Gamification in Energy Production

Application of engaging and motivating game thinking in an optimization tool for production of district heating

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Abstract

While digitalization is changing the way we work and live, new methods and strategies are needed for motivating future generations at work. An approach to this is gamification, described as the use of game mechanics and elements for creating motivation and engagement in non-game contexts. In this thesis, theory on gamification is studied along with connecting areas of games, user-centred design and motivation. The theory is used for conducting a case study with a user-centred approach, applied in a design process. The case study investigates the use of an optimization tool for production of district heating, developed by the thesis initiator Sigholm, and used by operating technicians in the control room at power plants. The use and use context of the product is studied where user needs, goals and motivations are addressed and used as design problems to investigate. By applying the theories studied, ideas are generated, visualised, tested and evaluated in a prototype. The results of the case study show that including gamification in a user-centred design process helps in focusing on the user motivations and acts as an inspiration in finding engaging design solutions. Applying gamification in the case study showed that the game mechanics and elements themselves were not appealing to the whole user group, but that solutions directly connected to the user needs and use context were more appreciated. The thesis addresses a wide scope of integrated fields where several areas of further studies are identified.
Acknowledgements

This thesis work has been the last step in completing my five-year education in Design and Product Development at Linköping University. The thesis has given me the opportunity to explore an area that is new to me by using my experience and knowledge in the design area and reaching beyond it. Never have I been so engaged in something, and so eager to learn more about a subject. Writing this thesis has been a challenge, and I would never have made it entirely on my own. Therefore, I would like to thank the people that have supported me, and a special thanks to following people who have had a significant impact on my work:

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To my supervisor at LiU, Mathias, who took the challenge to supervise a student from a different area and who has been a great inspiration and support when I mostly needed it. My examiner Mattias, who took the time to examine my work and give feedback and support. And last but certainly not least, my opponent Anna, who has taken the time to critically judge the work in detail and given great feedback and advise during the work.

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Malin Rosengren
Västerås, May 2016
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1. Introduction

With new generations constantly entering the labour-market, and the digitalization changing the way we work, we need new ways to create variation, motivation and engagement in work tasks. The generation born in the 80s and 90s, also called millennials or digital natives (Howe & Strauss, 2000; Prensky, 2001), have grown up surrounded by digital interfaces and interactive entertainment. Prensky (2001) claims that the average millennial has already spent 10 000 hours on video- and computer games before turning 21. To create motivation and engagement for the millennials at work may require new ways of presenting and organizing the work tasks.

At the same time, we cannot forget about the generations that still have many years left in the workforce. For them the digitalization have instead resulted in more and more digital tools being introduced, changing the way of work that they are used to. This may instead cause difficulties to adapt to new digital tools being introduced and implemented into organizations and the every-day labour (Giang, 2013).

When developing a tool to support individuals in their daily work, both the aspects above could be important to consider. For the tool to be accepted, both by the new millennials and the senior experts at the workplace, it cannot just be another complicated, boring tool to learn. It should bring something more to the users, like personal value and a greater meaning, that creates engagement and motivation in work tasks.

An approach to this that has grown in the last decade, and which the thesis will study, is gamification. In brief, gamification aims to create engagement through applying game thinking and game elements in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011). There is still a lack of academic research about gamification, so there are various definitions and frameworks, but few best practices and studied outcomes (Seaborn & Fels, 2014).

1.1. Background

Sigholm is a company focusing on supporting other companies in the energy industry in business management, project management and optimization. They are currently developing a new web based optimization tool that aims to support operating technicians at power plants in their work of planning and streamlining production of district heating. The tool is already in use at six plants in Sweden, but is still under development at Sigholm in parallel with the thesis work.

Sigholm has the intention of making the operating technicians more aware of how the production planning affects the costs for the company and the environmental sustainability. Their belief is that higher awareness leads to more meaning and engagement in the work. For creating this awareness, and a desire to use the tool, their aim is to design it with high usability and focus on the user experience. And this is where this thesis arose, to study if gamification can be used in the design of a motivating, engaging and awareness-building optimization tool.
1.1.1. The Optimization Tool
The product studied in the thesis is an optimization tool for production of district heating. The tool is used by operating technicians in the control room of power plants for helping in planning how the energy can be produced in the most economically optimal way. The tool content is based on models and prognostic calculations, performed in the back-end of the tool. Each user has an individual account, but all accounts see the same content. Changes made by one user are immediately reflected in the view of the other users. The tool generates plans for how the energy can be optimally produced. The plan can be modified by changing the settings in the tool to reflect the real-world conditions. Once a week, the production outcome is calculated and visualized in a graph for comparing to another graph for the optimal outcome.

1.2. Objective & Scope
The aim of the thesis is to investigate if and how gamification can be used to create a more engaging and motivating interaction with an existing software optimization tool for operating technicians at power plants. This aims to be done by conducting a case study, generating a process of working with gamification with a user-centred approach, and develop a concept of a gamified solution for the case, presented in a prototype. An intention of the work is also to contribute to the gamification research by providing a case study in which a work process of working with gamification in a design process is used.

1.2.1. Delimitations
The development process of a gamified solution will end at the prototyping stage to be handed over to the development team at Sigholm. No programming solutions will be investigated. User tests will be performed, but will only include first impression validation of the prototype. Long term validation tests will not be included in the work. Since the thesis aims at conducting a case study, only theories that impact the emerging process of working with gamification and results of the case study are included.

1.3. Research questions
The research questions cover how gamification can be used in the case study by including it in a design process with a user-centred approach.

RQ1: How can gamification theory be used in practice by including it in a design process?

RQ2: How can gamification be applied with a user-centred approach in the development of an existing optimization tool for production of district heating?

RQ3: How can a prototype be used to visualize and test gamification concepts in the development of an existing optimization tool for production of district heating?
1.4. Report Structure
The report presents the work in a structure that helps the reader to follow the work process.

1. Introduction
   The first chapter introduces the topic of the thesis, as well as the case and research questions that are studied.

2. Theoretical Framework
   A literature study is presented, focusing on the area of gamification, and parts of game theory, user experience design and motivation theory.

3. Methodology
   Methods and tools used in the case study are described.

4. Case Study: Work Process & Results
   The work process and results of the case study are presented, starting with a user and context study and resulting in a high-fidelity prototype that is tested and evaluated.

5. Discussion
   The approach and the outcome of the case study are discussed and connected to the theory and methods used.

6. Conclusions
   Conclusions are presented as answers to the research questions.

7. Areas of Further Studies
   Areas of further studies are summarized.
Gamification in Energy Production
2. Theoretical Framework

For approaching the research questions, a theoretical framework for the thesis is created. Since the main theme of the thesis is to study the use of gamification, the theory in that area is used as a foundation for the framework. Three key areas emerge from the gamification theory, that have impact on how gamification can be used in the case study. The three areas that are lifted and compared with gamification are the areas of games, user-centred design and motivation.

2.1. Gamification

“Since games have spent decades learning how to master motivation and engagement, we are now learning from games, and that is why we call it Gamification. Games have the amazing ability to keep people engaged for a long time, build relationships and trust between people, and develop their creative potentials.” - Chou (2017, What is Gamification)

To start working with gamification, literature in the area is studied to create understanding of what it is, where it comes from, and how to use it in a design process. Since the purpose of the theoretical framework is to support the process of working with gamification in practice, theories are compared and guidelines are created that can help the case study process.

2.1.1. Definition

Using games as inspiration in software development has been a rising trend, emerging from research both in human-computer interaction and game design (Deterding et al., 2011). There are various concepts for using game design and game inspiration for creating engaging and meaningful interactions, like alternate reality games, serious games and playful design (Seaborn & Fels, 2014). Gamification has been a rising trend to be added to the list, but there are few clear definitions of what gamification is and how it differs from the above-mentioned concepts (Deterding et al., 2011; Seaborn & Fels, 2015).

Research by Deterding et al. (2011) studies the heritage of gamification and concludes its definition simply to be “the use of game design elements in non-game contexts”. This definition has its foundation in using game design elements to create gamefulness, where gameful design has the design goal of creating a gameful experience and gamification has the design strategy of using game design elements (ibid.). The authors define gamefulness as the experiential and behavioural qualities of playing, while gameful design is defined as the art of designing for gamefulness, for example by using game design elements. So, the outcome of both gameful design and gamification could be the same, but the approach differs. While gameful design focuses on reaching gamefulness, gamification focuses specifically on how to use game design elements to reach gamefulness.

The use of gamification as a tool for creating gamefulness has been criticized by game developers for “cheapening” their work (Burke, 2014), and making it look easy to add simple, repeatable elements as points and levels to create engagement and maximizing business profit (Bogost, 2011). However, when Chou (2015) explains the origin and purpose of
Gamification he means that it is rather the inspiration of human-focused design and motivation in games that is the foundation. Having spent years of studying gamification and behavioural design, the author focuses on the human core drives found in games that motivate the player towards certain activities.

This is also seen in the work of Seaborn & Fels (2014) who have gathered research in gamification to see its connection to human-computer interaction studies involving users. Their conclusion is that gamification is still a concept under development, where the approach is to “encourage user motivation, engagement and enjoyment in non-gaming computer-mediated environments”. The authors believe that a gamification framework based on psychology theory on self-determination and motivation is emerging, but where there is still a lack of studies with human participants and long-term effects.

