to change (Gill, 2009). The building awareness phase is all about inspiring and assessing. The goal is to reach an understanding of the current situation, why it is not the most effective situation anymore, and reaching a vision of what the future situation should look like. Also, it is about building motivation and confidence that the new envisioned situation is going to have the desired effects, so that people will intrinsically believe in the need for a change in behavior. According to French (2012) in order to build awareness for the need for change two aspects are of major importance. 1) Allow time for digestion: make space for people to talk and listen to each other. Do not expect immediate change, but provide the opportunity to let the information be processed by the target group for change. 2) Give information, but do not tell people what to do: a key principle of transition from early on is to give good information and then trust people to find their own response.

With the learning goal for building awareness being for people build an understanding for the need to change, focus is put on processing information and giving a certain meaning to it. Cognitive learning focuses on the information processing that takes place within the brain, which is needed to get an understanding of the knowledge that is provided to the learner (Vygotsky, 1978). Cognitive learning is all about how people build an understanding of provided knowledge, which is directly connected to the process of building awareness. In order to be able to enable cognitive learning it is important to get a better understanding of what cognitive learning means and how the behavioral change process can benefit from this way of learning.

*Other learning goals*

Although focus is put on building awareness, it is important to understand that the behavioral change process is not finished when the second phase of the behavioral change model (fig 2) has been successfully completed. All stages within the behavioral change process can be seen as phases that focus on fulfilling a certain
learning goal. Change is learning, and learning is change (Greenwald, 1968; Boekaerts, 1992; Lamomski, 2001). Table 2 provides an overview of each stage and the potential learning purpose of the stage in order to give the complete picture of the behavioral change process as a learning process. Defining each learning goal provides input for the learning process a learner goes through when trying to reach this goal (Blumenfeld, 1992).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Learning goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Status – quo</td>
<td>Understanding the current situation</td>
</tr>
<tr>
<td>2. Building awareness</td>
<td>Understanding for need to change</td>
</tr>
<tr>
<td>3. Preparation</td>
<td>How can we change? What are we changing?</td>
</tr>
<tr>
<td>4. Action</td>
<td>Learn specific new behavior (skills)</td>
</tr>
<tr>
<td>5. Maintenance</td>
<td>How can we maintain the changed behavior?</td>
</tr>
</tbody>
</table>

Table 2 Learning goal per behavioral change stage

With different learning goals for all stages of the behavioral change process, different learning processes might be needed in order to accomplish the learning goals. By building awareness a person can understand that something needs to be done, but he/she needs to start acting alike this need as well. This means acquiring skills, which is a different learning goal and process a learner goes through than with building awareness. It is important to be aware of the behavioral change process as a whole. However, the other behavioral change stages and accompanying learning goals will not be further addressed within this master thesis.

2.2 Cognitive learning

Learning is the act, process, or experience of gaining knowledge or skill. This gain leads to a change in behavior, or to the potential of being able to change behavior in a situation when it is needed to do so (business dictionary, n.d.). Cognitive, emotional, and environmental influences, as well as prior experience, all play a part in how understanding, or a worldview, is acquired or changed and knowledge and skills retained. Throughout the years many different learning theories have been developed in order to describe how people learn e.g. behaviorism, cognitivism, constructivism. Within each situation it can be decided which way of learning seems most suitable for accomplishing the specified learning goal. This thesis assumes cognitive learning as the most suitable way of learning for building an understanding
for the need to change while building awareness. Further examination of the
cognitive process is essential for developing a successful learning tool that can
stimulate this process (Jensen, 1998).
In order to build awareness, you need to process information and give meaning to it.
The cognitive learning theory describes how information is absorbed, processed, and
retained during learning. To be more specific, the theory describes the process that a
learner goes through when learning in a cognitive way. With the building awareness
phase having as a learning goal to build awareness, and with the cognitive learning
theory describing how people build awareness, it is assumed that building awareness
is accomplished most successfully if the process of learning is cognitive. Cognition is
a broad term covering psychological abilities and skills, but also processes like
problem solving, thinking and absorbing information. It covers all processes through
which people gather, process and preserve knowledge. Cognitivism studies how
people gain knowledge and how they apply it in practice afterwards. This is when a
change in behavior can be noticed (Ertmer & Newby, 1993). The implication for
organizational research is that organizations not just learn by reacting to some
external stimulus, but also through creating shared understanding or knowledge
structures that allow them to take purposeful actions at the time when it is needed
(Stewart & Gnyawali, 2003). Almost all cognitive approaches to learning are
concerned with how everyday experiences are transformed or processed into mental
images or sounds and stored for later use. In other words, they are concerned with
how information is processed (Sternberg, 2005). In order to have the learner go
through a successful cognitive learning process, it is important to think of ways of
how to positively influence his/her thinking (Sternberg, 2005). When developing a
learning tool that enables cognitive learning through its structure, the process of
building awareness can be supported automatically.

2.3 Learning strategies
Teachers, in the broadest explanation of the word (anyone who want to transfer
knowledge to someone else), make use of learning strategies in order to be able to
transit information effectively. Within this master thesis, it is the aim to enable
cognitive learning. By doing so, the goal is to build awareness for behavioral change.
The learning strategy and accompanying method have an influence on the success
of the learning process. (Keesee, 2014)
A cognitive strategy serves to support the learner as he or she develops internal procedures that enable him/her to perform tasks that are complex (Rosenshine, 1997). Cognitive strategies are general methods of thinking that improve learning across a variety of subject areas. Cognitive strategies go beyond the processes that are naturally required for carrying out a task (Pressley et al., 1992). The use of cognitive strategies can increase the efficiency with which the learner approaches a learning task. These academic tasks can include, but are not limited to, making mind maps, visualization, underlining key words, remembering and applying information from courses, constructing sentences and paragraphs, editing written work, paraphrasing, and classifying information to be learned (Krishna, n.d.). In fact, there are actually all kinds of methods possible if you want to support the cognitive learning process for processing knowledge and with that building an understanding. King (1989) found that the effectiveness of the tool you use depends a lot on how you trigger the learner group to learn for themselves instead of just performing the task at hand. E.g. by asking “what was the main idea of this article?”, learners have to provide their own understanding of what they read. It is about effective learner participation within the method you make use of.

However, some methods are automatically more ‘involving’ than others. "Given the choice between two techniques, choose the one involving the learners in the most active participation" (Knowles, 1980). Knowles (1980) suggests this ‘rule of thumb’ for any type of learning process you want to support. Engaging your learner within the learner task is essential for successful learning. Below (table 3) is a sample of techniques categorized according to participant involvement (Caffarella, 2002)

<table>
<thead>
<tr>
<th>Low Involvement</th>
<th>Medium Involvement</th>
<th>High Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Group discussion</td>
<td>Role play</td>
</tr>
<tr>
<td>Panel discussion</td>
<td>Behavior modeling</td>
<td>Debates</td>
</tr>
<tr>
<td>Demonstration</td>
<td>Observation</td>
<td>Case studies</td>
</tr>
<tr>
<td>Computer-based drills</td>
<td>Reflective practice--blogs, journals</td>
<td>Simulations</td>
</tr>
<tr>
<td>Computer-based tutorials</td>
<td>Asynchronous online forums</td>
<td>WebQuests</td>
</tr>
<tr>
<td>Socratic dialogue</td>
<td>Audio/Video conferencing</td>
<td>Internet searches</td>
</tr>
<tr>
<td>Tutorials</td>
<td>3D Interactive Learning</td>
<td>Concept mapping</td>
</tr>
</tbody>
</table>

Table 3 Learning method categorization (Caffarella, 2002)
When looking at the academic tasks provided by Krishna (n.d.) not many suggested methods for cognitive learning are categorized as high-involving within the table of Caffarella (2002). It is therefore interesting to further investigate the effects of high-involvement learning methods on cognitive learning for building awareness within the behavioral change process.

2.4 Conclusion

With this literature review, the existing knowledge on the behavioral change process and how learning takes place within that process was examined.

Up to 70% of change initiatives within organizations fail (Nohria & Beer, 2000). One of the reasons for this is that organizational change processes face difficulties because of the human factor that exists within these processes. Therefore, it is important to look for ways to support and improve the behavioral change process. One of the early stages within the behavioral change process is building awareness. By building awareness successfully, risks of failure will be reduced during the rest of the behavioral change process (Gill, 2009; Palmer, 2012). Building awareness means building an understanding of the need to change based on knowledge that is provided. This understanding needs to arise from the people that need to change themselves, based on the learning process that takes place within their brain. This internal process is recognized as cognitive learning (business dictionary, n.d.). With the assumption that awareness is best built when the target group for change learns in a cognitive manner, it is important to find ways to support this way of learning. King (1989) explains that cognitive learning is realized by the way you involve your learners in the process. However, the “common” cognitive methods are not always the most learner-involving methods. Therefore this thesis will try to measure the effects of a high-involvement learning method on cognitive learning for building awareness within the behavioral change process.

An arising tool for learning is the serious game (Pourabdollahian et al., 2012; Hainey, 2010; Griffiths, 2002; Guillen Nieto, V. & Aleson Carbonell, M., 2012). It is believed that games can be very effective for supporting the cognitive learning process (Wouters, 2013) as one of the high-involvement learning methods. Therefore the usefulness of games will be further examined within this thesis.
3 A serious game as a method

The main research question of this master thesis asks for a way to support the behavioral change process in an effective and efficient manner. In order to answer this question, this thesis examined the usefulness of serious games for its potential positive influence on the behavioral change process.

The serious game serves this master thesis as a method in two ways:
1) A serious game as a learning method: A serious game in general, used for educational purposes, is a learning method, which is gaining more interest in current educational practices (e.g. Pourabdollahian et al., 2012). This learning method is under investigation within this master thesis project for examining its capabilities for enabling cognitive learning and with that supporting building awareness.
2) A serious game as a method for conducting this research: The serious game, developed within this master thesis project, serves as a method for investigating the research question.

Within this chapter both ways of using the serious game as a method are described. First we elaborate on the choice of a serious game for supporting building awareness. Second, a description is provided on how the rest of this research was built in order to use a serious game as a tool for answering the research question.

3.1 Serious games

Serious games usually refer to games used for training, advertising, simulation or education (Susi, Johanneson, Baklund, 2007). They enable the learners to undertake tasks and experience situations, which would otherwise be impossible and/or undesirable for cost, time, logistical and safety reasons. (Corti, 2006). In general games are accelerating learning, increasing motivation and supporting the development of higher order cognitive thinking skills (Delanghe, 2001; de Freitas & Levene, 2004; Garris et al., 2002). Games-based learning is a sub-category of serious games, however it should be noted that the terms are sometimes used synonymously (Corti, 2006). The fact that these terms are used synonymously, although they are not exactly the same, points out that also in literature it is still hard to give one definition to serious gaming/games-based learning. Within this thesis both terms are used for referring to the same concept: games that are developed for fulfilling an educational purpose.
Games for learning purposes

In literature, serious gaming is suggested as a successful learning tool for educational purposes (Tang, Hanneghan and El-Rhalibi, 2009). Throughout the years, learning has been a misunderstood concept. Opposed to how learning is approached in the past (memorizing facts), it should be defined as acquiring thought processes in order to eventually respond appropriately under pressure in a variety of situations (Trybus, 2014).

With this above definition of learning, it is argued for that making use of games is the best way to accomplish an educational purpose. Trybus (2014) provides the following overview as a comparison between the different ‘main learning-method categories’ that are known in table 4.

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Hands-on</th>
<th>Game-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost effective</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Low physical risk/liability</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Standardized assessment allowing learner to learner comparison</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Highly engaging</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Immediate feedback in response to learner mistakes</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Learner can easily transfer learning to real world environment</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Learner is actively engaged</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Learning pace tailored to individual learner</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 4 Comparison of games to other instruction methods on an organizational level (Trybus, 2014)

Games put focus on the learning power of collaboration and the application of learned material in real-world scenarios (De Kanter, 2005). With that games are relevant to any kind or learning process. However, table 4 merely gives organizational reasons (low risk, cost effective) for why it is recommended to make use of serious games. For this study it is also important to determine why serious games are useful tools for learning processes based on their mechanics. Especially, proof for the use of serious games for cognitive learning is further examined.
3.2 Serious games for cognitive learning

A game can be of use for many purposes. Looking at table 2, there are different learning goals defined for each stage of the behavioral change process. A game could be useful for the action stage when trying to develop skills, but also for realizing an understanding of the need to change for the building awareness phase. When thinking about building awareness a game can be useful for realizing the ‘aha-erlebnis’ (all received information falls in its place, in such a way that learners understand its meaning and can translate the implications of this meaning) effect. Through experiencing and processing what you learn, information falls into place and the player can build an understanding. While accomplishing this goal of building awareness and reaching an understanding, a cognitive learning process takes place. In his meta-analysis, Wouters (2013) examines the cognitive and motivational effects of serious games. He significantly proves that serious games are more effective in terms of learning and retention than conventional instruction methods. However, no strong evidence was found in terms of learning. Therefore this thesis further examines the effect of games compared to more conventional instruction methods in order to see whether a significant effect can be detected when the game under investigation is built based on design parameters that stimulate cognitive learning and with that building awareness. The following chapter therefore goes into more detail on the learning parameters for games and how these are especially effective when trying to support cognitive thinking for building awareness.

Learning parameters

Game designers focus on solving a large educational dilemma, experienced in schools and workplaces: how to get people to learn and master something that is challenging in a way they enjoy it? In literature it is stated that good learning games incorporate good learning principles, principles supported by current research in cognitive science (Gee, 2003). In his book, “What video Games Have to Teach us about Learning and Literacy”, Gee provides 36 learning principles that good games should or could incorporate. In his later paper “Good video games and good learning”, Gee (2005) gives an overview of the principles he values the most. From this set of sixteen learning principles, eight are selected to be relevant for this master thesis. Table 5 provides an overview of these principles, what their meaning is and how it is relevant to the learning purposes of this project.
Looking at the cognitive learning process, which is about absorbing and processing knowledge in order to get an understanding of the necessary changes, some of these parameters are more effective than others for supporting this process. This set of parameters is based on linking the cognitive learning process to the parameters suggested by Gee (2005) and making assumptions on their effectiveness.

<table>
<thead>
<tr>
<th>Learning principle</th>
<th>Cognitive effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identity:</strong> Learning a new domain requires the learner to take on a new identity.</td>
<td>By giving the player a certain identity, relatable to that person's reality, the player can process the information from a certain perspective, making it easier to understand which information is relevant and which information is not.</td>
</tr>
<tr>
<td><strong>Customization:</strong> Good games allow players to solve problems in different ways</td>
<td>Every person processes information differently, also within cognitive learning. A game enables personal learning.</td>
</tr>
<tr>
<td><strong>Agency:</strong> A game makes that players feel a real sense of agency and control and a real sense of ownership over what they are learning</td>
<td>A game gives the learner a feeling of control over what he/she is learning. The learner can decide what he does with the information, and a certain understanding of a need to change feels as a result of the efforts the learner put in himself/herself.</td>
</tr>
<tr>
<td><strong>“Just-in-time”:</strong> Games give verbal information either just in time (right when the player needs it and can use it) or on demand (when the player feels a need for it)</td>
<td>Players learn step by step with digestion of information in-between, because knowledge is presented one step at a time.</td>
</tr>
<tr>
<td><strong>System thinking:</strong> Games encourage players to think about relationships, not isolated events, facts and skills.</td>
<td>Games make players think about the relationships between different elements and information they come across. This is supportive to the cognitive learning process, since it helps in processing the information as a whole.</td>
</tr>
<tr>
<td><strong>Explore</strong></td>
<td>A game provides learners with an opportunity to explore and discover new aspects of the learning process.</td>
</tr>
</tbody>
</table>
different attitude. They encourage players to explore thoroughly before moving on and to use such exploration and lateral thinking to reconceive one’s goals from time to time. (Gee, Hull and Lankshear, 1996)

**Interaction:** in a good game, words and deeds are all placed in the context of an interactive relationship between player and the world. In a game, nothing happens until a player acts and makes decisions. Opposed to other common cognitive learning tools, a game creates direct interaction between players. This means players can also help each other learn in getting an understanding.

**Pleasantly frustrating:** Good games stay within but at the outer edge of the player’s regime of competence (diSessa, 2000). They feel doable but challenging. In order to stimulate cognitive thinking, it is important to make the learner task challenging. This way, players will feel triggered to find the solution themselves.

<table>
<thead>
<tr>
<th>Table 5 Game parameters with a cognitive purpose (Gee, 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is the assumption that, when designing a game for stimulating cognitive learning, the above parameters will support this process. With that, a game can be designed effective for building awareness within a certain behavioral change process.</td>
</tr>
</tbody>
</table>

**Reality as a parameter**
Another important parameter for successful games is ‘reality’. For having a common understanding it is important to take a closer look at the concept of reality.

To go through a process that is based on reality, the concept of simulation is well known within literature. Serious games always incorporate a certain level of reality in order to support the envisioned learning process successfully. So what is the difference between a serious game and simulation? Many inconsistencies in interpretations exist which leads to misunderstanding and wrongful use of terms (Pratt & Spruill, 2011). They found that the explanation of these two terms depends on what kind of view one has, looking at the functionality of both concepts. Within
learning, and specifically for building awareness, a purpose-based view is commonly used which leads to the following interpretation of the concepts of simulation and serious games (figure 3):

![Figure 3 Reality and fun (Pratt & Spruill, 2011)]

To explain in more detail: the “serious games” are characterized by having another purpose besides the element of entertainment, such as education or training. This is the reason why they are sometimes called “games with a purpose”(Pratt & Spruill, 2011). In other words in such games the educational element is as important as the playful purpose. Simulations differ a little from the previous category, but there are authors who classify them in the same group. The simulations are about trying to recreate a situation that occurs in real life and that people involved have to act and think within that situation as if it was reality. The aim is to train the participants through risk of environments. The biggest difference therefore is the element of fun that does occur within a serious game and does not occur within simulation (Pratt & Spruill, 2011). It is actually this element of fun that makes learners more engaged in the process. The more learning feels like play, the more fun it is, the more it happens naturally (Midlarsky, 2013). Therefore this thesis uses a tool with both reality and fun.