Gartner, the world leading company in research on information technology, has its own definition of gamification as “the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals” (Burke, 2014). Both this definition and the approach of Seaborn & Fels (2014) delimit gamification to be computer-mediated and digital. Deterding et al. (2011) believe it should not be limited to digital technology, since games are not, but that gamification in digital systems creates a base of user data, derived from the interactions, which will profit future research and work in the area.

In summary, there is still no definite definition of what gamification is. The early definition by Deterding et al. (2011) concludes gamification to be the application of game elements in non-game contexts, while later theories put more emphasis on the behavioural aspects of games and what motivates the players to reach their goals. For this thesis, the noteworthy information is that while academics still have not reached a final definition, even less attention has been focused on how gamification can be used in practice. Therefore, the rest of the gamification theory chapter will focus on the existing practical methods and guidelines that can help working with gamification in a design process.

2.1.2. Gamification Process

The definition chapter highlighted that working with gamification is not as simple as just adding points and leaderboards to a system. The work should aim at understanding the user needs and motivations to be able to design an experience that helps fulfil the user goals (Burke, 2014). For this thesis, that means including gamification in a user-centred design process. Burke (2014) suggests adapting the process of design thinking to achieve the user-centred approach when creating a gamified experience. Design thinking is a human-centred, solution-based methodology of solving problems by iterating user input, design ideas, prototypes and user testing (Dam & Siang, 2017c).

Burke (2014) and Kumar & Herger (2013) present similar processes inspired by design thinking and user-centred design to approach working with gamification. The processes are shown in Table 1.
2.1.3. User Types and Player Types

Focusing on the users and what motivates them has so far been emphasized as the most important part of gamification. Marczewski (2015) has developed a framework for user types, based on behaviour and motivation theory, that can help designers in creating a gamified solution. The framework creates an understanding of different drivers and motivations, and
helps to create a system that can handle and satisfy as many users as possible. The user types and their main motivator are listed below.

<table>
<thead>
<tr>
<th>User Type</th>
<th>Main Motivator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socializer</td>
<td>Relatedness</td>
</tr>
<tr>
<td>Philanthropist</td>
<td>Purpose</td>
</tr>
<tr>
<td>Free Spirit</td>
<td>Autonomy</td>
</tr>
<tr>
<td>Achiever</td>
<td>Mastery</td>
</tr>
<tr>
<td>Player</td>
<td>Reward</td>
</tr>
<tr>
<td>Disruptor</td>
<td>Change</td>
</tr>
</tbody>
</table>

A well-known player type framework in game design are the Bartle player types. Bartle (1996) describes his player types to be created from analysing player behaviour and interests in social multi-player games, where he finds four main types: socializers, achievers, explorers and killers. These player types are often mentioned in literature on gamification, and are a good background for understanding player behaviour when learning about gamification. But, as Marczewski (2015) mentions, because the player types are built upon studies of players in game contexts they can help game designers create multi-player games, but may not be as applicable when creating a gamified system.

A key point that both Bartle and Marczewski make in their respective work is to note that no person or user group consists of one user- or player type alone. The types are created as stereotypical explanations of behaviour and motivation, and a well-designed experience should include all aspects that encourage the behaviour that favours the desired outcome (Marczewski, 2015).

### 2.1.4. Player Journey

When designing a gamified experience one aspect to consider is the journey that the user makes through the system (Burke, 2014). The confidence and level of skill that the user possesses at the beginning will not match the one that the user has after a certain time and experience in the interface. Creating an engaging experience requires insight and understanding for all the stages that the user will go through, and to always keep the user engaged offering new challenges for the current skill level (Kim, 2012). Chou (2014) approaches the gamification player journey through the following four steps:

1. **Discovery** is the phase before the user enters the system. Gamifying this part is mainly focusing on marketing and how the user will experience the first contact with the product.

2. **Onboarding** is where the user is new to the system. Here the user is trained to get to know the rules, options, mechanics and win-states of the system. In a simple way guiding the user through the first steps of using the system, engaging and convincing them to stay on board. Game designer Amy Jo Kim (2014) describes the onboarding as a learning process where expectations are set for what the game or system will offer.
3. **Scaffolding** is the regular activity and on-going process of using the system where the user will get better and better. Here it will really show if the system is designed to engage all types of players or if some will lose interest. In the process of working with gamification, mentioned in chapter 2.1.2, Burke (2014) suggests planning the journey by creating engagement loops of actions and feedback while maintaining a balance of challenge and skill. And Kumar & Herger (2013) highlight managing, monitoring and measuring the effectiveness of the system by collecting and analysing data to maintain the player motivation.

4. **End-Game** is where the user feels that there is no more to discover or learn. For this phase, it is important to make the user feel the value to stay. Depending on player type, this can be achieved either by creating social status of being a veteran in the system, or by giving the user opportunity to be creative with the tools and skills learned. If there is a finite end to the journey Marczewski (2015) suggests the end game should create a feeling of satisfaction for the user, feeling it was worth the effort.

Since a dynamic system is studied in the case study of the thesis, it is relevant to consider the steps of the player journey. Depending on which part of the journey the case study work focuses on, different approaches are appropriate.

### 2.1.5. Elements and Mechanics

When choosing game elements and mechanics for the gamified system there are many alternatives to choose from, but it is not as easy as just picking and applying. The elements need to be carefully chosen to fulfil the needs and motivations of the intended users and business goals (Burke, 2014). Werbach & Hunter (2015) have created a toolkit for gamification consisting of three base elements; Dynamics, Mechanics and Components, seen in Table 2.

**Table 2. Gamification toolkit adapted from Werbach & Hunter (2015)**

<table>
<thead>
<tr>
<th>Dynamics</th>
<th>Mechanics</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints</td>
<td>Challenges</td>
<td>Achievements</td>
</tr>
<tr>
<td>Emotions</td>
<td>Chance</td>
<td>Avatars</td>
</tr>
<tr>
<td>Narratives</td>
<td>Cooperation</td>
<td>Badges</td>
</tr>
<tr>
<td>Progression</td>
<td>Competition</td>
<td>Bossfights</td>
</tr>
<tr>
<td>Relations</td>
<td>Feedback</td>
<td>Collections</td>
</tr>
<tr>
<td></td>
<td>Resource Acquisition</td>
<td>Combat</td>
</tr>
<tr>
<td></td>
<td>Rewards</td>
<td>Content Unlock</td>
</tr>
<tr>
<td></td>
<td>Turns</td>
<td>Gifting</td>
</tr>
<tr>
<td></td>
<td>Transactions</td>
<td>Leaderboards</td>
</tr>
<tr>
<td></td>
<td>Win State</td>
<td>Levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Points</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quests</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Graph</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Virtual Goods</td>
</tr>
</tbody>
</table>
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The authors suggest starting with the Dynamics, and analyse how they can be used to motivate the users, before applying Mechanics and Components. Werbach & Hunter (2015) describe each element as:

**Dynamics**
are the foundation that make up how the gamified system is built.

**Mechanics**
are manifestations of the Dynamics that generate engagement and drive the actions forward.

**Components**
are the manifestations of Mechanics that work as tactics to achieve the goals of the higher elements.

The toolkit that Werbach & Hunter (2015) offers can be compared to the process of working with gamification in chapter 2.1.2. There, Burke (2014) suggests starting by defining the user and business goals, which make up the foundation for the work, and which here take the form of the Dynamics. While the gamification process inspired by design thinking has a rather exploring character, the Dynamics Mechanics & Components framework is more explicit, starting with the tools and combining them to a suiting solution that works in a specific case. Referring to the gamification definitions in chapter 2.1.1., this toolkit fits into the definition of Deterding et al. (2011) that gamification is the use of game design elements in non-game contexts.

In their work, Deterding et al. (2011) further suggest there are five levels of abstractions when designing with game elements and mechanics, presented in Table 3, where the lowest level only scratches the surface of the system interface and the highest level include deeper understanding and consideration of the players.

<table>
<thead>
<tr>
<th>Level of Abstraction</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Game design methodology</td>
<td>Player focus and value creation</td>
</tr>
<tr>
<td>Above medium</td>
<td>Game models for components and game experience</td>
<td>Challenges, fantasy, curiosity</td>
</tr>
<tr>
<td>Medium</td>
<td>Game design principles and heuristics</td>
<td>Clear goals, variety in game styles</td>
</tr>
<tr>
<td>Below medium</td>
<td>Game design patterns and mechanics</td>
<td>Limited resources, time constraints</td>
</tr>
<tr>
<td>Low</td>
<td>Game interface design patterns</td>
<td>Badges, levels, leaderboards</td>
</tr>
</tbody>
</table>

By comparing the levels above with the toolkit by Werbach & Hunter (2015), the toolkit would by itself end up at a medium-level. But by adding a user-centred approach, like the design thinking inspired gamification process, the highest level of abstraction can be reached.
2.1.6. Summary of Findings

A summary of the findings in the area of gamification is made to determine further areas that affect the case study:

- Literature showed a gap between gamification theory and practice, where there is a need for connecting theory to work with human participants.

- The user should be the centre of attention in gamification where understanding the user goals and motivations are vital parts of creating an engaging gamified experience.

- Creating meaningful gamification requires understanding of why humans play games and how the core drives found in games can be used in other contexts.

- Using gamification in a human-centred, design thinking inspired design process is suggested which can help reaching higher levels of game element abstraction.

2.2. Games

“In culture we find play as a given magnitude existing before culture itself existed, accompanying it and pervading it from the earliest beginnings right up to the phase of civilization we are now living in. We find play present everywhere as a well-defined quality of action which is different from “ordinary” life. We can disregard the question of how far science has succeeded in reducing this quality to quantitative factors. In our opinion it has not.”

- Huizinga (1949, p. 4)

For working with gamification, this thesis needs a brief chapter on games, highlighting aspects of the meaning of games in human life and society. Games and play have always been an important part of human life, which Huizinga (1949) writes about in his book Homo Ludens. The author reflects upon the importance and meaning of play in life, for its freedom, imagination and social function, and believes it to be a phenomenon of nature and culture.

Even though Huizingas theories and thoughts are of a philosophical character, he finds a point in reflecting on that many activities are serious and strict and that humans by nature are in need of play and the freedom of playing in life. This may be one reason why games today have become an important part of life and society. The work of Lazzaro (2004) shows that people play games to escape the thoughts of school, work or the social norms of the real world and to enjoy the challenge and complete absorption that games offer.

2.2.1. Defining a Game

There are many definitions of what a game is. Salen & Zimmerman (2003) summarize multiple definitions and end up with the definition that “a game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome”. The authors explain artificial conflict as an individual or multiplayer interaction with a system outside the
boundaries of real-life time and space. Rules are described as an important part of a game which create the structure and organization, while the quantifiable outcome is whether the player wins, loses or gets a score at the end.

Prensky (2001) describes games as a form of fun and play that give us the feelings of enjoyment, pleasure and passionate involvement. He further structures games to be made up of six elements: rules, goals & objectives, outcomes & feedback, conflict/competition/challenge/opposition, interaction and representative/story. This is similar to the definition of Salen & Zimmerman (2003), and both attempts of defining games will help the thesis work in studying and analysing how game-like experiences can be used in the case study.

2.2.2. Digital Games

One reason mentioned why gamification builds on using inspiration from games to create engaging user experiences is that games, and especially today's digital games are great at just that (Chou, 2017). They are great at capturing the player in an engaging experience away from what is conceived as the serious real-life of work and responsibilities (Lazzaro, 2004).

As soon as technology allowed it, games became an important part of driving the digitalization (Linderoth, 2007), now digital games and entertainment are everywhere. Williamson (2009) claims in his research that generations growing up with digital games spend so much time playing that they create skills like multitasking and problem solving from the games. Games have the ability to teach in a way that the school system lacks, so involving games in future ways of teaching is important to adapt to modern ways of learning and working (ibid). A central argument of why to use games in teaching contexts are its potential to increase the motivation to learn because of the entertainment it brings (Linderoth, 2004).

Linderoth (2004) states that games and play have always been used to learn new things, because the positive effects we get out of playing games have fundamental impact on our cognitive development. But in a later article Linderoth (2012) explains the illusion of learning that many games give, where the progression and learning is only of value in the game context. He emphasizes that how the game is designed determines if the experienced progression and learning is real or just built into the game system. Also, Prensky (2001) describes how digital games are able to enhance the play experience by taking care of the “less fun” parts like rules and administrations around a game, supplying the player with only all the engaging interactions and possibilities of the game.

The work of Lazzaro (2004) concludes that there are four keys that unlock emotions in digital games: hard fun, easy fun, altered states and the people factor. She explains hard fun as challenges, strategies and problem solving, leading to both frustration and personal triumph. Easy fun is described as creating intrigue and curiosity, generating feelings of wonder, awe and mystery. Altered stages contain experiences of visceral, behaviour, cognitive, and social properties that awakes excitement and involves the player’s complete attention. The people factor is explained as social experiences obtained from competition, teamwork, social bonding and personal recognition. In the social aspect, Lazzaro (2004) also discovered that a group of players generated more intense emotions than an individual player.
2.3. User-Centred Design and User Experience

“The mark of the great designer is the ability to provide what people need without excessive complexity, without feature bloat. Make things understandable and they are perceived as being simple. It is the job of the designer to manage complexity with skill and grace, to ensure that complex things are understandable, usable, and enjoyable.” - Don Norman (Complexity is Good)

This work is initiated with a belief that a user-centred approach is important when working with gamification, which has now also been highlighted in the theory of gamification. No theories studied in gamification have contradicted this approach. Therefore, a high emphasis is put on the theory, methodology and guidelines of user-centred design and user experience design to create a good foundation for gamification in a usable and enjoyable interface. This chapter covers theory and guidelines on how to design for usability and user satisfaction, while practical methods are presented later, in the methodology chapter.

2.3.1. Defining UCD and UX

User-centred design (UCD) is described by Norman (1988) as the philosophy of focusing on user interests and needs to create usable and understandable products. Products should make it easy for the user to figure out what to do, and create understanding for what is going on. Norman later introduced User Experience Design (UX) which he explains is all about putting the user in the centre of attention focusing on designing the interaction experience between the end-user and the company, its products and services (Norman & Nielsen, 2016). UX includes all aspects creating the total impression that the user receives throughout the whole journey in interaction with a service or product, including industrial design, graphic design, interfaces, interaction and instructions (ibid).

2.3.2. Designing for Usability

The case study of the thesis work involves a digital product that is used daily by its users, as part of a work process. To work towards usable solutions, the usability of the interface is considered when designing for gamification. For user interface design, various authors have created guidelines for designing simple, usable and engaging interfaces. Two well-known lists of guidelines are summarized in Table 4.
Gamification in Energy Production

Table 4. Usability guidelines for interface design

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strive for consistency</td>
<td>1. Consistency and standards</td>
</tr>
<tr>
<td>2. Cater to universal usability</td>
<td>2. Flexibility and efficiency of use</td>
</tr>
<tr>
<td>3. Offer informative feedback</td>
<td>3. Visibility of system status</td>
</tr>
<tr>
<td>4. Design dialogs to yield closure</td>
<td>4. Match between system and the real world</td>
</tr>
<tr>
<td>5. Prevent errors</td>
<td>5. Error prevention</td>
</tr>
<tr>
<td>6. Permit easy reversal of actions</td>
<td>6. Help users recognize, diagnose, and recover from errors</td>
</tr>
<tr>
<td>7. Support internal locos of control</td>
<td>7. User control and freedom</td>
</tr>
<tr>
<td></td>
<td>9. Aesthetic and minimalist design</td>
</tr>
<tr>
<td></td>
<td>10. Help and documentation</td>
</tr>
</tbody>
</table>

2.3.1. Designing for User Experience

As Norman & Nielsen (2016) described, the field of user experience design covers a broad spectrum of aspects to consider when designing for the whole user impression, which reaches beyond the user interface. But for illustrating how to think about UX in digital interfaces, Morville (2004) presents seven facets of the user experience that are described below. The facets are created for evaluating and prioritizing when designing, and to go beyond thinking of usability as the only parameter in interface design.

**Useful:** Designing products and systems that are useful to someone.

**Usable:** Designing interfaces considering usability.

**Desirable:** Consider the value of emotional design such as image, identity and brand.

**Findable:** The ease for users to navigate and locating what they are looking for.

**Accessible:** Be ethical and accessible to people with disabilities.

**Credible:** Design products and systems that users trust.

**Valuable:** Create value, like user experience and customer satisfaction

Another set of guidelines to consider when designing for user experience can be derived from the Kano Model, showed in Figure 1. The Kano Model is described by Moorman (2012) as a way of measuring delight in the use of a product by analysing user reactions to different features. Moorman (2012) describes five characteristics of features that a product can have, and how they affect the entire use satisfaction:

**Attractive:** Are features that trigger delight when present, but do not disappoint when not. They are important for the positive total impression of the product. Over time, the attractive features turn into must-have features.

**One-dimensional:** Covers features that gives more satisfaction the more present they are, but disappoints when not present.
Theoretical Framework

**Must-have:**
Are features that users expect the product to have, and which trigger dissatisfaction if not present.

**Unimportant:**
Are features that do not matter to the user if they are present or not.

**Undesired:**
Are features that cause dissatisfaction if present and can decrease the positive effect of the attractive and one-dimensional features.

![Figure 1. The Kano Model adapted from Moorman (2012)](image)

Critical for this thesis is to note that the presence or absence of a single feature can affect the entire user satisfaction of a product.
2.4. Motivation and Engagement

“We know – if we’ve spent time with young children or remember ourselves at our best – that we’re not destined to be passive and compliant. We’re designed to be active and engaged. And we know that the richest experiences in our lives aren’t when we’re clamoring for validation from others, but when we’re listening to our own voice – doing something that matters, doing it well, and doing it in the service of a cause larger than ourselves” – Pink (2009, p. 134)

The theory so far has shown that a significant part of creating a gamified experience is understanding human motivation and engagement. What Pink (2009) describes in the citation above frames the core of intrinsic motivation, self-actualization and flow, which are described in this chapter as a background for creating motivating and engaging experiences.