3.3 Introduction of research procedures

With the defined reasons for examining the usefulness of a serious game for building awareness within the behavioral change process, the following setup for this master thesis project was developed. The whole thesis consisted of two studies: one for getting an understanding of the game development process and the game design, and one for actually examining the developed game for its effectiveness. A short introduction of each study is provided before going in to more detail within the following chapters. Figure 4 displays an overview of the process as a whole.
Study 1: Explorative study
Within the first study semi-structured interviews were used in combination with an analysis of existing games in order to derive at the necessary design parameters for the serious game to be developed in the preparation phases of study two. With that study 1 serves as the input for study 2. Within this study, the serious game was the learning method under investigation based on practice.

Study 2: Causal research: experimental study
Study 2 started with a preparation phase in which a serious game was developed. From this point, the serious game was the actual method, which was used for finding answers to the research question. After the game was developed, study 2 proceeded with the experimental phase, which focused on finding proof for the following two hypotheses:

- H1: A serious game is a more effective cognitive learning method than the commonly used cognitive learning methods of reading and listening
- H2: A serious game is a useful method for building awareness for the need for behavioral change

Outcomes of this study will confirm or reject the hypotheses about the usefulness of serious games.

For each study the following issues were addressed:
- Participants and procedures
- Scales / measurements
- Results of the study
- Quality of the study
4 Study 1

Study 1 was an explorative study in order to find out more about the game development process and game design based on practice. This study was conducted in as a preparation for study 2. The results of this study explain, based on the input from practice combined with the literature background, how a game can be developed and what specific elements need extra focus when you want to stimulate a cognitive learning process.

4.1 Participants and procedures

Within this explorative study, the main goal was to find more information on how to design and develop games. After that, the found input was used to construct the game concept for further investigation. Two types of resources were used for getting insight in developing a game; semi-structured interviews with game developers and observations of existing games. With the input from experts as well as making objective observations myself, a clear base for game development was defined.

Semi-structured Interviews

Within this study five semi-structured interviews were conducted. Such interviews are possible when there is pre-existing knowledge on the concepts under investigation. This pre-existing knowledge was gathered by literature on serious games in chapter 3. The semi-structured interviews follow an open and informal interview style. They allow exploring the possibilities of designing games and are open to brainstorming in the interview. The interviewer can continue to ask questions until the situation is fully understood. This method was used, because a lot of knowledge on game development and evaluation could be gathered through asking about people’s experience. Especially because there are no set methods for this, experts’ experience will add interesting guidelines that can be added to the current knowledge on game design and development from literature.

The different interviewees were selected based on their experience with building serious games for learning purposes for or within organizations/universities. All have experience with building games for training practices, learning skills, building awareness or any other learning purpose. Table 6 gives an overview of the interviews that were conducted for this master thesis.
<table>
<thead>
<tr>
<th>Interview</th>
<th>Why</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frisse Blikken: Martijn van Duurling and Carlien van Woensel</td>
<td>Entrepreneurial company that believes in the effectiveness of games for educational purposes</td>
<td>Open brainstorm Idea generation Game evaluation</td>
</tr>
<tr>
<td>The Game Master B.V.: Hans van Tol</td>
<td>Supervising company and developer of many event games for educational purposes</td>
<td>Game development Game evaluation Success factors</td>
</tr>
<tr>
<td>Vanderlande Industries: Katja Leijssen</td>
<td>Developer of a specific game for a company in order to change the behavior of employees within a certain process</td>
<td>Game implementation Reality Game development</td>
</tr>
<tr>
<td>BIG business experience games: Casper Janssen</td>
<td>Organizations that considers games as a successful addition to the whole process of change within organizations</td>
<td>Game techniques Game development Game effectiveness</td>
</tr>
</tbody>
</table>

Table 6 Overview of conducted interviews with game developers

Appendix 2 provides an overview of the general questions developed as guidelines for the interviews.

Observations

Observations are used as a tool for collecting data about people, processes, and cultures in qualitative research. Within this master thesis, observations were conducted to see what aspects of games are useful and motivate players to be proactive during the game play. Those insights helped in defining successful game elements. In order to observe all games in a similar manner a general observation form was used. The observational form is based on a form developed by the institute.
of play. The institute of play, based in New York, has developed a designer toolkit for enthusiastic game developers who want to design a game for a certain learning purpose. Table 7 provides an overview of the games that were examined for this thesis and why these games were selected for examination.

<table>
<thead>
<tr>
<th>Game</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verbind de wereld</strong> (The game master b.v.)</td>
<td>A game for a large group having a clear learning goal concerning cooperation and communication. Interesting because of group size and the dynamics with such large groups. <em>Cooperate to succeed</em></td>
</tr>
<tr>
<td><strong>Bricks and Brains</strong> (BIG business games)</td>
<td>A real business game with a simulation of a specific process in it (supply chain related). The game is part of a workshop and it is interesting to see how the game contributes to the workshop as a whole. <em>Improving effectiveness</em></td>
</tr>
<tr>
<td><strong>Spark (Philips)</strong></td>
<td>A board game for idea generation. Especially the dynamics of a board game are of interest. <em>Idea generation</em></td>
</tr>
<tr>
<td><strong>Girl's Choice (The Game Master B.V.)</strong></td>
<td>A game for girls that encourages teenagers to think about sexuality and intimacy. It is a board game that is used for educational purposes. <em>Awareness of sexuality</em></td>
</tr>
</tbody>
</table>

Table 7 overview of analyzed games

Appendix 3 provides an overview of the general observation form, used to objectively analyze each existing game.

### 4.2 Results

Through the setup of this study both data from interviews as well as data from observations were gathered regarding the design and development of games.


**Interview outcomes**

Appendix 4 provides an overview of the summaries of the transcripts of the interviews that were conducted for this master thesis project. Table 8 provides an overview of the main outcomes that are of interest.

<table>
<thead>
<tr>
<th><strong>Table 8 Main outcomes interviews game developers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Look into the concept of valorization and what the real problem is for engineers.</td>
</tr>
<tr>
<td>• Keep the learning goal simple for successful idea generation.</td>
</tr>
<tr>
<td>• Optimal evaluation process is pre-test, game, post-test. This way you can measure the difference.</td>
</tr>
<tr>
<td>• Game development knows different phases. First you set boundaries, then you think of different game options, choose one, develop and test multiple times. After testing all possible scenarios are covered and the game is ready.</td>
</tr>
<tr>
<td>• Add a control group to the process so you can prove that the game is more effective than other learning methods.</td>
</tr>
<tr>
<td>• The director of the game has a big influence on the game play. Competition, cooperation and scarcity are very important game elements.</td>
</tr>
<tr>
<td>• Keep it simple and practical. How do your players prefer to learn?</td>
</tr>
<tr>
<td>• Relate the game to the processes they are familiar with in their daily business.</td>
</tr>
<tr>
<td>• Visualization of what is going wrong and right is essential.</td>
</tr>
<tr>
<td>• Try to get a clear image of your target group. This way you can develop the game in such a way that it will appeal to them and also will trigger them to change.</td>
</tr>
<tr>
<td>• When you provide the players with a complete picture, they are better able to think, engage and act in the situation they are put into.</td>
</tr>
</tbody>
</table>

**Observational outcomes**

Appendix 5 provides an overview of the different games that were observed and analyzed in preparation for the development of the serious game. Table 9 provides an overview of the main outcomes of the observations that were done.
Main Outcomes

- If you don’t give a lot of explanation, people just start doing what they think is expected, without thinking of the possible goal of the game.
- By making use of a control group you can measure the effectiveness of certain assets of the game.
- Play multiple rounds in order to support learning behavior. This also provides the opportunity to learners to evaluate their game play in between and make improvements themselves.
- Focus on both competition and cooperation.
- Do not explain too much upfront but let players experience what is going wrong and right.
- Discuss with the players what the relevance of the game is to their daily business.
- Add time pressure in order to create chaos and with that force learning behavior.
- Within a board game it is very easy to implement roles, so that players represent a personage on the board.
- A board game is easy to understand and also easy to manage for the game leader.
- A game is a safe environment in which you have to feel comfortable. This enables players to think out of the box and take risks.
- A board game is suitable for small teams, but does not enable you to also make use of bigger player groups.

Table 9 Main outcomes game analysis

4.3 Definition of learning parameters for serious game

Game development

Based on the interviews and observations the outline of the game development process is defined as follows.

1. Preparation: first of all, the learning goal needs to be defined by the game developer (and the client if there is one). The following step is to define the game requirements by yourself or with the client based on the learning goal.
2. Development: the first step is to define the context of the game and incorporate the game parameters within the design. Also, it is important to get
an understanding of the target group that will play the game and their expected behavior. After that the first setup of the game can be developed. This prototype is then tested and improved until it is ready for play.

3. Finally, when the game is ready, the actual game play needs to be arranged and prepared for.

Game design
In combination with literature study that was conducted (Gee, 2005) I defined the following elements for any cognitive learning process, where it is the goal to build awareness and to have learners understand a certain provided set of information:

- Relatable to reality so that learners can apply in practice
- Interaction with the environment to get a better understanding
- Allow time for digestion so that learners can process
- Make it fun to learn, so that students can memorize more easily
- Show the relevance of the information provided to the learner
- Provide information in a logical way and not all at once
- Provide the big picture

Since a serious game is not always used for cognitive learning purposes, certain elements that are crucial for cognitive learning should specifically be filled in when developing the game for this purpose:

- Give players (relatable) identity to process information from certain perspective
- Allow for different ways to process information (customization)
- Put the learner in control of what he/she does and does not pick up
- Let learners explore, think laterally, and rethink goals
- Balance cooperation and competition to keep the motivation for learning high

When all of these elements are comprised within the game, it is believed that the game will be an effective learning method for cognitive learning goals. The game ensures that learners will be engaged in the learning process and therefore they will be intrinsically motivated to build an understanding. Also, these parameters ensure that learners are required to process the information themselves in order to understand what the game is about. According to French (2012) this is exactly how building awareness for change can be reached.
4.4 Quality

It is also necessary to look at the quality of the study. Based on Van Aken et al. (2012) the quality of a research can be measured according to controllability, reliability and validity.

Controllability

Controllability states that it is important to reveal how a study was conducted. Both the main text as well as the appendix provides all used tools for investigating the issues at hand within this study. Therefore, all aspects of this study can be controlled and repeated if desired by others.

Validity

Validity can be divided into three types: construct validity, internal validity and external validity (Yin, 2009). For this study construct validity is most applicable. Construct validity refers to establish the right operational measures for the concepts that are studied in the research. To improve the construct validity different types of data are used in the form or observations as well as interviews. The quality of the applied instrument influences the construct validity. Therefore all developed tools for gathering data were discussed with the involved professors at the university, which minimized the perception bias through triangulation.

Reliability

There exist four sources of reliability: the researcher, the instrument, the respondents, and the situation (Van Aken et al, 2007). Regarding the researcher, there is a potential bias that people have the tendency to interpret the results in the way, which confirms their (prior) beliefs (Van Aken et al., 2007). Therefore different resources like game developers, existing games and the university professors are used. Furthermore, different types of instruments should be used and different sources of information should be researched (Yin, 2009). For this reason not only interviews are used, but also observations. Also, during the interviews, respondents can unintentionally provide incorrect or incomplete answers. The fact that 5 resources are used for the interviews, and 4 games are analyzed and compared makes sure that the outcomes are more reliable. The last potential source is the situation. Differences in circumstances under which the study has been conducted can give unreliable results. To prevent this, the study is spread across multiple days at different time settings.
Study 2

One of the primary concerns associated with the game based learning literature is the dearth of empirical evidence supporting the validity of the approach (Connolly, Stansfield and Hainey, 2007; de Freitas, 2006). O’Neil, Wainess and Baker (2005) believe that an essential element missing, is the ability to properly evaluate games for education and training purposes. If games are not properly evaluated and concrete empirical evidence is not obtained in individual learning scenarios that can produce generalizable results, then the potential of games in learning can always be dismissed as unsubstantiated optimism. This lack of empirical evidence supporting game based learning is not a new issue. However, with the growing popularity of serious games for learning purposes, the need for the generation of empirical evidence is reinforced (Hainey, 2010). Many researchers try to develop a framework that can evaluate the effectiveness of serious games in a learning context (Purabdallahian, 2012). Bloom (1956) presented a prominent taxonomy in learning domains where three types of learning outcomes were identified. First there is the cognitive type, which describes acquired knowledge on different levels. The second type is psychomotor, focusing on improving skills including physical movement, coordination etc. Finally, the third type is affective learning, which identifies the role of emotional attributes in order to reinforce learners feeling so that they are engaged in the learning process. Within this master thesis, focus is on getting results for the cognitive type. This means that it is interesting to see whether players acquired knowledge and whether they were able to understand the essence of the information provided. Study 2 therefore was constructed in such a way that outcomes should give insight in the effectiveness of a serious game.

In order to be able to conduct experiments concerning the effectiveness of serious games, a serious game was built based on the input of study 1. Therefore, before explaining the experimental setup of study 2, first the developed game will be explained in detail.

5.1 Game design

The game to be described was developed in cooperation with The Game Master b.v.

In order to be able to evaluate the effectiveness of serious games in accomplishing a
predefined learning goal, a context was selected suitable for experimenting with the game. Although this specific context was defined for this master thesis project, the general idea behind the research as a whole, is that serious games are a supportive tool for building awareness as part of the behavioral change process. Therefore, this context is merely selected to be able to show the effectiveness of a game, but it is important to notice that any kind of process or context could be selected as the base for a serious game.

The context selected was the new product development process. Many organizations have incorporated this process within their business. A common strategy, although not the only one, within this process is the stage-gate model developed by Cooper (2008). Within this approach, the new product development process mostly takes place internally. This means that the people that work within that organization make decisions and choices regarding new products and innovations. Employees taking part within this process are engineers, who have a great understanding of the technological innovations they can use for innovating products and processes. However, they are hardly conscious of the voice of the customer and the impact of technological solutions and possibilities on the life of the customer (Vermeulen, 2005). This can lead to misunderstandings between the product developers and the market place, resulting in failing innovations on the market. As it is often characterized the way engineers think: “You do not know it yet, but you really need it” (Nijssen, E.J., 2013). The customer does not recognize the need for the innovation yet, but will recognize it as soon as they see the product. In reality, this is not how customers make decisions for buying a new product. The customer simply has a job that needs to be done and is looking for a solution (Christensen, 2007). By involving the customer within the new product development process the engineer can get a better understanding of the job that needs to be done, and the customer can get a better understanding of the possibilities of technology. When engineers start involving the customer in their process, they change their behavior from internally oriented to externally oriented. In order to make engineers build awareness for the need to change their behavior as such a game was built with as a learning goal:

*By playing the game, engineers will build awareness for the importance of customer involvement in creating a new product in order to solve the customer problem.*
Figure 5 displays the desired situation for which players need to build an understanding. The players need to start envisioning their position within the new product development process as being actively engaged with the customer as well as the marketer.

Explanation of figure 5: as can be seen, in the envisioned situation the customer is in direct contact with both the engineer and the marketer. This is not all at the same time in the process. In the beginning of the new product development process (when discovering needs, generating ideas and developing new product ideas) the engineer is in contact mostly with the customer. This will make sure that the products created for the market will fit the needs. When reaching the product launch phase, the marketer takes over the communication towards and with the customer. The marketer is responsible for selling the products when they reach the market, so the market needs to be prepared for this by advertising. After launch the marketer still stays in touch with the customer, receiving information from the user about their opinion now they are using the product. Finally, the engineer and marketer also need to keep communicating with each other, so that both departments stay on the same track during the new product development process. This means keeping deadlines in mind and communicating about the process and received feedback.

With this context in mind, the next step within the game development was to fill in the predetermined learning parameters, and to construct the game setup.
5.1.1 Game elements

The desirable elements for an effective cognitive learning tool were filled in as follows for the actual game design:

Relatable to reality: in the game, participants have to develop a new product based on describing the features that product will have. Throughout their development process they have several options to make us of for making their decisions (invest in technology, do market research, brainstorm internally, talk to the customer etc). This makes to process, although speeded up a lot, very realistic. Because of this, students are able to relate what they learn to practice.

Interaction with the environment: the whole setup of the game is based on interaction within teams, between teams, and with other included roles. Other roles are the customer, the marketing manager and the director. Those roles all receive a certain input based on which they could fill in their role. This has an impact on the communication with the participants.

Digestion: evaluation rounds are meant for discussion and processing information. By asking question to the participants about how they think they performed and what they could do better, they are triggered to process what they experienced themselves.

Fun: by paying attention to each detail (layout, roles, materials) the game is intended to be fun and exciting.

Relevance: relevance should be explained in the beginning before playing by stating that as an engineer you are responsible for successful innovation. In the wrap up this should be addressed again, so that participants leave the room with the relevance of what they did in their minds.

“Just in Time”: when needed players receive additional information. This makes sure that there is never an overload of information and participants have the time to process before learning something new. Also, information needs to be given in small steps. The first round players only receive the basic information needed to get started. Within each evaluation round, new information can be provided so that participants can rethink their strategy. This finally could leads to the important aha – erlebniss (awareness) of involving the customer.