2.4.1. Flow

A theory often mentioned in game design, gamification and user experience design is the concept of flow, first described by Csikszentmihalyi (1990). He describes flow as the optimal experience: “The state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it”. He finds that in flow goals are clear and we feel in control of our actions, which generates feelings of enjoyment and mastery.

Csikszentmihalyi (1990) discovers that the experience of flow is often reached when people perform activities that can be classified as work. Regardless if it is a farmer milking the cows or a surgeon performing a difficult operation – flow is found when someone is committed to, and feels enjoyment for, what he or she is doing. Already in his earlier work when he was grasping the surface of what he later defined as flow, Csikszentmihalyi (1971) argues that what we do for a living and what we do for enjoyment should not be two separate things. By identifying what puts us in the experience of play and enjoyment, we can have more control over activities and the balance between worry, boredom and play. And in his book on flow Csikszentmihalyi (1990) presents a strategy for doing so: by creating more opportunities in work to find flow and helping people reach flow by teaching them to identify actions, set reachable goals and enhance their skills.

2.4.2. Extrinsic and Intrinsic Motivation

Being motivated is described by Deci & Ryan (2000) as being moved to act towards an end. Their work shows that motivation from person to person varies both in level/amount and orientation, like attitudes and goals, but that a basic distinction can be made by dividing it into extrinsic and intrinsic motivations.

Deci & Ryan (2000) define intrinsic motivation as: “the doing of an activity for its inherent satisfactions rather than for some separable consequence”. They state intrinsic motivation exists within individuals and in the relation between individuals and activities, and approach that this kind of motivation is driven by the needs of competence, autonomy and relatedness.
Self-determination is fundamental in intrinsic motivation, because it circles around competence and autonomy – two of the needs for creating intrinsic motivation (ibid.). Self-determination is described by Deci et al. (1989) as feeling freedom and control in initiating and managing actions, which positively affects emotional appearance, creativity, self-esteem and conceptual learning. The authors find factors that enhance someone’s self-determination are to give more freedom of choice, offer noncontrolling feedback and to show appreciation and acceptance to the other’s thoughts.

While intrinsic motivation and self-determination comes from within us, extrinsic motivation is created by outer forces, like activities performed that are “instrumental to some separable consequence” (Deci & Ryan, 2000). Pink (2009) writes about “if-then motivators” (if you do this – you get that). He presents studies which show that trying to reward high-performance activities with tangible if-then rewards can have negative effect on intrinsic motivation, creativity and performance. Rewarding simple routine tasks in the same way can help for increased motivation, but should still focus on giving the performer an understanding of the underlying importance of the task and encourage autonomy in performing it (ibid.).

2.4.3. Points as Encouragement
An encouraging element that is often seen in games and gamified solutions is to have points of some kind. Marczewski (2015) describes the use of points in gamification as a motivation to complete less enjoyable tasks, but also for a digital system to keep track of progress and data which can be used both back-end and front-end in the system. In a similar way, points or percentages are used in the school system. A study from University of Waterloo (2017) claims that being able to see the own progress and distance to the goal/milestones, makes the student feel more in control. Linking this back to the theory on intrinsic and extrinsic motivation, studies showed that rewards can have negative effect on creativity and performance (Pink, 2009), so do points and percentages have the same effect? The University of Waterloo study (2017) further suggests that designing with points or percentages needs to include margins and optionality. This means that the student or user does not have to perform everything to collect all the points or percentages, but be able to choose what level/grade to strive for (ibid.).

The work of Farzan et al. (2008) shows that a reward system consisting of points, levels and leaderboards in a social interface create a short period of engagement. The test-users were motivated to reach a certain level or gather a certain amount of points, primarily driven by a social factor of not being less competent than friends and colleagues (ibid.). The study also showed that with the short period of engagement, which caused the users to generate content in the interface, a behaviour was boosted which created greater value for the users. In time this behaviour lead to the users caring less about rewards and more about the content they created.
3. Methodology

The chapter summarizes theory of methods and tools used in the case study. Gamification literature in chapter 2.1 initiated a process and strategy for approaching working with gamification in practice, as part of a design process. A process is presented along with theory on methods and tools from user-centred design and user experience design. The methods are presented in the order they are applied in the study, but how they are applied is described in chapter 4.

3.1. The Design Process

Design is learning about what a problem really consists of and which possibilities and limitations there are, as well as what solutions are desired (Arvola, 2014). Sanders & Stappers (2008) describe the design process as a fuzzy way of uncertainty and failures until the end when it clears. Both Shneiderman & Plaisant (2010) and Stolterman & Löwgren (2007) emphasize the complexity of the design process and uniqueness of various design situations, which makes it hard to define a process that is generic. Despite this, designers need methodology and theory to help plan their specific design processes (Stolterman & Löwgren, 2007), and for this, a variety of models have been constructed.

In the field of user-centred design, there must be room for tests and changes of the design for reaching high usability, therefore an iterative approach is necessary (Benyon, 2010). In the theory of gamification, a process is described that is inspired by design thinking (Burke, 2014). The Stanford Design School (2010) and The Interaction Design Foundation (2017c) describe the design thinking design process as a five-step model with iterations between the steps, shown in Figure 2.

![Figure 2 The design thinking process adapted from Dam & Siang (2017c)](image)

The first phase, empathise, aims at creating understanding for the humans in the context of the design project to be able to build the design solution on what is important for them (d.school, 2010). Empathising can be performed by combining observing, asking questions and listening to the people involved (ibid.). The authors describe that the define stage aims at bringing clarity to the discoveries made when empathising, which can be made by defining who the user is, what their needs are and what insights are gained. The insights are transformed to problem statements that are brought to the ideate phase, where ideas of solutions are generated by for example brainstorming and sketching (ibid.). After considering
the ideas and making a selection, Stanford Design University (2010) suggest multiple ideas are taken into prototyping for iterating simple prototypes that get more detailed after testing with users and colleagues. When prototyping and testing, the authors suggest creating an experience for the user and letting them interpret it rather than explaining the solution and letting the user evaluate it. The arrows in Figure 2 describe that iterations are made between the phases of the process, where new information and feedback in each step may lead to new understanding, insights and ideas (Dam & Siang, 2017c).

3.2. Qualitative User Research
As described in the design thinking process, the users are the main focus, and the design process starts at understanding who is going to be affected by the design solution (d.school, 2010). Also Hackos & Redish (1998) argue that involving the intended users early in the design process is of high importance both for studying what needs and desires an intended product or system should fill, or how an existing product is perceived by the users. A poorly designed tool can generate massive costs for a company because of usability problems that require customer support and maintenance after the initial price has been paid (ibid.).

3.2.1. Site visits
In the pre-design stage, Hackos & Redish (1998) suggest visiting the site where the product or system is going to be implemented for talking with and listening to the users. By studying and analysing intended users and their activities in the intended environment, designers obtain better understanding of the user goals, what they do to achieve these goals as well as the personal, social and cultural aspects in their work (ibid.). Careful planning is important to get as valuable information as possible from the users when visiting the site (Hackos & Redish, 1998). Iterating site visits during the pre-design phase can give the best information because experience and knowledge about the users and context is built up, and the visits can be better prepared (ibid.).

3.2.2. Interviews and Observation
For talking to the users, Hackos & Redish (1998) suggest semi-structured interviews are suiting for getting the users to speak freely but still in the desired area of interest. They are also easy to analyse and generate qualitative information (ibid.). However, Boijen et al. (2013) mention the limitation of only using interviews as method and suggest observations as more in depth methods for collecting user data. Ulrich & Eppinger (2008) describe observations can be carried out by passively observing the users or by interacting with the product and/or users. The observation is ideally made in the actual use environment (ibid.).

3.2.3. Number of Participants
Wilson et al. (1997) and Hackos & Redish (1998) suggests choosing the number and variety of the users for the study so that they represent the whole user group, where as few as 5-10 participants can be sufficient (Hackos & Redish, 1998). Also, Cooper (2004) emphasizes the focus on few users, because trying to design for everyone can instead create an unspecific product with too many incoherent features.
Bonde (2013) has summarized research regarding how many interviews to perform in qualitative research before reaching data saturation. The conclusion reached is that there is no correct number of participants or interviews, but that it depends on the scope and what is expected. If the scope is broad concerning a wider population, more interviews may be needed, while a narrower scope with a more homogeneous population may not require as many (Bonde, 2013). By involving lead users and/or extreme users, needs can be identified more efficiently because of their experience, and they have often made discoveries and solutions in the area themselves (Ulrich & Eppinger, 2008).

3.3. User and Context Visualisations
Creating visualizations for structuring the important findings of the user and context data gathered makes it easier to synthesize insights, make connections and keep the user in mind in further stages in a design work (Segelström, 2010). Four methods are presented that are relevant for the case study and could be combined with gamification theory.

3.3.1. Empathy Map
Dam & Siang (2017a) introduce a map for structuring the user data gathered during field and user studies, showed in Figure 3. The empathy map helps to organize the user data based on what the they said, did, thought and felt, which helps the designer to develop a deeper understanding for the users (Dam & Siang, 2017c). The map will also help in further steps in the design process for defining user needs and form insights.

![Empathy Map](image)

**Figure 3. Empathy map for structuring user data adapted from (Dam & Siang, 2017a).**

The authors present the best way of using the empathy map in three steps:

1. Fill out the map with:
   a. quotes on what the users said
   b. notes on behaviours and actions
Gamification in Energy Production

c. interpretations about user motivations, goals, needs and desires
d. emotions and body language showing what the user felt

2. Synthesize needs from the map in form of verbs. Use both direct connections to single user data and combinations of data.

3. Synthesize insights from the map that can be of help when solving the design problem.

3.3.2. User Personas
After structuring information in an empathy map, Dam & Siang (2017a) suggest creating user personas. Cooper (2004) and Boeijen et al (2013) describe personas as representations of intended users that helps to communicate valuable information about the users to the design team throughout the design process. They should not replace the actual users, but work as support in the design process between user studies and tests (Segelström, 2010). Grundin & Pruitt (2002) describe that personas build upon interviews, focus group sessions, field studies and from exploring the market. Personas are a powerful tool to involve social, psychological and political aspects, containing qualitative and quantitative information about the intended users of a product or service (ibid.).

The personas should be specific and include details that are of importance to the target group and can include description of skills, attitudes, environment and goals (Cooper, 2004). It should be a narrative describing the flow in the person’s day or activities, rather than a list of characteristics (ibid.).

3.3.3. Task Analysis
When developing a product or service with a user-centred approach, there are several methods for creating understanding for the user interactions over time. One method is to perform a task analysis, which is made to create an understanding of the users’ procedure of performing tasks to reach a goal, often performed after or during site visits (Hackos & Redish, 1998). The authors suggest starting by identifying user goals, and then choose what kind of task analysis is most appropriate. A workflow analysis is suitable when analysing a situation where many people are involved because it maps every person and task involved in a process (ibid.). Hackos & Redish (1998) describe that while a workflow analysis helps create a flow of tasks, a job analysis creates deeper understanding for the jobs that each person in the flow performs. Mapping out and analysing the flow and different tasks involved of a situation makes problems and perspectives of the users clearer and helps the designer to approach them in the right way (IDF, 2017).

3.3.4. Customer Journey
Another method to map and analyse a use process and its activities is to create a customer journey map. Segelström (2010) describes the customer journey as a representation of the customer experience with a service or product over time, highlighting the emotions of the customer in different stages of the interaction. The journey can be visualized as a map describing user actions, motivations, uncertainties and barriers in the use process (Richardson,
Compared to a task analysis, the customer journey is more like the workflow analysis in focusing on the overall flow of activities and interactions, but the two can be combined by studying specific points in the journey with task analysis (Arvola, 2014).

### 3.4. Concept Generation

For creating ideas and concepts for solutions Ulrich & Eppinger (2008) suggest first to think wide and generate many ideas which are then carefully considered and narrowed down before selecting the most promising ones. Three steps are presented that can help in the process of generating and selecting ideas for the case study.

#### 3.4.1. Ideation

When initial data about the users and user context is gathered and structured, which have generated real needs and problems to solve, it is time for the ideation phase (d.school, 2010). Dam & Siang (2017b) describe ideation as the process of exploring and generating a large amount of ideas and solutions, typically held in ideation sessions. The authors suggest starting by asking inspiring and specific questions that are used as a guidance during the session. If ideas are generated around a complex problem, it is a good idea to break the main question or questions down into simpler sub-problems or sub-questions (Dam & Siang, 2017c; Ulrich & Eppinger, 2008).

For generating ideas, different brainstorming techniques are commonly used (Dam & Siang, 2017c). In classic brainstorming, questions or problem-statements are set, and the participants then write down as many ideas as they can, often while a facilitator gives inspiring and provocative instructions (Boeijen et al., 2013).

An alternative technique of brainstorming is brainwriting, which is described by Boeijen et al. (2013) as the following process: Each of the participants write down their ideas on a paper for a predefined number of minutes. The paper is then passed to the next participant who, inspired by the ideas on the paper, generates more ideas around them. The paper is then passed to the next participant and so on, until a satisfying amount of ideas have been generated.

Boeijen et al. (2013) argue that the important aspect to all kind of idea generating methods in the ideation stage is to put criticism and evaluation aside until entering that stage of the development process. In the idea generating stage, the goal is to gather as many creative and wild ideas as possible to open the mind and not limit the thinking (Dam & Siang, 2017d).

#### 3.4.2. Affinity Diagram

An affinity diagram is a way of structuring a large amount of data into clusters of similar data, which can be useful after an ideation session where there are many ideas that needs to be processed (Bergman & Klefsjö, 2002). The authors describe the process of using the method, which is summarized below:

1. Define a question that the ideas are going to answer.
2. Write all the ideas on separate post-it notes that are put on a wall.
3. Sort out duplicates, which should leave at least 20-25 ideas left.
4. Identify groupings of relations or similarities in the ideas.
5. Cluster the post-it’s in the discovered groupings on the wall and move around post-it’s until a satisfying organisation of groups and content is obtained.
6. Analyse the content in the groupings and set appropriate headings for what defines the different groups.
7. A weighting or voting can be made to prioritize the groups and solutions on how well they answer the initially set question. Or if the groups are related and together form a solution, relations or hierarchies can be drawn between the groups as in figure 4.

3.4.3. Concept Screening
To evaluate different concepts and narrow the number of them, Ulrich & Eppinger (2008) suggest using a method called Concept Screening. The authors describe the screening matrix, shown in table 5, that is used where the concepts are rated against each other and against a number of selection criteria. The selection criteria are chosen based on identified customer and enterprise needs (ibid.). When choosing the criteria for the matrix, it is important to define them clearly (Arvola, 2014). But they should not be too specific, like a list of requirements (ibid.).
3.5. Concept screening matrix by Ulrich & Eppinger (2008)

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Concept 1</th>
<th>Concept 2</th>
<th>Concept 3 (ref)</th>
<th>Concept 4</th>
<th>Concept 5</th>
<th>Concept 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of handling</td>
<td>-</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Ease of use</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Readability of settings</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Dose metering accuracy</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Durability</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ease of manufacturing</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Portability</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Sum of +’s</td>
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<td>0</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Sum of 0’s</td>
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<td>2</td>
<td>8</td>
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<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Sum of -’s</td>
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<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Net score</td>
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<td>-1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Rank</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Continue?</td>
<td>No</td>
<td>Yes</td>
<td>Combine</td>
<td>Yes</td>
<td>Combine</td>
<td>No</td>
</tr>
</tbody>
</table>

Ulrich & Eppinger (2008) describe the process of using the screening method as in following steps:

1. Prepare the selection matrix on paper, whiteboard or in digital form and enter the concepts and criteria chosen. Chose a concept to act as the reference concept against which the other concepts are being rated.
2. Now rate the rest of the concepts against the reference on if they fulfil each criterion better (+), worse (-) or the same (0).
3. Calculate the score of +’s, -’s and 0’s for each concept and enter it in the matrix. Now rank the concepts, preferably depending on how well they scored against the reference.
4. Analyse the results and consider if any concepts can be improved or combined to receive a better result.
5. Select which concepts to continue with to the next step in the development.

3.5. Prototyping

For prototyping, three phases are presented that are helpful in the process of the case study. As the design thinking process of The Stanford Design School (2010) suggests, prototyping should start easy with multiple ideas and then get more detailed as the solutions are iterated with users and colleagues.

3.5.1. Lo-Fi Prototypes

When designing a digital interface, it takes a lot of time to create a functional prototype that shows the functions and experience you are striving for, therefore Retting (1994) suggests creating low-fidelity (Lo-Fi) prototypes as a first step in the prototyping process. The author describes lo-fi prototypes as simple paper prototypes that help in demonstrating the interaction with an interface early in a design process. Prototyping is easiest initiated by sketching for turning thoughts and ideas into illustrations, diagrams and mind maps to explore different options for interface solutions and elements (Dam & Siang, 2017e). When the
structure and flow of the interaction is clearer, the sketches can then be turned into a kit with all the interfaces and elements that are going to be tested (Retting, 1994). The lo-fi prototypes should be roughly put together and clearly show that it is not a finished solution, but be inviting for feedback and criticism (Arvola, 2014).

### 3.5.2. Hi-Fi Prototypes

High-fidelity (Hi-Fi) prototypes are a more exact representation of how the actual interface is going to look and function (Arvola, 2014). There are many ways to build a Hi-Fi prototype, for example it can be coded in the same way as the end-product, or be constructed with help of a Graphical User Interface (GUI) builder (ibid.). The Hi-Fi prototype makes it possible to test the appearance and feeling of the interface and to test changes of an existing interface (Retting, 1994).

### 3.5.3. Prototype Testing

Buxton et al. (2006) emphasizes that testing many solutions in a simple form is better than only one, since there is more room to explore and get feedback on multiple simple and cheaper solutions before putting in effort and time to detail design the best one. Therefore, it is valuable starting tests with multiple Lo-Fi Prototypes, and then continue with one to iterate tests and refinements before going on to the Hi-Fi Solution (ibid.).