In specific for the serious game:

Identity: participants are put in the role of young ambitious engineering teams, working in a small enterprise on innovative processes. Each team member is held
responsible for a specific part (e.g. money, communication, design). By giving the small company a name and the necessary tools, teams feel engaged with being successful with their own business.

**Customization:** there is not one optimal way to play the game, which gives participants the freedom to learn in a way that they prefer. Some do it by trial and error. Others first make a strategy and see what others do and then start to act.

**Agency:** participants are in control of the information they receive. They need to think for themselves what is relevant and what is not.

**Explore and rethink:** the game provides an environment where you can explore your options and rethink your strategy. By having several moments for participants to think about what went right and wrong in the form of evaluation rounds, players are provided with the opportunity to rethink their strategy and play different the next round.

**Cooperation vs. Competition:** within and between teams there is a competitive environment because every team wants to be the best performing team, but also a cooperative element through sharing information with each other in order to find the necessary data to base decisions on.

With the parameters filled in, the final game play procedure was described. The full description can be found in appendix 7.1.

### 5.1.2 Game procedure

The game play is described according to the following process displayed in figure 6. The game manager is the one who has the overview during the game and the one responsible for careful transition between phases. Appendix 7.1 provides the process in more detail.

![Figure 6 Game process](image)

**Introduction**

Within the introduction the reason why the participants are going to play the game needs to be explained clearly, so that players feel the need for actively participating within the game. Also, the goal of the game needs to be explained; a new product
needs to be developed that solves the problem of the customer. The best team is the team that is able to deliver the most suitable product based on the features they have chosen for the product. Furthermore it is important to explain all roles that are involved within the game play; the teams of engineers (game players), the game manager (not in the game but having an overview), and all other additional roles (in this game: the marketing manager, the investor, the customers and the warehouse manager of the product features). Apart from that, the tools that are available to the players also need to be explained. In this case these were:

- Money which players received from the investor in order to buy features and research
- A product lists to be able to determine which features the engineers wanted to buy for their products
- Market- or technology research cards that participants could buy to get more information on what movements in the market are.

After providing this information the game play can begin.

**Rounds**

Within the different rounds participants have to work together in teams and make choices on which features they want their product to have. They make their choices based on internal discussion, discussions with other groups, market research, talking with the investor, and (if they come up with this) talking with the customer. Making use of the resources in the correct way will lead to hints to the players on which features customers need and which features they do not need. It is about finding the job that needs to be done for the customer.

**Evaluation**

After each play round there is an evaluation round. Within these round the game manager is in charge. He/she asks questions to players about what they did and why they did it that way. This gives an insight in the decision-making processes teams went through. Also, results are given within this round. Each correct feature is worth 1 point. The point system is based on the job that needs to be done of the customer, which is relatable to 10 out of 28 features. So, if the players would talk to the customer, they would be able to understand his problems and so understand the necessary features. It is to this understanding the students need to come; the so-called ‘aha-erlebnis’. It is important to not tell this to the students, but to let them come up with the idea of involving the customer themselves.
Wrap-up
Within the wrap up the game is finalized and the relevance of the game is once more explained. Also, the opportunity is provided for players to give feedback and comments on the game.

5.2 Participants
The Eindhoven University of Technology was chosen as an interesting environment for testing and evaluating the game, since this university is full of young engineers that have to deal with making choices within the new product development process. The experiments were conducted with a group of 130 students that followed the course ‘Entrepreneurship in action’. Participating students differed in age and gender, and originated from different studies provided at the TU/e. Table 10 provides the basic descriptive statistics of the research sample.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Background</td>
<td>Industrial Engineering: 49% Other: 51%</td>
</tr>
<tr>
<td>Gender</td>
<td>Male: 80% Female: 20%</td>
</tr>
<tr>
<td>Age</td>
<td>18 – 26 years old</td>
</tr>
</tbody>
</table>

Table 10 Sample descriptives participants (Appendix 6)

5.3 Experimental Procedures
The experimental setup is displayed in figure 7. The setup was constructed in such a way that the customer-oriented approach was measured over time. This provided the opportunity to estimate the differences in approach at certain points in time, giving insight in the effects of the game on whether participants were more customer-oriented in their decision making or not.

Figure 7 Experimental setup
**Experiment 1**: Participants were provided with a questionnaire to measure their current new product development approach. By doing this, it was possible to see the extent to which the participants are customer-oriented in the new product development process.

**Experiment 2**: Students were split up in three groups. All different groups were provided with a different cognitive learning method; a game, a lecture and a reader. The content of these different methods was the same: “It is important to involve the customer within your new product development process, in order to create successful products”. Apart from the content, it was also made sure that students had an equal amount of time for learning the information provided. The descriptives of the different experimental rounds are provided in tables 11, 12 and 13.

**Game**

Wake up Call: a game for building an understanding for the involvement of the customer within the new product development process.

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>42</td>
</tr>
<tr>
<td>Number of sessions</td>
<td>2</td>
</tr>
<tr>
<td>Number of participants per session</td>
<td>22 / 21</td>
</tr>
<tr>
<td>Number of play rounds</td>
<td>3</td>
</tr>
<tr>
<td>Duration</td>
<td>± 45 minutes</td>
</tr>
<tr>
<td>Extra people needed</td>
<td>Minimum of 3</td>
</tr>
<tr>
<td>Minimum participants required</td>
<td>Minimum of 4</td>
</tr>
<tr>
<td>Maximum participants possible</td>
<td>With current layout: 30 (possible to enlarge)</td>
</tr>
</tbody>
</table>

Table 11 Game descriptives

**Listen**

Speed lecture: the importance of customer involvement. This lecture was provided to students by me and also included a movie from Christensen on the job that needs to be done.

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>41</td>
</tr>
<tr>
<td>Number of sessions</td>
<td>1</td>
</tr>
<tr>
<td>Number of participants per session</td>
<td>41</td>
</tr>
</tbody>
</table>
Duration ± 35 minutes
Extra people needed 1
Minimum participants required 1
Maximum participants possible Depending on size of space but no limitations due to setup

Table 12 Listening descriptives

Reading
The reading experiment provided students with several messages concerning the importance of involving the customer in the new product developing process for generating successful product ideas.
1: Summary of article Christensen (2007): finding the right job for your product
2: Example of customer involvement “you need it but you don’t know it yet” (Nijssen, 2013)
3: Example of developing a swing and misunderstanding the customer
4: An overview of why innovations fail
5: 2 quotes of researchers who stress the importance of customer involvement

Number of participants 47
Number of sessions 2 (due to space)
Number of participants per session 24 / 23
Duration ± 40 minutes
Extra people needed 1
Minimum participants required 1
Maximum participants possible Depending on size of space but no limitations due to setup

Table 13 Setup reading experiment

In order to make sure that the game, listening and reading experiments were comparable based on approach, similar parameters for cognitive learning tools were used as design rules for the both the reading and the listening method. With that it was possible to compare all methods based on their effectiveness for the same learning goal. The desirable elements for an effective cognitive learning tool were filled in as can be found below. A more thorough description is places in appendix 7.
Listening

Relatable to reality: the movie and lecture slides both addressed clearly the issue of innovation and how you could make it more successful. By explaining to the participants that they are going to be the ones in the future that have the opportunity to come up with the next best thing, it was related to their reality.

Interaction with the environment: a questions and answers session to discuss what had been explained in the lecture and whether participant understood what had been explained and

Digestion: the customer-oriented approach was also evaluated 1.5 weeks after the experiment took place. This gave the opportunity to digest the given information.

Fun: by showing movie, it was aimed to make the session more fun and interactive than just listening to someone without having images to support that story.

Relevance: by stressing out the importance of innovating successfully in current business environments and in society in general

“Just in Time”: first the problem was addressed, then the possible solution was discussed with students. New information was given in a logical order and when needed. The information gave food for thought, but did not tell students how they should perform or act.

Reading

Relatable to reality: innovation is the reality for every participant. So, making it successful is very much relatable to what all participants currently do.

Interaction with the environment: not so much, since a reader is normally provided to prepare in your own time, the similar setup was used now

Digestion: students had the time to learn and process at their own speed

Fun: by having articles and pictures in the reader, and by making the different parts not too long, it was aimed at keeping the participant motivated and interested

Relevance: what is your responsibility as an engineer? This question was relevant to all participants and also within the reader the main message.

“Just in Time”: the articles had a logical order, first the problem, then the suggested solution to give students something to think about and process. The information stressed the importance and relevance of successful innovation and how customer involvement is valuable without obliging participants to change their behavior but to inspire them to consider a change.
**Experiment 3**: the final part of the experimental rounds was to see whether the impact of the method was also measurable 1.5 weeks after participants had received information through a certain learning method. This in order to see whether awareness had really increased due to the activity, and also to be able to compare the differences in impact between the learning methods.

### 5.4 Scales for measurement

In order to get the desired results from the experiments, scales for measurement were predetermined based on existing scales or approaches. All questionnaires used can be found in appendix 8.

**Questionnaire 1**

The first questionnaire included the following scales in order to measure the desired concepts. Most of those scales are based on evaluated and tested scales provided in previous studies. All scales are measured on a 7-point likert scale, where 1 is “strongly disagree” and 7 is “strongly agree”.

**Behavioral change**: In order to measure the student’s attitudes towards change we use the resistance to change scale developed by Oreg (2003). This scale gives insight type of resistance towards change. The aim is to measure in what way the students would resist change. (e.g.: cognitive rigidity, emotional reaction) (Cronbach’s α = 0.73)

**Open communication**: for this measure intergroup approach-avoidance tendency (Yashima et al., 2004) is used as an example scale. The aim is to measure whether the students are likely to talk to the customer directly, although they do not know the customer (e.g. open attitude, confidence) (Cronbach’s α = 0.65)

**Entrepreneurial mindset**: the entrepreneurial mindset of students is based on scales such as Problem-solving (Rubin et al., in press), (Heppener & Petersen, 1982), risk-taking (Dohmen et al., 2009), and decision-making (Scott & Bruce, 1995). The aim is to get an insight in the expected behavior of the students during the game play (e.g. rational decision making, intuitive decision making).

The results that came from these questions will not be further discussed within this master thesis, but were used for getting a better understanding of the target group for
playing the game. Having this insight was important for guiding the game play as the game manager, but did not have an impact on answering the research question.

**Questionnaire 2**

The second questionnaire included questions related to the experiment in order to measure how students perceived the game as a learning method. The following table gives an overview of the variables determined as relevant to get an insight in based on the perception of participants on the game as well as the other two learning methods.

<table>
<thead>
<tr>
<th>1. Relevance of content</th>
<th>9. Challenging</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Addition to current knowledge</td>
<td>10. Complexity</td>
</tr>
<tr>
<td>3. Usefulness</td>
<td>11. Interaction</td>
</tr>
<tr>
<td>4. Enjoyment</td>
<td>12. Fun</td>
</tr>
<tr>
<td>5. Variation</td>
<td>13. Duration</td>
</tr>
<tr>
<td>6. Interesting</td>
<td>14. Overall Grade</td>
</tr>
<tr>
<td>7. Excitement</td>
<td>15. Likeliness of recommending</td>
</tr>
<tr>
<td>8. Informative</td>
<td>16. Change of current behavior</td>
</tr>
</tbody>
</table>

**Table 14 Variables for determining game quality**

Learning Method: on a 7-point likert scale, students showed their opinion regarding their evaluation of the game as a learning method (variables 1 – 4 in table 14). With this 7-point likert scale participants could indicate their level of agreement with a certain statement concerning that variable (1 = strongly disagree – 7 = strongly agree). (Cronbach’s α = 0.74)

Quality: 11 parameters were predetermined based on general game evaluation variables (The Game Master, b.v.) and had to be scored on a scale from 1 – 10 (variables 5 – 15 in table 14). 1 indicates that a student was not at all satisfied with a certain aspect of the learning method, a 10 indicates high satisfaction. A 10-point scale is chosen, because the feedback of the students is seen as a grade for that variable. Since participants are used to a 1-10 scale for grading, this scale seemed the most appropriate. (Cronbach’s α = 0.85)

Behavioral change: One parameter (nr. 16) was selected to measure whether students thought that the lessons they learned would lead to a change in their
behavior. This question was posed in such a way that participants had to indicate their level of agreement on a 1-7 likert scale (1 = strongly disagree, 7 = strongly agree). Insights in this scale would tell whether participants feel like they built a certain awareness for changing their behavior, because they realized they are not performing in the optimal way yet. (No Cronbach’s α due to single variable)

Repeated measure scale
All three questionnaires included questions related to how customer oriented students are, asking their judgment in certain NPD-related situations.

New Product Development approach: To see how students prioritize within a new product development situation, we make use of the situational judgments test approach. This approach assesses the ability to choose the most appropriate action in workplace situations. These assessments are designed to determine how people would handle situations that you could encounter on the job. The scenarios provided in questionnaire 1 are also provided in questionnaire 2 and questionnaire 3 in order to see whether the approach changed in time. In order to make sure that students do not remember what they filled in in previous questionnaires, scenarios were rewritten. The aim of the learning methods is to make students aware of the fact that they need to involve the customer. The questions provided scenarios in which a participant can choose to involve the customer or not. If he/she does choose the answer, which involves the customer, a score of 1 is given. All other answers receive a 0. By doing so the number of ones on each time interval can be measure, giving an insight in whether the number of customer oriented answers increases or not. If so, the learning intervention had a certain impact on the participants’ awareness of the importance of customer involvement. An example is given below:

Scenario 1: Imagine you are developing a product that should be produced in the color red, but within the production warehouse you find out that the color red is out of stock? Waiting for the right color would take at least 2 weeks, but you should deliver the product within 3 days. You do have the possibility to deliver the product in the colors blue, purple and green. What would you do?

- Develop the product in one of the other colors, since it will not affect the functionality of the product (= 0)
- Wait for the red parts and delay the product with 1.5 week (= 0)
• **Inform the customer and ask him/her what he/she wants (=1)**
• **Ask your teammates what they would do, and then base your choice on the general opinion (= 0)**
• **Find another supplier for the red color, although the costs of the product might become higher because of this (= 0)**

Within this scenario it would be most customer oriented to discuss with the customer what he/she wants. Similar scenarios were provided in order to see which choices participants made and more importantly whether their decision making changed through the impulse of the learning tools. (No cronbach’s α because no likert scale)

### 5.5 Results

All SPSS output can be found in appendix 9, 10 and 11.

#### 5.5.1 Quality of the game

The one-way between subjects ANOVA was conducted to measure the perceived quality of the game compared to the other two learning methods. Only the variables with relevant outcomes to this thesis will be discussed. An overview of all variables and their outcomes can be found in appendix 9. Because the ANOVA test compared three different groups (game, listen, play) the outcomes indicate whether the perceived quality of participants differs significantly from the other learning methods. I used an alpha level of 0.05 for all statistical tests: p<0.05 for \[ F(df, dfw) = F, p = x \]. However, these significant outputs do not explain which differences between learning methods specifically are significant. Therefore the post-hoc Bonferroni comparisons test was conducted to see the differences in results between the game and the listening experiment, the game and the reading experiment, and the listening experiment and the reading experiment.

The effect of the learning impulse was significant p<0.05 for usefulness \[ F(2,127) = 12.69, p = 0.00 \]. Post hoc comparisons using Bonferroni indicated that the mean score for the game (M = 5.17, SD = 1.15) was significantly higher than the listening experiment (M = 3.90, SD = 1.46) as also for the same variable for the reading experiment (M = 3.91, SD = 1.37).

The effect of the learning impulse was significant p<0.05 for enjoyment \[ F(2,127) = 53.88, p = 0.00 \]. Post hoc comparisons using Bonferroni indicated that the mean score for the game (M = 6.29, SD = 0.84) was significantly perceived more
enjoyable than the listening experiment (M = 4.85, SD = 1.06) and the reading experiment (M = 3.85, SD = 1.34).

The effect of the learning impulse was significant p<0.05 for excitement [F(2,127) = 33.03, p = 0.00]. Post hoc comparisons using Bonferroni indicated that the game (M = 8.00, SD = 1.10) was perceived as a more exciting way to learn than the listening experiment (M = 6.24, SD = 1.32) and the reading experiment (M = 5.79, SD = 1.53).

The effect of the learning impulse was significant p<0.05 for informative [F(2,127) = 7.34, p = 0.00]. Post hoc comparisons using Bonferroni indicated that the reading experiment (M = 7.66, SD = 1.11) was perceived significantly more informative than the game (M = 6.71, SD = 1.26).

The effect of the learning impulse was significant p<0.05 for challenging [F(2,127) = 23.38, p = 0.00]. Post hoc comparisons using Bonferroni indicated that the game (M = 7.45, SD = 1.27) was more challenging than the listening experiment (M = 5.10, SD = 1.97) and the reading experiment (M = 5.81, SD = 1.54).

The effect of the learning impulse was significant p<0.05 for interaction [F(2,127) = 41.04, p = 0.00]. The level of interaction of the game (M = 8.07, SD = 1.19) compared to the listening experiment (M = 4.95, SD = 1.95) and the reading experiment (M = 5.17, SD = 1.98) differed significantly in favor of the game.

The variable fun indicates how much participants enjoyed the learning method for gaining information. The effect of the learning impulse was significant p<0.05 for fun [F(2,127) = 22.27, p = 0.00]. Post hoc comparisons using Bonferroni indicated that the game (M = 7.86, SD = 1.13) differed significantly from the listening experiment (M = 6.59, SD = 1.47) and the reading experiment (M = 5.81, SD = 1.60).

Participants were also asked to give the experiment an overall grade. The effect of the learning impulse was significant p<0.05 for average grade for learning method [F(2,127) = 3.69, p = 0.028], Post hoc comparisons using Bonferroni indicated the differences between average scores were only significant between the game (M = 7.29, SD = 0.94) and the reading experiment (M = 6.79, SD = 0.832).