Retting (1994) suggest following activities for preparing and conducting prototype tests:

1. Select test-persons that are representative for the user group of the interface. It could be both beneficial and harming using actual users. They have the best knowledge of their needs but may also be biased by associations of how their present solution works.
2. Prepare scenarios and tasks that are going to be tested in the sessions, and be sure to practice the procedure within the team so that everything works as it is supposed to when the time comes to perform the test.
3. Perform the tests, preferably having enough team members so that the test is performed smoothly in all tasks: welcoming the test-person, handing the written tasks, displaying the right interfaces at the right time, and taking notes. Try to get the test-person to think out loud when performing the test.
4. Debrief with the test-person with some questions about the test.
5. Evaluate the results and impressions to improve the prototype for the next stage in the process.

### 3.6. Usability Measurement

When testing and analysing the interaction with a system, a statistical measurement could help in analysing the results. Sauro (2011) describes using the System Usability Scale (SUS) as a simple and reliable way of measuring the perceived usability of a system. The author describes using the SUS by providing the users with a questionnaire containing following ten questions:

1. I think that I would like to use the system frequently
2. I thought the system was easy to use.
3. I found the system unnecessarily complex.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in the system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

For each question, response options from 1-5 are given where 1 represents strong disagreement and 5 represents strong agreement (ibid.). For scoring the SUS, Sauro (2011) describes that the score of the odd questions is subtracted by 1, and for the even numbered questions the response is subtracted from 5. The converted responses for each questionnaire are summed up and multiplied by 2.5, resulting in a value between 0 to 100 (ibid.). The author claims that a score of over 68 is considered as above average, and below 68 as below average.
4. Case Study: Work Process & Results

This part of the report describes the work process and results of the case study, where a gamified solution for a software optimization tool is designed and evaluated. Theory studied in previous chapters is applied to the case study and the work process and its outcomes are described step by step. An iterative work process, inspired by the design thinking process described in the methodology, chapter 3, was used in the design of the gamified solution. Figure 5 illustrates the process, what activities were performed and where iterations were made.

![Diagram of the work process]

Figure 5. A summarizing model of the work process.

4.1. Discover: Theory and User Research

The work process started by conducting research in the areas of gamification, game design, user experience and motivation theory. In parallel with the theoretical studies, a process was initiated for getting to know the users and gathering user data. This was done by conducting site visits and interacting with the users in their natural environment while observing the optimization tool in use.
4.1.1. Theoretical Framework
The thesis work was initiated with a research phase, discovering and defining areas connected to the case study and research questions. The theory acted as a foundation for the work, and to quickly get started with the case study, the research was made in iterations between activities. Theory and models in gamification and user-centred methods were first studied briefly while creating a strategy for the user research. As the processes of working with gamification suggests, motivation theory was studied during early phases of the case study for creating a better understanding of human motivation and connecting it to the case.

4.1.2. Site Visits
The primary users of the optimization tool are a specific user group, namely operating technicians at power plants. Therefore, as Hackos & Redish (1998) suggest, site visits were conducted as a start of the case study to create an understanding of the context and users and to gather user data. The current customers of Sigholm consist of several power plants spread out in various parts of Sweden. The customers have diverse characteristics and needs, but the common factor is that they all have technicians operating the plants.

Seven site visits were conducted during four weeks at four different power plants. A variety of users were involved through observation, semi-structured interviews and small talk in the control room of the plants. Interview questions were prepared and acted as guidance during the visits. The questions are found in Appendix I. Data on user tasks, needs and goals in the daily work and in interaction with the optimization tool was gathered. Also, customer needs and ambitions in a greater perspective were identified by participating in meetings with shift leaders and power plant managers discussing the implementation, goals and possibilities with the optimization tool. A decision made during site visits was not to have the main focus on gamification and not to talk about gamification with the users. Instead the focus lied on the overall use experience of the optimization tool and of work in general. The users were told that the study aimed at creating a better user experience of using the optimization tool.

4.1.3. Analysing User Data
Data collected during the site visits consists of answers to interview questions and a great amount of notes on actions, behaviour and other details. These were analysed and structured, using the Empathy Map described in the methodology chapter. The map helped to structure the collected data on what the users said, did, thought and felt which also facilitated the identification of user needs. A simple version with the most general inputs is shown in Figure 6 below, and a more extended version can be found in Appendix II.
4.2. Define: User Needs, Goals and Motivations

In the define stage, the user data gathered was used for defining user needs, creating user personas and creating a user journey for attaining a more structured understanding for the users and use context.

4.2.1. Defining User Needs

From the user data collected and structured in the empathy map, user needs were defined, which are presented in Table 6. The needs were generated from data joined together from multiple users and from all the four squares of the empathy map, so they consist of both spoken and unspoken needs. Since the needs were derived mainly from observing the optimization tool in use, many of the needs concern the process of use and interaction with the interface. Some needs, however, cover overall work environmental needs. The needs are divided into emotional needs and functional needs.


Table 6. List of emotional and functional user needs

<table>
<thead>
<tr>
<th>Emotional Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Feel safe and confident in using the tool</td>
</tr>
<tr>
<td>2. Feel that the work is done in collaboration and that the responsibility for the outcome is shared, not individual</td>
</tr>
<tr>
<td>3. Feel ownership and control</td>
</tr>
<tr>
<td>4. Feel included/relatedness</td>
</tr>
<tr>
<td>5. Get a holistic understanding</td>
</tr>
<tr>
<td>6. Feel confident in what needs to be done</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Understand the values, labels and other settings used</td>
</tr>
<tr>
<td>8. Not destroy what others see when exploring in the tool</td>
</tr>
<tr>
<td>9. Get information on what needs to be done in the own work-time</td>
</tr>
<tr>
<td>10. Get feedback on actions</td>
</tr>
<tr>
<td>11. Get feedback on performance</td>
</tr>
<tr>
<td>12. Get feedback on the status of the tool</td>
</tr>
<tr>
<td>13. Optionality in what to perform beyond the necessary</td>
</tr>
<tr>
<td>14. See connections to reality and real-world conditions</td>
</tr>
<tr>
<td>15. See connections to the own power plant</td>
</tr>
</tbody>
</table>

4.2.2. Creating User Persona

From the data gathered and analysed, three user groups, or archetypes, were identified. For the data to become more structured and easier to work with, visualizations for the three user groups were created in form of user personas. Inspiration was gathered from gamification theory and examples of user personas from which a template was created that matches what is relevant to visualize for the case study. From the template, three personas were created with varying needs, goals and motivations, which are found in Appendix III. The personas show the discovered personality data for each of the user archetypes, which display that there are some common traits. The strongest common characteristic of all users is the importance of social relations at work, and that work is done in collaboration in a team. Connecting this to the gamification theory on player types, all personas show the characteristics of the socializer, who is motivated by relatedness.

4.2.3. Mapping the User Journey

Inspired by task analysis and customer journey mapping described in theory of methods, a user journey was created which shows a flow of activities in the use of the optimization tool (Figure 7). The activities cover the interaction in the daily workflow of the operating
technicians, and the once-in-a-week meeting where production results are analysed in the tool. User thoughts connected to the activities were added to the activity flow that address problems and frustrations in the use process, but also noting moments and tasks that awake positive reactions. The intention of the visualization is to create an overview of the use process and to highlight positive and negative interaction points that can be used in the work of creating a more engaging experience.

Figure 7. User journey for current use of the optimization tool.

4.3. Ideate: Concept Development

In the ideation phase the user input and theory were put together to create ideas of gamified solutions. An idea generation session was held and the ideas are further evaluated and modified until four concepts are taken further for prototyping.

4.3.1. Exploring Ideas

When enough user data had been gathered, analysed and structured, creating understanding for the users and the use context of the optimization tool, an ideation session was held. Participating in the session were both members of the development team, and additional employees at Sigholm with less experience of using the product. In total eight participants were included. All participants were familiar with the user target group, and were prepared a few days before the session by studying the user personas.

During the ideation session, the participants were first introduced to the subject and goal of the session, where the main question was: “How can we create a more engaging and motivating design for the optimization tool – can we achieve it by using inspiration from games?”. The participants were then introduced to the background information on gamification, games, intrinsic and extrinsic motivation. Individual brainstorming was performed on a few questions around each subject.

After the background had been presented, the participants performed an individual brainstorming on how to integrate game thinking into the optimization tool to satisfy the users, by focusing on both intrinsic and extrinsic motivation. The user personas together with
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citations from actual users worked as facilitators in the brainstorming. After the individual brainstorm, a brainwriting was performed according to the procedure described in the chapter of methodology. After a number of turns, when the ideas started to diminish, all the participants were told to pick and describe their favourite idea on the paper in front of them, leading to even more ideas and discussions on ideas. The ideation ended with a reflection on what the participants had gained from the session, and what the next step in the design process would be.

4.3.2. Concept Selection

After expanding the space of ideas in the ideation session, the number of ideas needed to be narrowed down to, in a strategic way, create the most appropriate concept to proceed with. This part was done individually but with consideration to insights from the field studies and ideation. First, a list of all the ideas was created where similar ideas were eliminated or merged, resulting in 77 unique ideas. A second elimination was made, eliminating ideas that were far off the topic and not in line with the needs, goals and motivators of the personas and user journey. The 48 ideas left were clustered with the method described for affinity diagram, resulting in twelve concepts. The affinity diagram and the concepts are found in Appendix IV and Appendix V.

With the twelve concepts, the concepts were iterated and refined with the development team at Sigholm. Then a concept screening was conducted in two iterations resulting in three concepts remaining. In the screening, the selection criteria were based on the needs, goals and motivations of the users. A description of the screening process can be found in Appendix VI. One bonus concept was later chosen to be studied further even though it did not score high enough in the screening. The whole concept selection procedure is illustrated in Figure 8.

Figure 8. Illustration of concept selection process
The screening results can be seen in Appendix VI, and the four selected concepts are described below:

**Onboarding process**
The concept consists of two initial concepts that are combined during the screening. It concerns an onboarding process where the individual users, as part of the work team, collaborate by gathering experience in the tool. The experience is gathered through simple activities performed by the users, generating feedback and a progress measured in experience points and experience levels. Team challenges are added for creating more collaboration and adding a social aspect to the onboarding process. The concept is built on a low-level gamification abstraction and extrinsic motivation. By adding the team challenges it goes more towards an intrinsic motivation by embracing the user motivation of social relations and collaboration.

**Guide**
The second concept is a guide, or instruction, to the optimization tool for helping the users to find more information and help for each page in the tool. This aims to be created with fun illustrations and/or videos for guiding and informing the user which gives more meaning to the tool and a better understanding of why optimization is important. This is a combination of extrinsic and intrinsic motivators since it encourages the users to learn more about the tool, and creates a greater meaning of using it.

**Informative start page**
The third concept concerns the start page of the tool that can give more relevant information to the users. The idea is to display current conditions that have impact on the work that will be performed. Also, a social feed is added for sharing news, important information or just fun stories with the team and colleagues. This concept is based on both usability issues and the intrinsic motivation of social relations and collaboration.

**Bonus concept: Higher usability of the settings**
One of the concepts that made it to the screening concerns the usability of the settings, since a big issue identified is that users are hesitating in changing the settings when they do not know why it was changed last and who changed it. Since this is a usability focused issue with less connection to gamification, it did not make it further in the screening. But since the problem affects the entire use experience of the product, and an idea of a solution already exists, it is taken further to prototyping.

**4.4. Prototype: Concept Visualisation**
During the first stage of prototyping the ideas were visualized as simple sketches. After iterating the sketched interfaces with the development team, the prototype was created as a digital interface.
4.4.1. Lo-Fi Prototype

When four concepts had been selected for further work, the prototype phase was initiated by individually sketching details and interface solutions for the concepts. During sketching, iterations were made back to the ideation phase, exploring more ideas on how to solve and display various functions and features. All the concepts were integrated in one prototype to be able to study both how they work independently and together. During interface sketching, theory in gamification, user experience design and usability was used as support for achieving both an engaging experience and high usability.

Upon completing a first draft of the design for the entire interface solution, the design was discussed and iterated with the development team at Sigholm to gather more ideas and perspectives. Some modifications were made to the concept ideas before continuing the prototyping in high-fidelity.

4.4.2. Hi-Fi Prototype

After iterating the sketched interfaces, the prototyping was taken into high-fidelity prototyping, using Adobe Experience Design (Adobe, 2017) software. The hi-fi prototype was created by partly using and manipulating the existing interface design of the optimization tool. This allowed a smooth prototyping process where much of the current design could be re-used, focusing on integrating the new ideas in the interaction-flow.

With the prototyping software, realistic interaction simulations could be created by linking different actions to specific outcomes. Figure 9 shows all the frames of the hi-fi prototype and how they are linked to each other to create a realistic interaction flow. The frames of the prototype and a comparison to the initial software interface are presented in chapter 4.6.

Figure 9. Prototype frames and links of possible interactions.
4.5. Test: Prototype User Testing

Prototype tests were prepared and performed with users at two different plants.

4.5.1. Test Preparations

When designing the hi-fi prototype, seven tasks were created preparing for the prototype tests, which are found in Appendix VII. The interaction flow of the prototype was created reflecting upon all the possible interactions that the user could make when encountered with the different tasks. This because the prototype had to be able to handle more than the ideal outcome of the tasks.

The test session was prepared by creating paper notes for each task, and two user surveys to fill out, one before and one after the test. The initial survey gathers information on the users’ current experience with the tool, and the end survey gathers information about the use experience of the prototype. The end survey was constructed according to the SUS measurement survey. Both surveys are found in Appendix VIII.

A computer was prepared for the test so that the user could be able to interact independently with the prototype while the observer could focus on taking notes and handing the tasks. Before testing the prototype with actual users, it was first tested with the development team. Then the user tests were planned for being conducted at two different plants. The plants were chosen for their different characteristics in management, to study if that may affect the user reactions.

4.5.2. Test Procedure

The prototype testing was conducted similar to the procedure for prototype testing described in theory of methods. The prototype was tested digitally, were the user could interact with it individually on a computer. Except from the user and the computer, only one person was involved in the test session documenting the tests by observing and taking notes in a pre-prepared protocol. The protocol contained all the test tasks with a space for notes on reactions and behaviour. The users participating in the prototype testing were only users already familiar with the tool and most of them had participated in the initial user study in the discovering phase of the case study. The prototype testing involved twelve users in ages approximately between 25 and 65. The prototype was tested with six users at the first plant, five at the second and one employee at Sigholm who is working with implementing the tool at the power plants.

The user was welcomed and introduced to why he or she was there and how the test would be performed. It was pointed out that the ability of the designer is tested and not the performance of the user, and they were asked to think out loud while performing the tasks. The users were then asked to fill out the first survey while the computer was prepared for the test. The computer was then put in front of the user, and the tasks were handed one by one. If the user got stuck, or was asking questions, help was provided for getting the most out of the test. When all the tasks were performed, the user was asked to fill out the second survey, and some small talk was made around the test, the tasks and the survey questions. One
protoype test with a user took approximately 20-25 minutes to perform. After all the twelve tests had been completed, the test results were structured and analysed. This was done both by calculating the SUS-score, and by analysing what each user said and did during the test. The prototype and test result are presented in the following section.

4.6. Result and Analysis
This chapter describes the outcome of the case study. The prototype and test results are presented and analysed on how the gamified system is perceived by the users, and how to proceed with the result.

4.6.1. Prototype and Test Results
The prototype and test results are first presented and analysed for each of the test tasks. The user responses to the design are summarized and the critical results are analysed. Then the SUS-score and the overall perception of the prototype and the different solutions is analysed for defining areas and details for modifications. More detailed information on the users and the test responses are found in Appendix VII.

The prototype is presented as one interface for each concept. To create understanding of how the changes are perceived by the users, each interface is presented by first describing the current interface of the tool, as Before, and then describing the changes made, as After. Each of the prototype test tasks are related to a specific concept, therefore they are not listed in numerical order but presented and analysed together with their respective prototype interface.

Concept: Informative Start Page
The start page of the tool is redesigned as one of the concepts. The user response is tested with one question, to study the reaction.

Before:
Previous, one news feed is displayed where the users can read information sent from Sigholm. But no further interaction is possible. During the observations made in the beginning of the case study, many users commented on the start page as being irrelevant to them, or that they never looked at it. The current start page is shown in Figure 10.
After:
In the redesigned version presented in Figure 11, the old news feed is only one out of three feeds. The users now also have the option of sharing news, information and stories both with the own work team, and with the rest of the colleagues at the plant. The start page also displays information on the current conditions of the plant, fuel prices and weather (which are parts of what the tool makes its calculations on). The user can already on the startpage see what changes have been made in settings, and some personal data. The changes are based on the need for more information on values and settings and seeing connections to real world conditions. The social feed builds on the motivations of social relations and collaboration and to feel includeded and that work is done in collaboration.

Figure 10. Previous start page interface of the tool

Figure 11. Start page of the prototype
Prototype test task:
Task 1: Find out from the start page if there are any news since you were last online.

Observation and analysis:
Most users reacted similar, by scanning the start page, and many seemed a bit stressed by finding the right information. Most users were curious and happy while some got more frustrated and confused. Since the change made is a big, it may have been too much information to take in during the test, and while being watched. What the users reacted on depended on where their focus landed, which seems to be different from person to person, but also depending on how the user interpreted the task. Many got stuck analysing the settings, while others directly focused on the social feed and the tabs of the feed. The users seemed to like the settings being displayed on the start page, and were curious of the social feed. The overall conclusion is that there is much new information displayed and the circumstances did not allow the users to explore the page and give relevant feedback. But the reactions, and the time spent scanning the page indicates that most users became interested in the content.

Bonus Concept: Higher Usability of Settings
This change is added as a completely usability focused concept for studying the user reactions on a solution to a problem that is highly emphasised during field studies. It is tested in the prototype with one task.

Before:
The current settings interface is displayed in Figure 12. The settings consist of descriptions of the settings, its current value and a status indicating if the setting has been changes from its initial value. The users have issues with knowing why a setting has been changed and when, which makes many of them uncomfortable in making changes to them.