Finally the difference for average scores, indicating whether participants would recommend others to take part in the experiments was measured. The effect of the learning impulse was significant p<0.05 for likeliness of recommending [F(2,127) = 6.096, p = 0.003]. Post hoc comparisons using Bonferroni indicated that promoters’
score for the game was significantly higher (M = 6.74, SD = 1.67) than the listening experiment (M = 5.56, SD = 1.16) and the reading (M = 5.70, SD = 1.78).

Apart from these parameters on quality, it was also questioned whether participants thought the information provided to them would lead to a change in their behavior. Based on the one-way between subjects ANOVA, the effect of the learning methods was estimated to be significant for this parameter with p<0.05 for [F(2,127) = 8.95, p = 0.00]. Also here a post-hoc comparisons test in the form of Bonferroni was used for further examination of this variable. Results indicated that game players (M = 4.76, SD = 1.3759) had a significantly higher agreement that their behavior would change compared to participants of listening (M = 3.88, SD = 1.3453) and reading (M = 3.49, SD = 1.572).

5.5.2 Customer orientation: finding proof for the effectiveness of the serious game

Table 15 shows the mean scores of customer-oriented answers given for each round including the standard deviation.

<table>
<thead>
<tr>
<th></th>
<th>Round 1 (No knowledge)</th>
<th>Round 2 (Directly after input)</th>
<th>Round 3 (1.5 weeks after input)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Game</strong></td>
<td>M = 0.48 SD = 0.50</td>
<td>M = 0.55 SD = 0.50</td>
<td>M = 0.69 SD = 0.46</td>
</tr>
<tr>
<td><strong>Listen</strong></td>
<td>M = 0.50 SD = 0.50</td>
<td>M = 0.54 SD = 0.50</td>
<td>M = 0.65 SD = 0.48</td>
</tr>
<tr>
<td><strong>Read</strong></td>
<td>M = 0.50 SD = 0.50</td>
<td>M = 0.53 SD = 0.50</td>
<td>M = 0.69 SD = 0.47</td>
</tr>
</tbody>
</table>

Table 15 Customer oriented approach over time

The mean scores for each round result in a certain growth process for the participants over time, impacted through the impulse of the game/listening/reading. Figure 8 displays the growth of each group, where means scores are displayed as percentages.

**Figure 8 Growth process in visual**
The implications of the growth of participants was further analyzed. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that the differences between the mean scores between time points for the game was significant \( p<0.05 \) for \( [F(2,208)=10.62, p = 0.00] \). Post hoc tests using the Bonferroni correction revealed that the difference between round 1 and round 2 was not significant \( (p=0.25) \), but the difference between round 2 and 3 \( (p<0.001) \) was.

A repeated measures ANOVA with a Greenhouse-Geisser correction determined that the differences between the mean scores between time points for listening was not significant \( p<0.05 \) for \( [F(2,203)=5.200, p = 0.06] \). Post hoc tests using the Bonferroni correction revealed that the difference between round 1 and round 2 was not significant \( (p=1.00) \) as well as the difference between round 2 and 3 \( (p=0.10) \).

A repeated measures ANOVA with a Greenhouse-Geisser correction determined that the differences between the mean scores between time points for reading was significant \( p<0.05 \) for \( [F(2,233)=8.45, p = 0.00] \). Post hoc tests using the Bonferroni correction revealed that the difference between round 1 and round 2 was not significant \( (p=1.00) \) but the difference between round 2 and 3 \( (p<0.005) \) was.

Table 16 shows that for each learning method a significant difference was measured between starting point and end point. In other words the customer approach participants had in the beginning of the process has changed and improved significantly over time because of the influence of the game, the listening experiment and the reading experiment. This finding confirms Hypothesis 2: A serious game is a useful method for building awareness for the need for behavioral change.

<table>
<thead>
<tr>
<th></th>
<th>Total Growth</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>+ 20.95%</td>
<td>( p = 0.00 )</td>
</tr>
<tr>
<td>Listen</td>
<td>+ 15.61%</td>
<td>( p = 0.01 )</td>
</tr>
<tr>
<td>Read</td>
<td>+ 16.60%</td>
<td>( p = 0.00 )</td>
</tr>
</tbody>
</table>

Table 16 Growth in customer oriented approach per group

Although no strong evidence was found for the differences between the effectiveness of the game compared to the other two learning methods. This overview does show that the game players experienced the biggest growth from beginning until the end. As a first test, the average growth percentages were compared to each other through a one-way between subjects ANOVA. However, for this test, it was assumed that all participants in each group respectively went to a similar growth, leading to a standard
deviation of zero for the measured average growth within each group (growth percentages as indicated in table x). With this assumption the post hoc Bonferroni test indicated that game players on average had significantly more improved their customer approach than listeners and readers. The mean difference between game players and readers ($M_{\text{difference}} = 5.34\%, \ SE = 0.18$) was significant at a level of 0.00. The same accounts for the difference between game players and readers ($M_{\text{difference}} = 4.35\%, \ SE = 0.17$) also at a significant level of 0.00. This way of testing however is not reliable because of the assumptions made. Therefore, more testing, especially on the long term, need to be done in order to be able to draw conclusions. Hypothesis 1, a serious game is a more effective cognitive learning method than the commonly used cognitive learning methods of reading and listening, is therefore not rejected, but also not confirmed through the results of this study.

5.6 Quality

Controllability

The description of the study is very detailed, and therefore it is also possible to repeat the study in a similar way. All aspects (from tools, to procedure, to scales) of the research can be controlled and repeated if desired by others. Therefore this study can be considered controllable.

Validity

Considering the construct validity in this case, the same method was used to collect the data, but different scales and measures within that method were used to quantify the data. Regarding the external validity this thesis is conducted with a game developer and not at a specific company. With that the aim was to develop a generalizable outcome concerning the effectiveness of games.

Reliability

Within this study scientific procedures are used for interpreting the SPSS output. With that the aim was to report the results in a scientific way, not from a subjective view. Furthermore, different types of instruments should be used and different sources of information should be researched (Yin, 2009). The game is tested by students from different departments at the technical university with different backgrounds. By doing so, it was accounted for that the outcomes are not based on the responses from a specific lens.
6 Discussion and Conclusion

“Tell me and I will forget. Show me and I will remember. Involve me and I will understand.”

- Confucius, Chinese Proverb

In order to make people understand something, you should not tell them or show them but actively involve them.

6.1 Summary and discussion

The goal of this master thesis was to find out ‘how serious games can stimulate building awareness for the need for a behavioral change in order to make the behavioral change process more effective’. This research provides a set of learning parameters for a serious game, which can be used for building any type of game that wants to put focus on building awareness. These parameters are consistent with Gee’s (2005) research on effective learning parameters for games with an educational purpose. Making use of these parameters leads to a cognitive learning game that supports building awareness among learners in a way that an understanding of a desired need for change is realized.

The significant results indicating the effectiveness of the game for building awareness are in line with the research of Wouters (2013), who also found that games are effective for realizing cognitive effects. The effectiveness of the game underlines the findings of several researches (Delanghe, 2001; de Freitas & Levene, 2004; Garris et al. 2002) that games are accelerating learning, increasing motivation and most importantly support the development of higher order cognitive thinking skills. Especially the focus of this study on stimulating cognitive learning, adds valuable insights to current literature. Looking at the specifics of the game the characteristics of the game were also analyzed for their effectiveness in order to see which elements of the game distinguish this learning method from the more conventional instruction methods.

The game is perceived as more comprehensive looking at the variables variation, challenging and complexity. As Trybus (2012) states in her research, games are successful because of their capability of engaging people with the
learning task at hand. It is believed that the variables variation, challenge and complexity specifically contribute to the engaging capacity of games.

Another important aspect of serious games is that it makes the learning process and also the learning task more enjoyable compared to the other learning method. Making learning fun and exciting apart from the performance results is important for creating a willingness to learn more and reach a certain understanding about the provided information (Pratt & Spruill, 2011; Midlarsky, 2013).

Furthermore the game is perceived significantly more useful compared to other learning methods than listening experiment and the reading experiment. Also participants would recommend the game to others significantly more than the two other methods. This also tells us that apart from the actual performance of participants through the impulse of the learning game, game players experienced a bigger impact of the learning method in the form of the serious game. This has a lot to do with the active participation that a game requires (Knowles, 1980).

Although all learning methods had a significant effect on the participants, it is important to notice that the above parameters distinguish the game from other learning methods on levels that are also important when looking at learning, and how to make learning more fun and effective (Gee, 2005). With the game also having realized the biggest improvement among participants, the usefulness of games for learning purposes is proved, confirming the effectiveness of the combination of reality and fun (Midlarsky, 2013)

Results furthermore indicate that the game players feel like they would change their behavior based on what they learned during the game play. The participants within the listening experiment and reading experiment feel significantly less like they would change their behavior based on what they learned. This confirms that people are usually not aware of the fact that they need to change their behavior until they experience that their current behavior is not sufficient (Lewin, 1947; Gill, 2009). Games have the distinguishing ability to let learners experience situations and in order have participants realize what is going right and wrong (Corti, 2006). The fact that game players are aware of the need to change their behavior is based on their experience relatable to reality through the game. This adds to the effectivity of the game especially on the longer term.
6.2 Scientific implications

Gaming is a field within literature which is very young and could still use a lot more explorative studies for finding evidence for the effectiveness of games (Hainey, 2010; Griffith et al., 2002; De Freitas & Levene, 2004). This study puts most of its focus on finding evidence for the effectiveness of games for building awareness, where the game is put to use as a cognitive learning tool.

Since there is no confirmed method for evaluating games for its effectiveness (Hainey, 2010), this research makes use of a specifically developed setup for this thesis in which a game is directly compared to two other learning methods; listening to a lecture and reading an article. With the experimental setup having several points in time for measuring the customer oriented approach of participants (before, directly after, and two weeks after) it was possible to get quantitative data confirming the effectiveness of the game, as well as the other two learning methods.

Based on the research several outcomes are useful for literature. First of all, the effectiveness of games is once more confirmed. With games being a learning method which is still under investigation (Hainey, 2010) the results confirm the potential games have for supporting educational purposes (Tang et al. 2009). Also, the evaluation procedure suggested within this study is relevance to literature, since knowledge is added on how games can be evaluated effectively.

6.3 Limitations and recommendations for future studies

The results are in favor of the effectiveness and enjoyment of the game. Still, there is no 100% guarantee that the conclusions drawn are proof of the effectiveness of games for a change in behavior in any case. In order to be able to really conclude that a game is effective, the participants should be tested again around six months after playing the game. These tests will make the effectiveness of the game more reliable. Also, testing at a later point in time would provide the opportunity to see whether a game is on the longer term a better learning method than other instruction methods (Wouters, 2013). Due to the setup of the experiments, and the time constraint, it was not possible to evaluate the long-term effect properly.
Also, the experiment at the university was considered to be a final test instead of an actual implementation within a certain course program or organization. This means that the feedback of participants can be used for the improvement of the game before making use of it in an organizational environment. This means that the game in the current analysis was not reaching its full potential yet. In order to draw stronger conclusions, the game should be further improved and then tested and evaluated again with a different sample.

Furthermore realizing change is not only about building awareness as was addressed within the literature study. Once awareness has been built, the actual change still needs to be made and, more importantly, maintained. For this, other impulses are need in order to make the learning process and change process successful. The tool developed within this study is therefore limited to be supportive for a small part of the behavioral change process as a whole.

Finally, this setup makes use of a specific context for which the experiments were conducted. The results clearly show that participants have become more aware of the need to involve the customer. However, this gives no guarantee that a game will be helpful and supportive for any random context. It is likely that a game in fact will be useful for any cognitive learning process, but testing and proving this for several contexts can turn this assumption into a strong statement.

Based on the above limitations of this research project, new opportunities arise for future studies. First of all it would be interesting to build a research that would test the influence of the game also after for instance six months after playing. Awareness is something that should not fade over time. Second of all, the use of a game should be incorporated within a whole behavioral change plan from beginning till end when the change is maintained. What is the role of a change agent in this for organizations? What actions and interventions are needed in order for learners to be able to make the envisioned change when looking at it practically? The change process does not stop at awareness. Finally it would be interesting to test the effectiveness of a game for different contexts, so that the conclusions of this study become more reliable.
6.4 Managerial implications

For organizations, in order to engage their employees within an envisioned change process, a game has proven to be an effective learning tool for building awareness for the need to change. Although such a game does not realize the behavioral change completely (Gill, 2009), it does help in building a strong base from which the change process can start. Investment of time (and with that money) is required in order to make the game really work for the organization, but once the change process has been completed, performance of the organization will increase automatically, without anyone resisting the new way of working. Having less resistance to change will speed up the change process within organizations, will make your organization more effective and most importantly will engage your employees in the processes that take place within the organization.

One of the biggest obstacle organizations might see in making use of a serious game is the effort you need to put in yourself to make it work. Instead of providing learners with a reader you need to set up a setting relatable to reality in order to make the game effective. In order to make this work you also need the help of extra people, which makes a lot more expensive and time consuming. However, making use of this setup enables an organization to let employees experience their behavior within their job. Insights that result from this experience are very valuable to an individual, but also for the group dynamics (Corti, 2006). Games allow for coworkers to get to know each other better. Also, one of the biggest benefits of the setup of the game is that players need to act and play based on their own insights and decisions. The outcome of their performance can directly be discussed (Trybus, 2012) which is useful for the learning process.

Another potential pitfall of the game is that it has as the major objective for players to build awareness. Once awareness is built, this is something that is lasting until that awareness is altered through new information. This means that the game cannot be played multiple times by the same group of learners. Because of this a game might again seem as a big investment to make. However, the effectiveness and engagement that can be realized among employees is worth this investment. Also, it is possible to think of another experiment, to see whether players really understood
the message. This should then be introduced a few months after playing the game. This way the participants of the game stay involved with the subject.

6.5 Conclusion

The goal of this thesis was to find proof for the effectiveness of games for building awareness and with that answering the research question:

*How to support building awareness within the behavioral change process by making use of a serious game?*

Based on how the research was constructed, both studies contributed to finding out how a serious game could be an effective learning tool for building awareness for a need for behavioral change. Study 1 developed a set of learning parameters based on which the game for this master thesis was developed. With the effectiveness of that game proven within Study 2, the success of the defined set of learning parameters was in a way also confirmed.

I know now that once understanding the learning goal of what you want to accomplish, and by defining the way the target group should learn, it is possible to develop a game that takes the way of learning as well as the learning goal that needs to be accomplished into account. The significant results of this master thesis project confirmed that a serious game indeed is an effective learning tool which is more than just a learning method, but a way to engage your learners in the task at hand. In my opinion it is especially this part of the game that makes it a recommendable tool.

“The concept of serious games is gaining popularity and is with that being fully examined in current ages. With this study it was possible to add a piece to that investigation. Still, there are questions unanswered, and with that recommendations for future research concerning the effectiveness of serious games. There is still a long way to go before the capacity of serious games will be fully understood. It is my hope and recommendation that in future practices, games will be the common learning tool used for any type of learning purpose”.
7 References


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All scientific scales for measurement on likert scales (study 1, questionnaire 1) are retrieved from: [http://www.sjdm.org/dmidi/All_Scales.html](http://www.sjdm.org/dmidi/All_Scales.html)
### 8 Appendices

#### 8.1 Appendix 1 – supporting tables and figures for literature study

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Table 17 Appendix 1 - Literature articles categorization

Note: Articles are classified as T if they only present a theoretical overview/model not tested in practice and not developed based on empirical data. Articles are classified as E if they are merely focusing on testing hypotheses through empirical data. Articles are classified as T+E when they both make use of theory and practice for developing and testing frameworks.
8.2 Appendix 2 – Interviews

General Interview Questions

*General approach for interview with X (60 minutes max.)*

Pitch my ideas for the serious game. What is the problem? What kind of change is needed? Why is a game the best solution for this? Discuss and receive feedback on my plans, approach and content.

Goal of further questioning is to

- Gain knowledge on the development of a game (from idea to game content)
- Gain general knowledge on serious gaming
- Gain insights in how to test and evaluate a game (measure effectiveness)

Questions can fall into four different categories. Not all of those questions will be asked during each interview. Table 8 gives an insight in the possible questions to ask to inspire every different interview but not fixate it too much.

<table>
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<tr>
<th>General Questions</th>
<th>1. What does the serious gaming department of X do for companies?</th>
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<tbody>
<tr>
<td></td>
<td>2. What is your role within the department?</td>
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<td></td>
<td>3. What is most of the time the reason for companies to want to make use of a serious game?</td>
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<td></td>
<td>4. Why do you believe in the effectiveness of serious games?</td>
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<td></td>
<td>5. Is a serious game that can be used as a learning tool on its own?</td>
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<td></td>
<td>6. Do you believe in the generalizability of a serious game?</td>
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<tr>
<th>Serious Game Development</th>
<th>7. What is within X the approach for creating a certain game content?</th>
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<td></td>
<td>8. How can you translate the situation from reality into a game that on the one hand provides the learning with the right lessons for reality, but still has the features of a non-realistic game?</td>
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<td></td>
<td>9. To what extend is the learner involved in the process</td>
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</table>
of developing a serious game?
10. How long does a development process take?
11. What are successful game mechanics to make use of?
12. To what extent can you manage the gameplay and with that the outcomes?

### Serious Game Evaluation
13. How many in-between evaluations do you perform on average?
14. What different ways of evaluation methods do you use and how do they work?
15. Which parameters of a game do you evaluate and why?
16. How can you measure the effectiveness of a serious game?
17. How do you involve the customer in the game evaluation process?

### Rounding off
18. Based on your experience, what are essential things to keep in mind while developing a game? (Tips and Tricks)

**Table 18 Appendix 2 - General interview questions**

If agreed upon, the whole interview will be recorded, because then it is easier to remember all the discussed items. In order to go home with the right information, the important points mentioned in the interview will be summarized in the end. This will make sure that everything was understood the right way.

The interview will be rounded off by agreeing upon a feedback moment after the interview.
8.3 Appendix 3 – Observation form

Observation forms

Form 1

Name of the Game:

Goal:

Description of the game:

Observational Remarks

The game enabled all players to participate.

1  2  3  4  5

How do you know

This game gave players immediate feedback about their learning.

1  2  3  4  5

How do you know?

Players were constantly challenged during the game.

1  2  3  4  5

How do you know?

Players reached all learning goals by playing this game.

1  2  3  4  5

How do you know?

Players were able to fail and try again during the game.

1  2  3  4  5

How do you know?

Most successful parts of the game

Suggestions for improvement
8.4 Appendix 4 – Interview Transcripts
In this appendix only the most important statements and findings from the interviews are shown. Parts of the interview that were not adding value to this research are therefore deleted.

Interview 1) Mathijs van Duurling, Carlien van Woensel

  Gamification Team Leader, Gamification intern  
  Experience in game development: 2.5 years, 0 years

Summary of interview findings
Problem definition
The first step within the interview was to discuss what the actual problem and with that, what learning goals are regarding the master thesis project. The aim was to find out whether, based on current experience, the employees of Frisse Blikken saw value in the suggested game idea. In order to define this, the current game idea was pitched and the interviewees provided comments and feedback.

Initially the interviewer defined the problem as follows: Engineers develop a lot of innovative and high-tech products, but they do this all by themselves and therefore customers do not always understand the need for those products or the technology behind the product. The interviewees suggested another view regarding the problem. Engineers develop a lot of innovative, high-potential technologies, but they often don’t have the ability to translate this into a product that is actually solving problems for the customer. So, I do believe that engineers have to involve the customer more, but not only to create a better understanding between them. The desired situation would be that customers and engineers start co-creating products by making use of new and innovative technologies. This process is also referred to as valorization, which means translating knowledge into commercially viable products, processes or services.

This suggestion is considered within determining the goals for the game.

Game Development
Within this part of the interview, the aim was to find out whether Frisse Blikken makes use of certain fixed development steps when they make a game for a certain customer. By knowing this, a procedure for the game could be defined.
Within Frisse Blikken there is no fixed procedure for game development. Every customer is different, so steps to be taken follow the needs of the customer. The only fixed step then is to define the requirements for the game with the customer before the actual development starts. This means defining the learning goals and also determining organizational requirements like maximum duration and involved parties. Defining requirements is a very thorough process for which 1.5 months form the total of 5 months of developing is taken. Frisse Blikken views the development process as co-creation in which the customer provides the necessary details for the game, and Frisse Blikken uses its game expertise to translate the needs into an actual working game.

Based on this it is considered very important to define requirements with the customer or by yourself in order to reach the learning goals. Actual involvement of the game players is not considered necessary, but with the customer you can discuss the type of players you are developing a game for.

Game Evaluation
The aim is to find out whether Frisse Blikken evaluates the game they develop and whether they have a certain method for this.

Based on the interview it was found that Frisse Blikken has no specific evaluation process for the games they develop. What they evaluate depends a lot on what the customer wants. Measuring effectiveness takes time and cannot be seen directly and in most cases there is no contact with the client anymore then. Debriefing sessions are used most of the time directly after playing the game in order to discuss the learned lessons and the layout of the game. This always provides useful feedback on whether players understood the underlying goals of the game.

Based on scientific research the ideal evaluation process knows three stages. You do a pre-test before the game play. You have a debriefing session directly after playing the game for immediate feedback. You have a post-test after a few weeks later to see what the players took home with them and remember from the game.

Based on this it is taken into account to have multiple elements for evaluating the game that need to be taken into consideration in order to prove the effectiveness and quality of the game. Especially the 3-point evaluation process is considered to be relevant.
Interview 2) Hans van Tol

Business owner, the game master
Experience in game development: 10 years

Summary of interview findings

Short introduction of company/experience
The Game Master was founded in February 2004 and in January 2005 we started with the first application for a serious business game with an educational goal. The goal of the game master from a business point of view is to provide companies/universities with a new method for learning goals. By making learning more fun, you can actually accomplish something among your target group.

Game example
Dilemma: for the town Nieuwerkerk aan den IJssel a game was developed with the goal to bring the town (politicians) and the inhabitants closer together. The game could be played with a maximum of 150 people. Basic idea: put the inhabitants of the town in the shoes of the politicians and have them realize that dividing the budget among different areas that are of interest for the town is not so easy. This would result in more respect and understanding towards each other during the game, but also in real life when looking at decisions made by the politicians.

Game Development
Within this part of the interview, the aim was to find out whether The Game Master makes use of certain fixed development steps when they make a game for a certain customer. By knowing this, a procedure for the game could be defined.

The Game Master makes use of a fixed set of development phases, but those differ in content based on the client’s needs. The following phases are: initial meeting, game design (make choice), test round I, evaluation with client, develop, test round II, and Game Play. The players are not so much involved in this process, only their learning need is defined with the client and also what type of players they are. Successful game elements are: a clear goal, excitement, surprises, high interaction between players, feedback (for the learning effect), and competition. Competition is good for the level of excitement, but social interaction is even more important. Find the right balance.
Based on this it is considered very important to define requirements with the customer or by yourself in order to reach the learning goals. Also, successful parts of games are identified, which could also be implemented within the game design for this master thesis project.

Game Evaluation
The aim is to find out whether The Game Master evaluates the game they develop and whether they have a certain method for this.

The Game Master does not have a certain procedure for evaluating what the players thought of the game. They only discuss with the client about whether he/she is satisfied with the game, but not with every individual player. However, it is measured whether players learn something while playing the game. This is built in within the setup of the game. This is done by having several rounds in which players have to do something twice. This way you accomplish that players have a certain moment of “ahaaa”. This is when they understand what the game is about and that they have been doing it all wrong. Even better, they also understand what they should do instead. Also, you should prepare players for the game play so they will feel attached to the envisioned learning goals.

Based on this it was learned that you can measure the effectiveness of the game by having players play several rounds within the game. This way you can see whether they change their approach.

Managing game play
You are the manager of the game. This means that you can guide players into going the wrong and after that right direction. This ensures the desired learning behavior. There is a difference between the learning goal and the game goal. At the beginning of the game you tell the teams that are playing that they have to earn as much money as possible (game goal). What they don’t know that they can only make a lot of money if they work together (learning goal). Directing the players into certain ways by setting rules and for instance not giving all information at once. One key element in directing the game play is scarcity. This always leads to the effect that people have to think about the optimal route, it leads to excitement and it has innovativeness as an effect. Scarcity can be in time, money, information or anything else.
Summary of interview findings

Game experience

We developed a game for the group leaders within the production warehouse. Goal was to optimize the efficiency within the production facility. For this a new methodology for the way of working was created. The game, similar to the real process, was developed in order to show the usefulness of the introduced changes.

Game Development

Within this part of the interview, the aim was to find out whether Vanderlande makes use of certain fixed development steps when they make a game for a certain customer. By knowing this, a procedure for the game could be defined. Vanderlande did not make use of a specific design and development process. With reality as a solid base for the game, trial and error procedures resulted in the final game setup. The client in this case was Vanderlande itself so the developers determined requirements. The type of players did play a role in the layout of the game. Because of their practical way of working the game was simple and fast. During the game development the game was tested by playing the game several times in order to see whether the setup was clear, the information provided was sufficient and whether the goal was expected to be reached with the developed game. Some important elements regarding games: not too long, easy to understand, simple to play, interactive, concrete, practical, visibility of results and relatable to reality. The latter one is of great importance. This way they can really apply their gained knowledge in the future in practice. Based on this some new insights are gained in successful elements regarding game elements.

Game Evaluation

The aim is to find out whether Vanderlande evaluates the game they develop and whether they have a certain method for this. The game was not evaluated for improvement. It was just a one time intervention.
Summary of interview findings

Short introduction of company/experience
The idea to start with BIG is based on unsuccessful learning interventions used earlier by the founders of BIG. They noticed that cases and workshops (classical learning practices within companies) did not seem to appeal to all kinds of players. For instance cases were boring for WO educated players, but too hard to solve for older players from a different level in the company. Because of this, the founders of BIG tried to look for a durable way of learning (that really made a lasting change) that appealed to all kinds of players. Therefore: Gamification/serious Gaming.

Why? → The nature of games/gaming appeals to people because of the psychology of people (people like to win, people like to play).

The application of games
The goal is not to make a cope of reality, but to approach the situations from reality as good as possible. This way, players can relate the game play to their daily business and with that apply learned lessons to situations they encounter in real life. So the situation you put the players in must be realistic, but it is aloud to have interferences that are a “coincidence”. As long as it is something that could happen in real life as well and also it should be something that seems solvable to the players. Gaming should be part of a broader learning experience. With a game you can build awareness and create an aha-erlebnis. More content and feedback should be provided in order to make the effects of the game last.

Games are usually used for an analysis of the behavior of employees, assessment, selection of new employees, and to learn new methods or practices.

Based on this it is confirmed that with a game you can build awareness very well. Also for the development it should be kept in mind that the game is relatable to reality in order to be effective after game play.
Game development

Within this part of the interview, the aim was to find out whether BIG makes use of certain fixed development steps when they make a game for a certain customer. By knowing this, a procedure for the game could be defined.

BIG makes use of several building blocks when a game needs to be developed. The client then decides where they want to put focus on, so this is variable (customizable). Fixed building blocks tackle problems with lean production, leadership, customer approach among employees, negotiations, framing, cooperation, and team development. The client then decides where for which learning goal he/she wants to play a game. Further requirements are also discussed and agreed upon with the client.

Successful elements of a game: direct feedback, competition, conditioning, relatable to practice/reality, feeling of control for players, and total experience (materials, shape, light, sound, pictures). Also you want to force choices from players and time pressure is a key mechanism for doing this.

There is no fixed stepwise approach for developing a game, but there is a development strategy of which steps can be followed when needed. The first step is setting goals (what do I want to accomplish). For this also a quickscan is done at the client to see who the target group for the game is and what their need is. Next is to build the framework for the game based on the requirements. Then a certain game logic is chosen (for instance, players have to earn money) which is followed by the prototype. This prototype is tested and improved leading to the final pilot test. After this pilot test you keep improving your game every time, because each new play might lead to new insights.

Based on this useful insights are gathered concerning the development strategy for games, useful/successful elements and the generalizability of games.

Game evaluation

BIG has no fixed evaluation approach. However they do try to measure during and after game play whether people liked the game and get an insight on what the players feel like the learned.

Based on this we can conclude that it is very important to get an understanding of what the players thought the game was about. This gives feedback on the accuracy and effectiveness of the game.
Interview 5) Lilian Bakker

*Business owner: Acting in Dialogue*

*Experience with role-play games*

**Summary of interview findings**

During this interview the aim was to develop the roles that were created for the game. A role-play game is a platform within which participants are challenged to shape their emotions and experiences they encounter in daily reality. By playing a role-play, the participant experiences the different reaction form the environment on his behavior. Playing supports, creativity, introspective and expressive abilities and interaction with the environment.

For the game, four roles were introduced: engineer, director, customer, and marketing manager. Of great importance is that roles should be short and simple. You only need to push the players into a certain direction, but how they act within this direction is totally up to the players. This is most interesting, because then you can see how they interpret and translate certain comments. When describing roles it is always the most fun to make use of clichés and exaggerations. This way people will more likely be able to act and think from another perspective.

Based on the interview the following characteristics for each role were established.

*Director*

Bossy, the investor, afraid of the competition

*Marketing manager*

Very busy, salesman, focus on low prices, tight deadlines

*Customer (try to develop different types of customers)*

All customers receive a list of wishes and problems.

A male student: always too late, lazy, cheap

50+ woman: business woman, high standards

Construction worker: Needs to get up in the dark, Grumpy,

*Engineer (3 different roles in one team)*

Planner: responsible for delivering the product design on time

Finance: keeping an overview of not spending all the budget

Communication: responsible for all communication
8.5 Appendix 5 – Game observations

Game 1: Bricks & Brains
BIG Business IXperience Games: Dhr. C. Jansen
Dhr. A. Van Pelt

Goal
The setting in which the game was played was all aligned with the main theme: “Owning the leader: new trends in leadership”. The day started with an introduction on Louis van Gaal and his role as a leader for the Dutch Soccer Team. With this the organization of the day tried to set the tone by defining what good and strong and clear leadership is. During the day participants played two rounds of the bricks and brains game as described below. In between the games there were speed lectures giving interesting views on aspects around leadership like authenticity and authority. With this day the organization tried to engage people through the game and with that spread a specific vision on leadership in current society.

Description of the game
The Business game “Bricks&Brains” is a practical and interactive game within which a group of participants of different departments/companies/organizations have to work together on a certain companies supply chain. The goal of the organization is to provide the best delivery service as possible, reaching the highest efficiency possible. To reach this goal teams have to overcome some obstacles on the road. Each “play year” participants get clues that can be helpful in improving the efficiency for the next year. After a few years of playing it becomes clear whether the players were able to perform in a profitable way. With this players get insight on the small and easy improvements they can make within their own role or team that have great effects on the outcome of the game.
Observational Remarks

The game enabled all students to participate.

1 2 3 4 5

How do you know? All participants were assigned to a certain group and with that to a certain role. This gave people the opportunity to formulate a personal or team goal.

This game gave players immediate feedback about their learning.

1 2 3 4 5

How do you know? Results as in actual outcomes based on performance were displayed but not so much the discussion on why one team performed better then the other.

Players were constantly challenged during the game.

1 2 3 4 5

How do you know? Throughout the game each team endured several obstacles (one of the members had a depression, one of the employees went on a strike, one of the managers was a touch person to have a discussion with etc.). This made the game challenging and also fun.

Players reached all learning goals by playing this game.

1 2 3 4 5

How do you know? When I look at the game that was played, for me it was the idea to be able to cooperate together and to be efficient. However, the whole game setup was about leadership and it was hard to find the link with the game and leadership.

Players were able to fail and try again during the game.

1 2 3 4 5

How do you know? The whole setup of the game was actually about fail and try again. In the first round the instructors just gave everyone a task description and a process description and then let everybody play. The results were disastrous. Then after a break and some thinking, the same game was played again (with here and there some hints for improvement). The second round results were way better.
Most successful parts of the game

- Unexpected obstacles  \textit{Why?} Because this made the game a lot of fun
- Roles  \textit{Why?} Because this gave everyone a personal goal
- Team evaluation  \textit{Why?} Providing the team to sit back and look for improvement was very effective for the second round.

Suggestions for improvement or change for the game

Although all parts of the day were interesting, it was hard to find the link between the different elements. Especially the link between the game “Bricks&Brains” towards leadership was hard to define after playing.

Learned lessons in relation to the master thesis project

Although it was hard to define what the actual goal of the game was within the leadership concept, still certain elements of the game were very good and therefore useful for the creation of the game in this master thesis project. In order to keep a good overview only the three main learned lessons are captured from playing and observing the game.

1. \textit{Make use of unexpected environmental influences}. Especially when players start understanding what the game is about, they will start to act more and more based on their instincts. When confronting them with certain obstacles related to the goal, it will show how well they understand the idea behind the game.

2. \textit{Provide opportunity for team evaluation}. Without getting actual feedback from the game leaders, teams were provided with the opportunity on how they could improve the strategy. Because problems were noticed during the first part, solutions could be discussed in this “break”. Own improvements led to better results. This created a bigger feeling that we accomplished something with the team.

3. \textit{Arrange for enough game leaders}. The game was played by 30 people at the same time and because of the layout of the game this became a chaotic setting within seconds. There were however enough people (4) to manage the game in a way that it stayed fun instead of too much chaos.
Game 2: Connect the World
The Game Master: Dhr. H. van Tol

Goal
The main goal of this game is to get a better understanding of the concept cooperation. As a player you are part of a certain team, which has to reach a certain goal, but also part of the world, which has a more common goal. During the play, participants experience that cooperation is not only useful within the team but also between teams to get better results.

Description of the game
The group consisted of approximately 300 students. This group was split up in two parts of 150 students, both representing the world. Every group was divided into 6 teams that were categorized by continent. Both groups and within that, teams got the exact same goal: every continent should make sure that their population was happy and satisfied. By creating an experimental environment groups were competing against each other by cooperating within the group. One of the groups was given total freedom in working without any guidance, the other group was provided with hints on how to act (of which they could make use, but didn’t have to). Those hints were all concerned with showing how you can look at cooperation within the world, letting go of only looking at the happiness of your own continent. Participants had to make difficult decisions together and set priorities from their continent’s point of view. This led to surprising and more importantly interesting results. This setting is called a simulation game.

Observational Remarks
The game enabled all students to participate.

How do you know? Every participant was put in a certain role in a continent. Teams had to intensively work together so everyone got the opportunity to play along.
This game gave players immediate feedback about their learning.
How do you know? After playing the game results of the two worlds were compared. Also it was explained what the purpose of the game was and how decisions made by the different groups affected the outcomes.

Players were constantly challenged during the game.

1  2  3  4  5

How do you know? By constantly proving new insights and revealing how the different continents are performing participants were challenged throughout the whole game. Seeing you are not reaching the goals keeps you motivated to try and do something about it.

Players reached all learning goals by playing this game.

1  2  3  4  5

How do you know? Especially by discussing afterwards what the game was about the goal (that students would think about the concept of cooperation) was reached. Especially by discussing relevant topics with the participants a discussion revealed interesting aspects students picked up during and after playing.

Players were able to fail and try again during the game.

1  2  3  4  5

How do you know? Throughout the game participants were updated on their performance, this kept them motivated and more importantly provided them with the opportunity to be able to improve their performance.

Most successful parts of the game
- Big Groups Why? Not many serious games are suitable for such big groups. Being able to manage this number of participants is a useful asset.
- Discussion Why? Discussion stimulates learning
- Control Group Why? Having two groups play the same game under different circumstances is useful in proving effectiveness.

Learned lessons in relation to the master thesis project
Based on the content of the game “connect the world”, several interesting aspects are concluded that are also useful for the game developed within this project. First of all playing in multiple round provides the opportunity to provide the players with continuous feedback. Providing this feedback keeps players motivated to perform better the next round. Also, this game clearly showed that if you provide a certain context but not explaining all options to the players, they usually stay within that context and do not think out of the box. This provides the developers with the opportunity to actively direct the game and with that make players do what you want them to do. By directing the game you can make sure that the players first go into the wrong direction and then find out that they should change their way of working and improve on this. The players feel like they all did it themselves (authority) but actually this was all thought of in advance.

**Game 3: Spark**  
Philips: Slava Kozlov

**Goal**  
The goal or reason for developing the game is to stimulate and improve insight generation within the concept of innovation. The game should stimulate creative thinking among players, in a way that they feel comfortable with thinking out of the box. After playing this game, participants should be able to come up with new ideas more easily and confidently.

**Description of the game**  
The board game is played in teams and is part of a whole workshop. By rolling a dice you move characters around the board into different life situation or contexts. As an example you may move a character, described as ‘Jane, a 20-year-old female gamer’ onto a context space, which says something fairly predictable like ‘walking the dog’. It is also possible you land on a less likely space, which says ‘undergo Botox treatment’. In each case, you get a couple of minutes to brainstorm on the implications of this combination of character and context being discussed. There are also wild cards (e.g. ‘you discover you are broke’) that can add to the complexity of the given context. Finally, participants have to imagine how to help this person to achieve their main lifestyle aspirations (such as ‘I want to have immediate and direct access to others and to information’), which enriches and stimulates the thinking still
further. By playing this game participants can broaden their perspectives and come up with fresh ideas related to the proposition.

**Observational Remarks**
The game enabled all students to participate.

1 2 3 4 5

*How do you know?* Everyone is a single player on the board and needs to think from their own appointed perspective.

This game gave players immediate feedback about their learning.

1 2 3 4 5

*How do you know?* The game is not directly providing feedback on how well you did during the game. Especially because the game is part of a whole workshop this is not really necessary because the game supports the content of the workshop and within the workshop the game and actually all learned lessons are discussed.

Players were constantly challenged during the game.

1 2 3 4 5

*How do you know?* The whole game is challenging because you have to generate ideas from another perspective then your own. Especially the wild cards add a challenging factor to the game because you have to be even more creative to be able to come up with a suitable solution.

Players reached all learning goals by playing this game.

1 2 3 4 5

*How do you know?* This game is not used as a single tool to reach the learning goals. It is part of a bigger workshop in which the learning goals are reached through different elements of the workshop. Of course, the game does contribute to the goal of being able to generate ideas from a different perspective, so this game has a big effect on the outcomes.

Players were able to fail and try again during the game.

1 2 3 4 5
How do you know? The game does not specifically state that a player did something wrong and that you need to try again. However, the players do go round a big playing board on which they can land on many different spaces and with that land on many different situations. Each new situation provides the player with the opportunity to try again to come up with something new. The main difference with other games is that most of the time the game provided feedback and then the player can try again. With this game the player plays until the game is finished challenged to come up with new ideas again and again during the play.

Most successful parts of the game
- Workshop Why? This proves the effectiveness of games in a learning context and purpose
- Persona Why? In order to generate ideas the game requests players to think from another perspective
- Board Game Why? Brings the players close together

Learned lessons in relation to the master thesis project
Giving players a role makes them think from a different perspective. This will help them imagining certain scenarios and think of the best way to act from this role. Furthermore, a game is never a game just on itself. It is also really important to relate the game to the real-life situation for which the learned lessons are intended. Also it is useful to put the game in a broader perspective and let the players think by themselves about its meaning and usefulness. Finally, you have to add surprise elements to the game. In this case this is done by the wild cards. Those add a sudden new dynamic to the game while already playing and force the player to rethink the strategy. This has both a fun and challenging effect.

Game 4: Girls’ Choice
The Game Master & Rutgers WPF

Goal
The goal of this game is to make participants (girls between 10 – 15) understand that it is important to set boundaries concerning sexuality and safe sex. This should give the girls more confidence in how to approach difficult situations. Also, the game
should enlarge knowledge concerning relationships and sexuality and with that make girls more conscious about their own ideas and desire.

**Description of the game**

Girls’ Choice is the first board game for sexual education developed by the Game Master in cooperation with Rutgers WPF. It is an educative game especially developed for girls between the age of 11 – 15 and is used throughout the whole world. The game consist of assignments, like a role play, a general question, a personal question or a non-verbal exercise. The game is designed in such a way that it is a useful contribution to educational workshops or lessons about sexual and relational developments and is suitable both inside as well as outside school walls. Main questions girls should think about are: how much do you know about sex and safe sex?, How do you feel about parenthood in the future?, How do you behave towards boy- or girlfriends?, How well can you step up for yourself? Those questions help the players think about

**Observational Remarks**

The game enables all players to participate.

1 2 3 4 5

*How do you know?*

Everyone takes turns in taking a card and throwing the dice. This means that everyone has to answer certain questions from certain areas on the board.

This game gives players immediate feedback about their learning.

1 2 3 4 5

*How do you know?* The players do not actually receive feedback on their learned lessons. However, the players do get feedback from each other stating how they feel about the answer and how honest or thorough it is. So feedback is received, but not on their learning.

Players are constantly challenged during the game.

1 2 3 4 5
*How do you know?* Every question is a new challenge. Furthermore it is also a challenge to share thoughts and ideas on such sensitive topics. You really have to trust each other.

Players reach all learning goals by playing this game.

1 2 3 4 5

*How do you know?* The goal is that players in the end feel more comfortable to talk about sex. This goal is reached, but only in a safe environment. Whether they dare to say no to boys for instance does not become really clear.

Players are able to fail and try again during the game.

1 2 3 4 5

*How do you know?* The beauty of the game is that the players cannot really fail.

Most successful parts of the game

- **Workshop**  *Why?* This proves the effectiveness of games in a learning context and purpose
- **Persona**  *Why?* In order to generate ideas the game requests players to think from another perspective
- **Board Game**  *Why?* Brings the players close together

Learned lessons

The most important lesson is that a game should be a safe learning environment in which players feel comfortable to say and do anything they think is useful. If the players feel like they can say and do anything what comes to their mind, you will see the most natural behavior during game play. This is something very useful, especially when playing a game for learning purposes. Players should not me held back by fear of doing something wrong.

Furthermore a returning point of interest is that a game for learning purposes is not enough on itself if you want to reach the learning goals. The game should be part of a bigger learning setup.
8.6 Appendix 6 – Data collection on participating students before game play

In order to have a good idea of the sample group the following characteristics are determined. This group is randomly divided over the different experimental rounds, taking gender and educational background into account to make sure this is somewhat equally spread. Also, different experimental rounds must be of around the same size.

![Gender Descriptives](image1)

![Nationality Descriptives](image2)

![Educational Background Descriptives](image3)
8.7 Appendix 7 - Game Development

The game was developed in parallel with the data collection process of this master thesis project. In order to develop an effective game, different parts needed to be tested and improved before the final test. This appendix discusses this process and goes into detail when considering the core mechanics of the game.

Planned approach

In cooperation with The Game Master, the Test-, evaluation-, and improvement plan was determined, in order to make sure that the game would reach its full potential and meets all requirements for a potentially successful game.

<table>
<thead>
<tr>
<th>Round</th>
<th>Date</th>
<th>Test group</th>
<th>Goal</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-5</td>
<td>TGM (3)</td>
<td>First feeling with the prototype. Determine ways to improve, what is wrong with this first setup? How to test the game?</td>
<td>2 hours</td>
</tr>
<tr>
<td>2</td>
<td>7-5</td>
<td>Alone (1)</td>
<td>Go over the process several times. Implement provided feedback from first session. Focus on money flow and mechanics.</td>
<td>1 day</td>
</tr>
<tr>
<td>3</td>
<td>11-5</td>
<td>Students (5)</td>
<td>Do players understand what they have to do? How is the time schedule? Is it both challenging and fun?</td>
<td>3 hours</td>
</tr>
<tr>
<td>4</td>
<td>15-5</td>
<td>TGM (3)</td>
<td>Go over the decision tree and the chance matrix. Are they reliable and realistic?</td>
<td>1 hour</td>
</tr>
<tr>
<td>5</td>
<td>21-5</td>
<td>TGM (3)</td>
<td>Game setup is fixed. The game will now be measure according to fixed success criteria. All mechanics will be discussed in order to see whether there are any bottlenecks to take into account.</td>
<td>2 hours</td>
</tr>
<tr>
<td>6</td>
<td>23-5</td>
<td>Family (5)</td>
<td>Game setup is fixed. The game will now be measure according to fixed success criteria.</td>
<td>½ day</td>
</tr>
<tr>
<td>7</td>
<td>27-5</td>
<td>TU/e (4)</td>
<td>Game setup is fixed. The game will now be measure according to fixed success criteria.</td>
<td>2 hours</td>
</tr>
</tbody>
</table>
After the final “pre-test”, the final layout of the game was prepared for the final test, scheduled with the sample group of students.

**Core mechanics**
Apart from the setup and layout, certain game mechanics were determined to influence the gameplay. These mechanics had to work properly in order to be effective. Therefore a lot of focus was put on them while testing the game.

*Information*
Information is on the one hand beneficial for the teams, but it can also distract them from what is relevant for them and what not. Before each round, new information will be provided, and students need to decide how they act upon this.

Round 1: Players get the assignment and learn on how they can spend their money. Also, they are told that they are 100% in their approach to find the best product. Also, in order to understand what the session is going to be about, an introduction movie will be showed, which stresses the high failure rate of innovations and that we need to do something about it.

Round 2: Players are provided with feedback on their performance through their scores. Based on those scores, the different approaches of different teams are discussed so students can learn from each other. Additional to this patents and new technologies are introduced, which might distract the students from focusing on the assignment (developing the best product). Within the game mechanics it is expected that students will fight over the patents, without first analyzing which one they would really like to have.

Round 3: Questions are asked to have the students mention the customer. As soon as the customer is mentioned, additional information is provided by introducing them.

*Time*
Time pressure is very useful, because players will need to make decisions fast. There are three rounds of 7-8 minutes. Every round will be shortly interrupted when necessary. After each round there is a 5 minute evaluation in which scores are given.
Money

For the game it is desired that students have enough money to feel free to spend it on features or market research. However, they should not have too much money. That is, it should not be possible to buy everything that can be bought. Because of this students need to make choices.

In order to calculate the amount of money needed, we first calculate the possible cash outflow students could have based on the minimum and maximum expenses.

<table>
<thead>
<tr>
<th>Expense</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>10 correct patents</td>
<td>All 28 features</td>
<td>14 features</td>
</tr>
<tr>
<td></td>
<td>€4,000</td>
<td>€11,200</td>
<td>€5,600</td>
</tr>
<tr>
<td>Patents+Rights</td>
<td>3 correct patents</td>
<td>6 rights (max price)</td>
<td>1x patent, 3x rights</td>
</tr>
<tr>
<td></td>
<td>€900</td>
<td>€6,000</td>
<td>€2,550</td>
</tr>
<tr>
<td>Research</td>
<td>Useful research</td>
<td>All research</td>
<td>8 research cards</td>
</tr>
<tr>
<td></td>
<td>€2,400</td>
<td>€4,800</td>
<td>€2,400</td>
</tr>
<tr>
<td>Total Costs</td>
<td>€7,300</td>
<td>€22,000</td>
<td><strong>€10,550</strong></td>
</tr>
</tbody>
</table>

Based on this, we determine how much money we aim to give at students during the game play, but also build in a safety net. Money is always provided before the start of the round, so the overview also gives insight in the money students receive before starting a new round. The average price of selling rights is estimated at €750 and all students that bought a patent can sell it three times. Students receive a bonus of €500 for each correct feature. Subsidy is only provided when one of the teams cannot play anymore due to money problems.

<table>
<thead>
<tr>
<th>Type</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>€2,500</td>
<td>€1,500</td>
<td>€1,000</td>
<td>€5000</td>
</tr>
<tr>
<td>Bonus</td>
<td>€0</td>
<td>€0 - €2,500</td>
<td>€0 – 4,000</td>
<td>€3000</td>
</tr>
<tr>
<td>Sell Rights</td>
<td>€0</td>
<td>€0</td>
<td>€0 - €13,500</td>
<td>€2,250</td>
</tr>
<tr>
<td>Subsidy</td>
<td>€0</td>
<td>€0</td>
<td>€ var</td>
<td>€var</td>
</tr>
<tr>
<td>Total Income</td>
<td>€2,500</td>
<td>€1,500 - 4,000</td>
<td>€1,000- 18,500</td>
<td><strong>€10,250</strong></td>
</tr>
</tbody>
</table>

This overview shows that the expected pattern is for students to receive a little bit less money then they are expected to need during the game play. Of course this is an expected average, so some teams might have a lot more money.
8.7.1 Game Description

“Wake up Call”

Game Instructions

Although new product and technologies are developed at high speed, it is still a fact that 40% of new innovations fail when reaching the market. As an engineer within the new product development process, it is also your responsibility to improve this failure rate by making products more relevant and suitable for the market place. Why is this failure rate so high? What can you, as an engineer, do about this? and most important how can you turn your innovative products into a success? It is time to find out. This is your “wake up call” (introduced through a movie).

The game leader

As the game leader it is your responsibility to overview the game play and make sure that everyone understands what needs to be done. Therefore, your introduction needs to be clear and to the point so players understand what is expected of them. Also, you keep track of the time and warn the teams that they need to hurry up or make choices. The most important task is to guide the evaluation rounds in between and after the game. These evaluation rounds are the moment to have players think about what they are doing and why it is not leading to the best result yet.
**Game Setup**

The game can be played with 2 to 6 teams. Each team should at least consist of 1 person but preferably there are at least 2 team members. A maximum of 4 players per team is advised, which means this game is desirably played with 4 to 24 people. For the game, find a spacious room, so participants have the freedom to walk around.

Within the room the following setup is recommended (the setup is displayed for the situation where there are 6 teams playing):

**Game Roles**
1. Game Leader (in front of beamer, can walk around)
2. Marketing manager
3. Feature seller
4. Customer panel
5. Director

**Teams**
A. Ambitious Minds
B. Big Thinkers
C. Challenge Accepted
D. Driven by Technology
E. Everlasting Innovations
F. Fantastic Four

This setup can be altered based on the situation. It is for instance also possible to have the features and market research all in one place, if there are not enough people available to assist. Also, the game leader can take the role of director, giving the students investment money and their assignment.
Game Tools
The game consists of the following elements (all developed in a set of 6, so the maximum amount of teams is 6):

- **28 x feature cards per team**; feature cards can be bought at the feature seller. Players tape these pictures on a poster to keep an overview of what their product has.

- **10 x market research** (€300); market research can be bought at the marketing manager and gives insight in what the market does and doesn’t want.

- **6 x technology research** (€300); technology research can be bought at the marketing manager and gives insight in what the market does and doesn’t want.

- **6 x patent** (for each new technology 1); can be bought at the feature seller for €300 euros additional to the original product price.

- **18 x rights** (with each patent 3); can be bought from the other teams (owning the patent of that right) for a price between €500 - €1000 additional to the original product price.

- **1 x feature catalogue per team**; the feature catalogue gives teams an overview of the features that are for sale, including price.

- **1x introduction movie**; to introduce the issue at hand.

- **6 x role card customer** (max of 6 for customer panel); includes the checklist for the customers about the features they need and explains how they can respond in answer to the questions of teams

- **1 x team description for each team**; the description explains students how they need to divide tasks within the team and has some key points to keep in mind on it.

- **1 x role card marketing manager**; explains the role of the marketing manager and gives suggestions on how to play the role in a way that it reflects reality

- **1 x role card director**; explains the role of the director and explains what the assignment is that needs to be given to the students “we need to find a products that helps people waking up more easily”.

- **40x €500 notes, 40x €200 notes, 40x €100 notes**; to be distributed by the director to each team before each round
Some examples:
*Feature Card that can be purchased in shop*

**Feature 4**

![Feature Card](image)

**Market research**

**Feature 20: Randomizer**

A forecast was made to predict the expected popularity of the randomizer for the next coming years.

<table>
<thead>
<tr>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>2015</td>
</tr>
</tbody>
</table>

**Patent card**

This is a Patent giving you ownership of feature 21

**Team Description**

You are team Ambitious Minds, one of the competing engineering teams working within the innovation lab. Your goal is to develop the best new product for helping people to wake up in the morning.

Of course you work on those tasks together as a team, but there are also some specific roles to fulfill (you can decide yourself who does what, but everyone needs to do at least one task)

- Communication: you are responsible for talking to stakeholders/other people of interest
- Financials: you are responsible for the money flows (in and out)
- Planning: you are responsible for keeping an eye on the deadlines
- Delivery: you are responsible that you have something to show at the end of each round.
Goal of the game The game has two goals. First of all there is the goal within the game that players need to reach with their actions. For this game that is scoring the highest score based on the number of correct features. The highest score can be interpreted as the “best” product.

The underlying learning goal is for players to get an understanding of the importance of customer involvement within the New Product Development process. By involving the customer actively within this process a better mutual understanding can be developed.

Game play

Introduction

The game leader welcomes all players and makes sure that teams are around the same size. There is a short mention of the fact that the people present will participate in a serious game, before starting the introduction movie on the importance of new product development. After the movie is finished. The game can begin. First of all the director is introduced. He/she will tell something about his-/herself and then addresses the issue that he is looking for a new breakthrough in the alarms market. He/she challenges the engineering teams to come up with the next best thing, of which they are sure it will sell best on the market. How? That is totally up to them. The director is the investor and hands out €2500 as a starting budget for the development of the product. After that the game player explains what the students have in front of them and what they can spend money on.

In front of them: feature catalogue, poster, tape, and money.
Ways to spend money: market research at marketing manager and features and the feature seller.

Put the timer on the big screen and explain students have 10 minutes for round one to come up with product ideas → Press start

Round 1

During round 1, teams work together on a plan for the new product. They can walk around the room and buy features, buy market research, negotiate with other teams if they like and even can talk to the customer if they come up with this immediately within the first few minutes. At this point the customer is outside the classroom, so
that students do not immediately go for this option. After 8 minutes the game leader says that there are 2 minutes left to play. Players can make their final buys and need to tape their features on the poster. When the time is up, the marketing manager collects all posters to calculate the scores: 1 point for each correct feature.

Evaluation
While waiting for the feedback, the game leader and director can together ask questions to the teams. How do you think you scored? What went well? What went wrong? This gives players the opportunity to evaluate their process and think of ways to improve it.

After that scores are given, and the game leader asks students why they only scored 3 out of 10 (as an example). They can think about this, but no comments are provided yet on how the game leader and director think they should improve.

Before starting round two, all teams receive an additional catalogue of new technological features they can make use of. These technologies can also be bought, and if you are the first one to buy this technology, you are invited to patent the technology. This means that you receive the rights of this technology, which you can sell to the other teams. Please state that teams can only sell rights for a price between €500 and €1000. Please do not give more than 2 rights cards additional to the patent (other teams are too late → missed the opportunity).

To clarify: when a team purchases the patent, or the rights from the team owning the patent, this is additional costs to the original feature price. E.g. Technology 26 = €800. The patent is €300 euros. In total having this feature means paying €1100 euros. This should also make students think before they buy.

Also, teams receive new money from the director. Each team gets €1500 and an additional bonus for each correct feature they have after round 1. Again set the time at 10 minutes and press start.

Round 2
Within round two, more chaos will come up. Apart from communicating with each other, teams now also need to negotiate amongst each other about the rights. They can also still buy market research and additionally technological research (which
relates to the new introduced technologies) the director visits all teams to see how they are doing. While round 2 is halfway, the customers will enter the room and sit next to the marketing manager. The marketing manager and director can talk to the customers in order to show that these people might be of interest for the players. Again mention the two minute mark so that players can add the final features they bought to their poster. The marketing manager again collects the posters.

Evaluation

After round 2 again the game leader and director ask teams to share their thoughts and way of making choices for the features they buy. The director puts an extra stress of the fact that it is his money that is spent and that he wants to see that students clearly though about is. Before scores are shown, the game leader should ask each team how well they think they performed. After that scores are revealed and this is the moment where the game leader should pay focus on why there are still no scores of 8, 9 or 10. It is important to not point out to the students, as a game leader, that this might be because they did not ask the customer about his/her problems. The game leader should ask questions like “how can you find out whether your idea will actually work for the market place” or “who do you need additionally to all tools you already made use of”. This way players need to come up with the correct answer themselves: the customer.

As soon as one of the players mentions the customer, the customers can be introduced. Especially point out that they have been in the room for a while now. Also point out that the customer has problems he/she wants solved and that not all of their problem solvers are added to the product yet. This is what they need to find out.

Set the clock at 7 minutes for the last part and press start.

Round 3

Students can still do all the same things as before, but will most likely ask a lot of questions to the customer. It is important to instruct the customers that they must put focus on their problems and not give the correct answer away to soon. When players do a good job, the customers can reveal the last two features.

Evaluation & Discussion
After round 3 the marketing manager collects the posters and calculates the final scores. In the mean time the game leader asks questions to the students to find out how they changed their approach after the second round. When the final scores are given the game ends, and the winner is of course the team with the most points. Should there be teams with an equal amount of points, it is interesting to look into how much money the teams “wasted” on not wanted features. The team with the lowest wasted money is the winner of the game.

After ending the game, it is important to evaluate with the players what they thought of the game and also to discuss what they learned from the game. This way, the game leader can find out whether the players actually understood the idea behind the game. This also provides the opportunity to add some final comments, so that the players have a full understanding of the relevance of the game for their daily practices.

8.7.2 Listening description

The listening consisted of a lecture and a movie, which were both based on the article of Christensen (2007) finding the job that needs to be done. It is, looking at the content, quite similar to the information given in the reading part.

8.7.3 Reading description

Summary – finding the right job for your product


Two Quotes

“It’s not just about finding the right technology, the right parameters or the right piece of hardware. It’s also about finding a way to communicate with consumers.” (Philips Research Fellow Dr. Tom Nuijs, Philips website, May 2015)

“You need to reason form the customer, so what are his needs, what does he see, and what does he want. Then you can answer this with a product or a service” (Olaf van Duren, Master student innovation management).
Involve your customer

Retrieved October 2013 from lecture slides prof.dr. E.J. Nijssen (TU/e) of the course Entrepreneurial Marketing.

The above picture addresses a well-known problem within the new product development process (or actually a problem that appears directly after this process). What happens a lot is that products enter the marketplace, of which the customer does not understand that he needs it. This product is very high-tech and innovative, but it does not solve a problem for a customer. Or at least, the customer is not able to see how that product solves his problem. Because of the fact that the customer does not understand the product, he is very unlikely to buy or try it. Because of this, it is important for you as an engineer to involve the customer in your development process, so that the understanding for the product grows while developing. This also allows you to optimize the product while developing, so that it meets the customer needs, but still remains a high-tech innovation.
Developing a Swing

Most problems faced by organizations have to do with miscommunication. Below is a well-known example to show what miscommunication can lead to when a new product needs to be developed for the customer. The example is about developing a swing.

What you see in this picture is that because of all the different people that say something about what needs to be done, the end product is not what the customer really needed. A customer does not always explain to well what he/she really wants. Therefore, as a product developer, it is of major importance to talk to the customer by yourself instead of the product leader. This way the engineer is able to translate the customer wants into a product that does solve the problem it needs to.
8.8 Appendix 8 – Questionnaires

For Questionnaire 1 the whole questionnaire is provided including introductions. The other 2 questionnaire will only provide insight in the new questions asked, but will not go through the whole questionnaire including explanations, introductions and general questions like requesting student number.

**Questionnaire 1**

Thank you for taking the time to participate in our research! This study is a joint project between Muriël Kol, Master Student Innovation Management, and Stela Ivanova, Doctoral Student at ITEM, TU/e. The study contains 2 questionnaires and one knowledge test. First, we ask you some general questions about your person.

<table>
<thead>
<tr>
<th>General</th>
<th>What is your student number?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What is your age?</td>
</tr>
<tr>
<td></td>
<td>What is your gender?</td>
</tr>
<tr>
<td></td>
<td>What is your nationality?</td>
</tr>
<tr>
<td></td>
<td>What is your study subject?</td>
</tr>
</tbody>
</table>

Second, we ask you to complete some answers to the following questions. There are no right or wrong answers. Please answer the questions based on your personal opinion.

**Behavioral Change**

Please fill in the following questions by stating whether you agree or disagree on a scale from 1 to 7. The following 20 questions are all related to your attitude towards change and how changing processes make you feel. Your answers will be treated confidentially, so please fill them in as honest as possible.

<table>
<thead>
<tr>
<th>Change</th>
<th>Agree – Disagree (1-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I generally consider changes to be a negative thing</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td>I’ll take routine day over a day full of unexpected events any time</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td>I like to do the same old things rather than try new and different ones</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td>Whenever my life forms a stable routine, I look for</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td>ways to change it (reverse score)</td>
<td></td>
</tr>
<tr>
<td>I’d rather be bored than surprised</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>If I were to be informed that there is going to be a significant change regarding the way things are done at school, I would probably feel stressed</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>When I am informed of change of plans, I tense up a bit</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>When things don’t go according to plans, it stresses me out</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>Changing plans or routine seems like a real hassle to me</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>Often, I feel a bit uncomfortable even about changes that may potentially improve my life</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>When someone pressures me to change something, I tend to resist it even if I think the change may ultimately benefit me</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>I sometimes find myself avoiding changes that I know will be good for me</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>I don’t change my mind or behavior easily</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>When someone tells me to do something differently, I usually don’t do anything with that comment.</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>I share my concerns with those who have initiated the change.</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>When a certain change is introduced, I seek clarification about the change and its implementation</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>I initiate changes myself</td>
<td>Agree – Disagree</td>
</tr>
<tr>
<td>I change my behavior to model the desired new behavior for others.</td>
<td>Agree – Disagree</td>
</tr>
</tbody>
</table>
I ask questions and try to learn more about change initiatives when introduced.  

<table>
<thead>
<tr>
<th>Agree – Disagree (1-7)</th>
</tr>
</thead>
</table>

I am usually afraid that changing my behavior will not have an effect on the results of processes.  

<table>
<thead>
<tr>
<th>Agree – Disagree (1-7)</th>
</tr>
</thead>
</table>

Being able to change your behavior makes you a better entrepreneur.  

<table>
<thead>
<tr>
<th>Agree – Disagree (1-7)</th>
</tr>
</thead>
</table>

**Communication**  
Please fill in the following questions by stating whether you agree or disagree on a scale from 1 to 7. The following 10 questions are all related to your attitude communicating with people you don’t know. Your answers will be treated confidentially, so please fill them in as honest as possible.

<table>
<thead>
<tr>
<th>Communication</th>
<th>I feel comfortable talking to strangers</th>
<th>Agree – Disagree (1-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I try to avoid talking with people I do not know if I can</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>I like learning about others’ interests</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>I find it easy to keep a conversation going</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>In my opinion I have an open attitude towards others</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>Others would describe me as an introvert person rather than an extravert person</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>Talking to strangers is a challenge for me</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>When I explain something to others, they are able to understand me</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>I enjoy meeting new people</td>
<td>Agree – Disagree (1-7)</td>
</tr>
<tr>
<td></td>
<td>I feel confident about myself and about how other view me</td>
<td>Agree – Disagree (1-7)</td>
</tr>
</tbody>
</table>
Entrepreneurial attitude

Please fill in the following questions by stating whether you agree or disagree on a scale from 1 to 7. The following 18 questions are all related to entrepreneurial mindset and examines your probable behavior in certain situations. Your answers will be treated confidentially, so please fill them in as honest as possible.

<table>
<thead>
<tr>
<th>Entrepreneurship</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem solving</strong></td>
<td>When a solution to a problem was unsuccessful, I do not examine why it didn’t work</td>
</tr>
<tr>
<td></td>
<td>I am usually able to think up creative and effective alternatives to solve a problem</td>
</tr>
<tr>
<td></td>
<td>I find it easy to recognize and identify the correct problem</td>
</tr>
<tr>
<td></td>
<td>I value other people’s help and advice when making important decisions</td>
</tr>
<tr>
<td></td>
<td>I like solving problems because it benefits society</td>
</tr>
<tr>
<td><strong>Risk Taking</strong></td>
<td>I am comfortable with trying something new, even if I am not sure if it will be a good idea.</td>
</tr>
<tr>
<td></td>
<td>In general I am willing to take risks.</td>
</tr>
<tr>
<td></td>
<td>I am usually the first to try out something new in comparison to others.</td>
</tr>
<tr>
<td></td>
<td>Taking a risk gives me a feeling of satisfaction</td>
</tr>
<tr>
<td></td>
<td>I tend to avoid taking risks</td>
</tr>
<tr>
<td><strong>Decision making</strong></td>
<td>I explore all of my options before making a decision.</td>
</tr>
<tr>
<td></td>
<td>I don’t like to take responsibility for my</td>
</tr>
</tbody>
</table>
I don't like to make decisions quickly, even simple decisions like choosing what to wear  
Agree – Disagree  

I avoid making important decisions until the pressure is on  
Agree – Disagree  

I make decisions in a logical and systematic way  
Agree – Disagree  

I generally make snap decisions  
Agree – Disagree  

When I make decisions, I tend to rely on my intuition  
Agree – Disagree  

I rarely make decisions without consulting other people  
Agree – Disagree  

Customer involvement in product development

You are provided with several scenarios that might come up during the new product development process. All described scenarios are based on literature, so it is likely that those might come up when you will be actually working as a new product developer. Please rank the different with 1 being the most appropriate option and 5 being the least appropriate option as a suitable action within this type of situation.

**NPD Scenario 1:** Imagine you are developing a product that should be produced in the color red, but within the production warehouse you find out that the color red is out of stock? Waiting for the right color would take at least 2 weeks, but you should deliver the product within 3 days. You do have the possibility to deliver the product in the colors blue, purple and green. What would you do?

- Develop the product in one of the other colors, since it will not affect the functionality of the product
- Wait for the red parts and delay the product with 1.5 week
- **Inform the customer and ask him/her what he/she wants**
- Ask your teammates what they would do, and than base your choice on the general opinion
- Find another supplier for the red color, although the costs of the
product might become higher because of this.

Scenario 2: Your team is asked to come up with a set of new product ideas for a beer company that wants to bring a special product line on the market for females. You are appointed as the team leader and have to decide on what the first step in the product development process will be. What would you choose? (Lilien et al., 2006)

- Do a market analysis
- Start a brainstorm with your teammates
- You build a competition among your team members to come up with the best idea
- You interview the stakeholders in order to find out what they think will be most successful on the market
- **You invite a group of lead users as representatives of the target market to identify problems and generate ideas**

Scenario 3: Imagine you and your team working on a new product idea for months, when you find out that one of your main competitors is working on the same idea as well. Although both processes are in an equal stage, the chance is pretty high that your competitor will be able to launch the product a few weeks before your release date is planned. What would you do? (technori, http://technori.com/2013/07/4616-startup-not-first-to-market/)

- Stop the development and start with something new
- Wait until the competition launches the product, look into the details and then launch a better version of the product one month later
- **Launch the product idea and advertise for when it will be in the stores**
- Just finish the process as you had it in mind before you received the bad news of the competition
- Ask your stakeholders for advice on what to do

Scenario 4: Imagine you developed a new product of which you are completely confident that it will be very successful in the market. However, when you demonstrate your product to the customer panel they do not seem to be enthusiastic about it because they are used to the product they have (Gourville, 2006). What argument would you use to convince the customer?
• The new product has a lot of new technical features the old product does not have
• The new product serves the customer’s problem better than the old product
• The new product looks much nicer than the old product
• The new product is easier to use than the old product
• The customer should be more open to new things in the current fast developing ages we live in

Scenario 5: You have a new customer, who has requested you to develop a product for him. This customer is a very busy man and you are informed that you are not able to request a lot of his time. You are aloud to invite him to the office only once before you send the product to him. This means that you have to decide when you will consult the customer within your new product development process. When will you ask the customer for his input? (Kaulio 1998)

• In the middle of the process to see whether I am going in the right direction (design with the customer)
• At the end of the process to demonstrate the end result to the customer (design for the customer)
• In the beginning of the process to verify the customer’s problem and needs (design by the customer)
• After the customer has received the product in order to see whether he enjoys the product (design for the customer)

Thank you for taking the time for filling in this questionnaire. The questionnaire is now finalized. You will be informed shortly about your next task in this set of experimental rounds.

Questionnaire 2
For determining the quality of each learning experiment:

<table>
<thead>
<tr>
<th>Setup</th>
<th>I was able to understand the game rules of the game. (1 – 7 likert scale, strongly disagree – strongly agree)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The theme of the game was relevant for me to learn more about.</td>
</tr>
</tbody>
</table>
This game was a nice addition to my education.

Compared to other learning methods (reading books, listening to lectures, making cases, doing homework assignments), how would you score this game as a tool for learning purposes looking at:

- Usefulness (1 = much less useful, 2 = less useful, 3 = equally useful, 4 = more useful, 5 = much more useful)
- Enjoyment (1 = much less enjoyable, 2 = less enjoyable, 3 = equally enjoyable, 4 = more enjoyable, 5 = much more enjoyable)

Please reward the game with a grade from 1 (real bad) to 10 (very good) based on the following criteria:

- Variation
- Interesting
- Excitement
- Informative
- Challenging
- Complexity
- Interaction
- Fun
- Duration

Please give the game a grade between 1 and 10 where a 1 is the lowest score you can give and 10 the highest score you can give.

Do you have any suggestions to improve this game? What could make it better in future practices?

How likely is it that you would recommend this game to others to play it? Give a score between 1 and 10 where 1 states that you would never recommend this game to others, and 10 that you would definitely recommend this game to others.

The following questions concern the effectiveness of the experiment, looking at the learning goal that was of interest when developing this experiment. *The way questions were asked differed per for each experiment but content of questions stayed similar.*
**Effectiveness**  Do you know the goal of this game (yes/no)? What do you think that the goal was of this game? Please describe in one sentence.

| It was possible to get an understanding of this goal by yourself, throughout the game play. |
| In my opinion I was successful in accomplishing this learning goal through the game play. |

The creator of the game described the goal of the game as follows:

*The goal is to make students aware of the fact that they need to involve the customer effectively in their product development process, in order to create products that are actually relevant and understandable for the marketplace.*

Please indicate of the following questions to what extend you agree with them or not. The scale is from 1 to 7 (strongly disagree – strongly agree).

**Effectiveness**  Reading the predefined learning goal, I think I was able to accomplish the goal of the game I played.

| My behavior and decisions had a clear impact on the outcomes of the game. |
| I will definitely put the learned lessons to practice when I encounter such a situation in the future. |
| Involving the customer earlier in the process is a change in my previous behavior. |
| The game gave me a good insight in the importance of customer involvement in the New Product Development process. |

The final part of this questionnaire requested students rank different ways of dealing with a certain situation.

**NPD**  Scenario 1: Imagine you are developing a product, which should go in production three days from now. You are almost finished with the design but you and a teammate do not seem to agree on one of the features. You believe that it is best to make use of a plug-in while your colleague wants to build in a wireless system. Building in a wireless system will delay the
production and increase the costs of the product. However, he does have a point that in current times almost all new products are wireless. What would you do to complete the design for production in time?

- Do a market analyses to find out more about the success of wireless systems
- Discuss the issue with your manager, since you are sure he will agree with you that it is important to not have any delays for business
- **Invoke the customer to your office to demonstrate the two ideas and see what they like best**
- Organize a vote with all employees of the company to see which idea gets most support
- Prove that the wireless option will cost a lot more money and take this to the stakeholders of the company.

Scenario 2: Imagine you are a team member of the new product development team of a company developing toasters. Based on a market analysis among current customer you found that users have two things they don’t like about the product. 40% of the users say that it is difficult to see (when the bread is in the toaster) whether your toast is going to fast or not (change costs €20.000). Another 42% says that they think the toaster is to big and that it takes a lot of place in the kitchen (change costs €30.000). You only have the budget to make one alteration to the product. How will you decide what to do?

- Make product smaller since more people have a complaint about the size
- Make product see-through because that is cheaper for the company to change
- **Ask for more budget to be able to make both changes to the product, since it is clear that there is a need for both features.**
- Find out what the competition has and does not have and decide which of the two options will give you the biggest competitive advantage.
- Ask company management what they think you should do

Scenario 3: The marketing department is working on a launch campaign for
the new product you and your team developed. Since it is a highly competitive market where your company will launch the product, it is of major importance to trigger the customer in such a way that they will feel most attracted to what you have to offer. Since you are the brains behind the innovation, the marketing manager has asked for your help on the campaign. What should be the main message of the campaign?

Market: alarm clocks

Your product: an alarm clock which spreads the scent of coffee when it's time to wake up

What's new?: making use of scent next to the usual use of sounds (so it is a combination of both)

- Through the combination of scent and sound, your whole body will be woken up in a comfortable way
- **Through the extra impulse of the smell of coffee, you will want to get out of bed more quickly because you are looking forward to your cup of coffee. Getting out of bed was never so easy.**
- Having the smell of coffee in your roam without leaving your bed, how awesome is that
- This alarm clock is only for highly innovative and design-loving customer whose are looking for the most fancy products to decorate their house with
- Such a product has never been created by any competitor

### Scenario 4: You are in the final stages of the product development process. However, you still need some feedback on it to improve it in such a way that it functions as it should. You have run out of ideas for improvement at this point, so you need to find a way to get useful feedback. How are you going to get the information you are looking for?

- Brainstorm with your team to see if anyone can come up with good ideas
- **You will pilot test your product with potential customers. This means that competition might already get notice of what you are doing, but you will get direct feedback from your own end users**
- You accept that it is not going to get any better, so you launch the
product in a suboptimal way

- You spy at the development office of the competition to see what they are working on
- You ask family and friends what they think you should do

Scenario 5: You have invited customers to discuss a just launched product that you and your team developed. Against all your expectations, they seem to have quite some complaints about how the product works and also that it does not fully fulfill the customer need they have. Taking your product of the market is not an option so what will you do in reaction to the feedback?

- You alter the whole product so that the customer is happy again
- **You alter the campaign by putting more effort in explaining how your product works and why it benefits the customer**
- Nothing. It is pretty clear to you that the customer just does not understand the greatness of the product you launched
- Nothing. For now, since it has been such a short moment after launch, you will wait. Maybe in time they will learn to appreciate your product more
- You will develop a second product that takes into account all wishes and you will take your current product of the market as soon as the new one is ready

Questionnaire 3

As a final measure point, student again had to evaluate New product development scenarios after digesting the information provided during the experimental rounds.

**NPD** Scenario 1: Imagine you are developing a product that should be produced in the color red, but within the production warehouse you find out that the color red is out of stock? Waiting for the right color would take at least 2 weeks, but you should deliver the product within 3 days. You do have the possibility to deliver the product in the colors blue, purple and green. What would you do?

- Develop the product in one of the other colors, since it will not affect the functionality of the product
- Wait for the red parts and delay the product with 1.5 week
• Inform the customer and ask him/her what he/she wants
• Ask your teammates what they would do, and than base your choice on the general opinion
• Find another supplier for the red color, although the costs of the product might become higher because of this.

Scenario 2: Your team is asked to come up with a set of new product ideas for a beer company that wants to bring a special product line on the market for females. You are appointed as the team leader and have to decide on what the first step in the product development process will be. What would you choose? (Lilien et al., 2006)

- Do a market analyses
- Start a brainstorm with your teammates
- You build a competition among your team members to come up with the best idea
- You interview the stakeholders in order to find out what they think will be most successful on the market
- You invite a group of lead users as representatives of the target market to identify problems and generate ideas

Scenario 3: Imagine you and your team working on a new product idea for months, when you find out that one of your main competitors is working on the same idea as well. Although both processes are in an equal stage, the chance is pretty high that your competitor will be able to launch the product a few weeks before your release date is planned. What would you do? (technori, http://technori.com/2013/07/4616-startup-not-first-to-market/)

- Stop the development and start with something new
- Wait until the competition launches the product, look into the details and then launch a better version of the product one month later
- Launch the product idea and advertise for when it will be in the stores
- Just finish the process as you had it in mind before you received the bad news of the competition
- Ask your stakeholders for advice on what to do

Scenario 4: Imagine you developed a new product of which you are
completely confident that it will be very successful in the market. However, when you demonstrate your product to the customer panel they do not seem to be to enthusiastic about it because they are used to the product they have (Gourville, 2006). What argument would you use to convince the customer?

- The new product has a lot of new technical features the old product does not have
- The new product serves the customer’s problem better than the old product
- The new product looks much nicer than the old product
- The new product is easier to use than the old product
- The customer should be more open to new things in the current fast developing ages we live in

Scenario 5: You have a new customer, who has requested you to develop a product for him. This customer is a very busy man and you are informed that you are not able to request a lot of his time. You are aloud to invite him to the office only once before you send the product to him. This means that you have to decide when you will consult the customer within your new product development process. When will you ask the customer for his input? (Kaulio 1998)

- In the middle of the process to see whether I am going in the right direction (design with the customer)
- At the end of the process to demonstrate the end result to the customer (design for the customer)
- In the beginning of the process to verify the customer’s problem and needs (design by the customer)
- After the customer has received the product in order to see whether he enjoys the product (design for the customer)
# Appendix 9 – Direct Feedback Game

One-way ANOVA with post hoc bonferroni multiple comparison

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<td>Std. Error</td>
<td>Sig.</td>
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<td>---------------</td>
<td>---------------</td>
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<tr>
<td>listen</td>
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<td>0.384</td>
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<td>0.345</td>
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<td>0.288</td>
<td>0.384</td>
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<td>-0.139</td>
<td>0.156</td>
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<td>0.173</td>
<td>0.345</td>
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<td>-0.048</td>
<td>0.288</td>
<td>0.384</td>
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<td>read</td>
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<td>-0.139</td>
<td>0.156</td>
<td>0.14</td>
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### Table 24 Appendix 9 - post hoc multiple comparison for quality

### 8.10 Appendix 10 - Behavioral Change output SPSS

**One-way ANOVA with post hoc bonferroni multiple comparison**

#### Descriptives

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<th>Behavior</th>
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<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>95% Confidence Interval for Mean</th>
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<td>Upper Bound</td>
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#### Multiple Comparisons

Dependent Variable: Behavior
Bonferroni

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<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>95% Confidence Interval</th>
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<tbody>
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<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
</tr>
<tr>
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<td>listen</td>
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<td>.31639</td>
<td>.018</td>
<td>-1.1165</td>
<td>1.6514</td>
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<tr>
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<td>.000</td>
<td>-1.8302</td>
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<tr>
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<td>game</td>
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<td>.31639</td>
<td>.018</td>
<td>-1.6514</td>
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<td>.000</td>
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<td>-.35302</td>
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<td>-1.3869</td>
<td>.30796</td>
<td>.028</td>
<td>-.3585</td>
<td>1.1358</td>
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* The mean difference is significant at the 0.05 level.
8.11 Appendix 11 - Awareness Output SPSS

Game – within → General linear model → Repeated measures with Bonferroni pairwise comparisons

Within-Subjects Factors

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<th>time</th>
<th>Dependent Variable</th>
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<td>Game_Before</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Game_Direct</td>
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<tr>
<td></td>
<td>3</td>
<td>Game_Post</td>
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</table>

Descriptive Statistics

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<th>Std. Deviation</th>
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<td>210</td>
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<tr>
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Table 27 Appendix 11 - Descriptive statistics game play

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<th>Value</th>
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<th>Error df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Nonsens. Parameter</th>
<th>Observed Power</th>
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<tbody>
<tr>
<td>Pillai’s Trace</td>
<td>.993</td>
<td>10.616b</td>
<td>2.000</td>
<td>208.000</td>
<td>.000</td>
<td>.093</td>
<td>21.231</td>
<td>.989</td>
</tr>
<tr>
<td>Wilks’ Lambda</td>
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<td>208.000</td>
<td>.000</td>
<td>.093</td>
<td>21.231</td>
<td>.989</td>
</tr>
<tr>
<td>Hotelling’s Trace</td>
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<td>10.616b</td>
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<td>208.000</td>
<td>.000</td>
<td>.093</td>
<td>21.231</td>
<td>.989</td>
</tr>
<tr>
<td>Roy’s Largest Root</td>
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<td>2.000</td>
<td>208.000</td>
<td>.000</td>
<td>.093</td>
<td>21.231</td>
<td>.989</td>
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</tbody>
</table>

Table 28 Appendix 11 - Wilks’ Lambda for significance within game

Pairwise Comparisons

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<th>(j) time</th>
<th>Mean Difference (i–j)</th>
<th>Std. Error</th>
<th>Sig. b</th>
<th>95% Confidence Interval for Difference b</th>
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<td>.253</td>
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<tr>
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<td>.045</td>
<td>.000</td>
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<td>1</td>
<td>.076</td>
<td>.044</td>
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<td>-.030, .182</td>
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<td>1</td>
<td>.210</td>
<td>.045</td>
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<td>2</td>
<td>.133</td>
<td>.047</td>
<td>.016</td>
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Based on estimated marginal means

a. The mean difference is significant at the
b. Adjustment for multiple comparisons: Bonferroni.

Table 29 Appendix 11 - Post hoc Bonferroni pairwise comparison for game play
Listening – within → General linear model → Repeated measures with Bonferroni pairwise comparisons

Within-Subjects Factors

Measure: MEASURE_1

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<tr>
<td>2</td>
<td>Listen_Direct</td>
</tr>
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<td>3</td>
<td>Listen_Post</td>
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Descriptive Statistics

<table>
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<th></th>
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<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Listen_Direct</td>
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Table 30 Appendix 11 - Descriptive statistics listening

Multivariate Tests

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<th>Hypotheses df</th>
<th>Error df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
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<td>.049</td>
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<td>.825</td>
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<tr>
<td>Hotelling's Trace</td>
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<td>10.400</td>
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</tr>
<tr>
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<td>.006</td>
<td>.049</td>
<td>10.400</td>
<td>.825</td>
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*a. Design: Intercept Within Subjects Design: time
  *b. Exact statistic
  *c. Computed using alpha =

Table 31 Appendix 11 - Wilks' Lambda for significance within listening

Pairwise Comparisons

<table>
<thead>
<tr>
<th>(I) time</th>
<th>(J) time</th>
<th>Mean Difference (I~J)</th>
<th>Std. Error</th>
<th>Sig. b</th>
<th>95% Confidence Interval for Difference</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
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<td>.095</td>
<td>-.237</td>
<td>-.237</td>
<td>.013</td>
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<tr>
<td>3</td>
<td>1</td>
<td>.156</td>
<td>.049</td>
<td>.005</td>
<td>.039</td>
<td>.039</td>
<td>.274</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>.112</td>
<td>.052</td>
<td>.095</td>
<td>-.013</td>
<td>-.013</td>
<td>.237</td>
</tr>
</tbody>
</table>

Based on estimated marginal means

a. The mean difference is significant at the
b. Adjustment for multiple comparisons: Bonferroni.
Reading – within General linear model Repeated measures with Bonferroni pairwise comparisons

Within-Subjects Factors

Measure: MEASURE_1

<table>
<thead>
<tr>
<th>time</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Read_Before</td>
</tr>
<tr>
<td>2</td>
<td>Read_Direct</td>
</tr>
<tr>
<td>3</td>
<td>Read_Post</td>
</tr>
</tbody>
</table>

Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read_Before</td>
<td>.50</td>
<td>.501</td>
<td>235</td>
</tr>
<tr>
<td>Read_Direct</td>
<td>.53</td>
<td>.500</td>
<td>235</td>
</tr>
<tr>
<td>Read_Post</td>
<td>.67</td>
<td>.472</td>
<td>235</td>
</tr>
</tbody>
</table>

Table 33 Appendix 11 - Descriptive statistics reading

Multivariate Tests

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis df</th>
<th>Error df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>time</td>
<td>.068</td>
<td>8.445*</td>
<td>2,000</td>
<td>233,000</td>
<td>.000</td>
<td>.068</td>
<td>16,889</td>
<td>.964</td>
</tr>
<tr>
<td>Wilks’ Lambda</td>
<td>.932</td>
<td>8.445*</td>
<td>2,000</td>
<td>233,000</td>
<td>.000</td>
<td>.068</td>
<td>16,889</td>
<td>.964</td>
</tr>
<tr>
<td>Hotelling’s Trace</td>
<td>.072</td>
<td>8.445*</td>
<td>2,000</td>
<td>233,000</td>
<td>.000</td>
<td>.068</td>
<td>16,889</td>
<td>.964</td>
</tr>
<tr>
<td>Roy’s Largest Root</td>
<td>.072</td>
<td>8.445*</td>
<td>2,000</td>
<td>233,000</td>
<td>.000</td>
<td>.068</td>
<td>16,889</td>
<td>.964</td>
</tr>
</tbody>
</table>

Table 34 Appendix 11 - Wilks’ Lambda for significance within reading

Pairwise Comparisons

<table>
<thead>
<tr>
<th>(i) time</th>
<th>(j) time</th>
<th>Mean Difference (i-j)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval for Difference</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-0.30</td>
<td>.046</td>
<td>1.000</td>
<td>-1.41 to -.081</td>
<td>-1.273</td>
<td>-.059</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>-0.36</td>
<td>.043</td>
<td>0.053</td>
<td>-.293 to -.034</td>
<td>-.293</td>
<td>-0.034</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>.166*</td>
<td>.044</td>
<td>.001</td>
<td>.059 to .273</td>
<td>.034</td>
<td>.239</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>.136*</td>
<td>.043</td>
<td>.005</td>
<td>.034 to .239</td>
<td>.034</td>
<td>.239</td>
</tr>
</tbody>
</table>

Based on estimated marginal means

a. The mean difference is significant at the

b. Adjustment for multiple comparisons: Bonferroni.

Table 35 Appendix 11 - Post hoc Bonferroni pairwise comparison for reading
Comparison average growth over time between groups → One-way ANOVA with Post Hoc Bonferroni

Descriptives

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>42</td>
<td>20,950</td>
<td>.00000</td>
<td>.00000</td>
<td>20.9500</td>
<td>20.9500</td>
<td>20.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listen</td>
<td>41</td>
<td>15,610</td>
<td>.00000</td>
<td>.00000</td>
<td>15.6100</td>
<td>15.6100</td>
<td>15.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>47</td>
<td>16,900</td>
<td>.00000</td>
<td>.00000</td>
<td>16.9000</td>
<td>16.9000</td>
<td>16.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
<td>17,6932</td>
<td>2.29523</td>
<td>2.0130</td>
<td>17.2949</td>
<td>18.0914</td>
<td>15.61</td>
<td>20.95</td>
<td></td>
</tr>
</tbody>
</table>

Table 36 Appendix 11 - Descriptive statistics average growth per group

Multiple Comparisons

Dependent Variable: Growth_average
Bonferroni

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>Mean Difference (I–J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game</td>
<td>Listen</td>
<td>5.34000 *</td>
<td>.00000</td>
<td>.000</td>
<td>5.3400</td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>4.35000 *</td>
<td>.00000</td>
<td>.000</td>
<td>4.3500</td>
</tr>
<tr>
<td>Listen</td>
<td>Game</td>
<td>-5.34000 *</td>
<td>.00000</td>
<td>.000</td>
<td>-5.3400</td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>-9.90000 *</td>
<td>.00000</td>
<td>.000</td>
<td>-9.9000</td>
</tr>
<tr>
<td>Read</td>
<td>Game</td>
<td>-4.35000 *</td>
<td>.00000</td>
<td>.000</td>
<td>-4.3500</td>
</tr>
<tr>
<td></td>
<td>Listen</td>
<td>9.90000 *</td>
<td>.00000</td>
<td>.000</td>
<td>.9900</td>
</tr>
</tbody>
</table>

*. The mean difference is significant at the 0.05 level.

Table 37 Appendix 11 - Post hoc Bonferroni pairwise comparison for effectiveness