![Figure 12. Previous settings interface in tool](image)
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After:
Two columns are added to the settings as presented in Figure 13; one for the date and time when the setting was changed and one displaying who changed it. It is also made possible to write a comment on settings when changing them, which is shown with a chat-symbol next to the name.

Figure 13. Modified settings interface in prototype

Prototype test task:
Task 2: Go to the settings page and find out more about the latest changed setting. Find out who changed it, when and why.

Observation and analysis:
This change is very appreciated, because it fills a need that every participant in the test could relate to. They found it easy to use, and that it added value to the tool, because it creates more understanding and eases the communication.

Concepts: Guide and Onboarding Process
One concept considers a gamified guide/instruction for the tool, which in a simple and joyful way helps the user and gives more information on how to use each page and function in the tool, and which create more understanding and meaning of why to optimize the energy production. During prototyping this is defined as an important part of the onboarding process, which is another concept – so the two are partly integrated in the prototype. Two tasks are testing the guide concept.

Before:
There is no current instruction or guide to the tool, since the goal is to create a product that can be used without instruction. This has been an issue because many users feel
uncomfortable in exploring the tool, because their actions are seen by all other users too. There is an anxiety of destroying what others see in the tool.

After:
A question mark is added on each page of the tool, as seen in Figure 14, which opens the guide in a pop-up window. The user is given explanations for the different features and functions on the page and then gets the possibility to answer a question at the end. The question will get the user to reflect upon the information given and help to transfer the information to knowledge. The idea is that each page has multiple guides/levels of information that are unlocked by answering the questions. The guide starts with basic information and gives the user more advanced information the more he or she wants to learn. The answers generate experience points that are added to a score shown in later prototype frames. Two tasks in the prototype test studies the user reaction to the guide.

Prototype test task:
Task 3: Go to the optimization page and find more information and help on how to use it.

Observation and analysis:
Not many users found the question mark on their own. When pointed out, many commented that the task was confusing, and it should instead just ask to find “help” and not “more information”. Approximately half of the users read the information, and a few less answered the question by first asking if they could do so. This task gave the conclusion that the symbol needs to create more attention before the user has clicked it. But most critically, the task was not formulated in a good way.
Prototype test task:

**Task 7: Find more information and help about the team page.**

**Observation and analysis:**
In a later task, the users are asked again to find more information and help. And the second time, all users directly connected the task to the question mark on the current page. Some also commented that it was nice that it was in the same place on every page. This implies that once the user has seen the symbol and created an understanding of what it is, they know where to look for the help and information. It is also noticed during the prototype tests that even in the other tasks, between task 3 and task 7, many users go to the question marks to look for information in the guide that can help them solve the tasks. This implies that the guide-function gives the users a feeling of safety, because they know they can turn to the guide when unsure on something.

**Concept: Onboarding Process**
The onboarding process concept intents to boost the user confidence and ownership in the tool by helping them learn and encouraging actions where the users currently show insecurity. This concept test what the theory describes as an often-seen approach to gamification; creating a progress system based on points. The user is encouraged to perform activities that create individual and team learning, and which create more value in the tool. As theory on points and other encouraging elements imply, points can help to boost engagement and initiate a behaviour that makes the users find enjoyment and meaning of activities. The onboarding concept also includes team challenges which satisfy the needs and motivations of social relations, collaboration and acknowledgement.

**Before:**
The onboarding process is shown on a personal user page that currently does not exist. The tool has individual accounts for each user, so the system has the requisites for generating personal information and statistics.

**After:**
The personal page, presented in Figure 15, shows statistics on the user activities and learning progress in the tool as well as the team challenges. The left page shows different activities that generate individual experience points and a progress bar showing the total experience progress. The user can also see an information feed of the latest activities performed. The right side of the page displays a team challenge where the team can follow their progress towards a given goal. The team challenge displays both the progress towards a more distanced goal, and the short-term performance of each day. By producing energy in an optimal way, the team gathers points which at a certain level can be exchanged for a team reward. The individual progress is meant to gain the team progress by creating points for the team when a certain individual experience level is reached.
Prototype test task:
Task 4: Find and go to the personal page.

Observation and analysis:
All users except 2 quickly relate to the user icon and name in the left corner of the interface and interact with it as a navigation list item, even though there is no personal page found there in the current product. This may imply that most users are familiar with this kind of feature and how it is displayed and positioned in the interface.

Prototype test task:
Task 5: Find out how to reach the highest experience level.

Observation and analysis:
Most users interpret the question as to study what activities generate experience points, which they do by studying the icons and the table of latest activities. Many users try to find the information by clicking the question mark. Some of the user (always the ones in ages around 30) relate to the experience points and immediately look at the progress bar showing the progress in experience points. Some younger users commented that it is fun to see the points and progress in learning. But many users did not entirely understand the concept of experience levels, experience points and how progress is shown. This implies that the way the solution is presented is not suitable for the entire target group of users.

The connection between the team challenges and the individual progress is questioned by some of the users, asking if the points are the same in both. The team challenge is not clear to the users during the test.
Prototype test task:
Task 6: Find out how to get experience point for signing in to the tool.

Observation and analysis:
Most users directly found the icon for sign in and clicked it. Many were critical to giving points for such easy activities as signing in to the tool, and more than one user said that it is always the same person in the team that signs in to the tool.

Users in ages between 25-35 showed excitement about the gamified onboarding concept, asking when it will be implemented in the tool. Some users were critical about the way of motivating by rewarding simple activities, but believed it could motivate others.

4.6.2. SUS Measurement Result
To achieve one additional measurement in addition to the interpretation of the user actions and reactions, the users were asked to fill out a survey based on the SUS questionnaire. The responses are calculated and turned into a graph showing all the individual scores and a mean score, seen in Figure 16. The green line shows what Sauro (2011) suggests as the average score, 68. The graph shows that the perceptions are varying, but that the mean is above average, implying that the overall impression is positive.

![SUS Score](image)

**Figure 16. SUS score for user perception of the prototype**

4.6.3. Suggestions for Modifications
From analysing the test results, areas in need of improvement, modifications and further studies are identified. The modifications are not implemented in this thesis work, but here a summary of suggestions for modifications is made for each of the concepts tested.

**Concept: Informative Start Page**
The prototype start page contains a lot of information which made it hard to interpret the reactions of the users. Overall a curiosity is shown, and different individuals were interested in different parts of the page.
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**Modifications:**
- A modification idea is to make the page more modular so that the user can choose to show the windows of interest and hide the others.
- The table with latest changed settings should also display the comments made on the settings so that the user doesn’t have to go to the settings page to find out why the setting has been changed.

**Bonus Concept: Higher Usability of Settings**
The minor change made to the settings page is well perceived by the users, commenting that the change is valuable in the use of the tool.

**Modifications:**
- As one user suggested, the comment should be made in the same place where the setting is changed.

**Concept: Guide**
Few users commented on the guide/instruction concept out loud. But by observing the user behaviour during the test sessions it was noticed that the guide became a safety for the user when not knowing how to solve a task. So, from the result it is interpreted that a guide for supporting the users is an effective way of creating more confidence in using the tool. But perhaps a question mark is not the right way to display the guide in the tool.

**Modifications:**
- Further studies on what the right way is to display the guide.
- One idea is to create a bot that the user can turn to for accessing the guide. The bot can suggest giving the user a guided tour through the tool when the user is new, and could also provide a customer support chat as one user suggested.

**Concept: Onboarding Process**
The personal page and team challenge created the most varying response among the users. The age differences in the target group seems to be a critical factor in the varying reactions. The younger related more to the game related elements, while others believe more in motivating through creating meaning and understanding. The individual onboarding process seemed to generate some positive reactions, while the team challenges need further work.

**Modifications:**
- More studies on how to create incentives more connected to what all users have in common. Instead of points and experience levels something can be used that has similar effect but that give more meaning to the users. For example, instead of filling a progress bar with experience points they could be filling an accumulator with energy.
- If implementing team challenges, further studies are needed to find the appropriate challenges and ways of visualizing them that engages the whole work team.
5. Discussion

The chapter aims at highlighting the important findings made in the process of working with gamification as part of a design process. First, theories and methods for the case study are discussed, and then the results with references from the theoretical framework.

5.1. Method Discussion

An exploring character is created in the thesis work by approaching the area of gamification with a user-centred approach in a design process. Chou (2015) and Burke (2014) highlight adapting a human-centred focus when working with gamification. Burke (2014) as well as Kumar & Herger (2013) give examples of such processes for working with gamification. But when searching for literature in the area, limited cases of practical gamification work is found where a theoretical user-centred process is used, which is also fortified by Seaborn & Fels (2014) that mention the lack of gamification studies with human participants. Therefore, this discussion is important both for highlighting the gap in gamification research which this thesis helps to fill, and for adding critique to the practical work performed in this case study.

5.1.1. Gamification in a User Centred Design Process

Early in the case study, the decision is made not to focus on gamification solutions up-front, but to approach the case with an open mind, as a design problem that could have any solution fulfilling the needs, goals and motivations of the users. Burke (2014) and Bogost (2011) highlight negative aspects and interpretations of gamification, being used as a simple solution or tool for creating motivation and maximizing business profit without spending time to understand user needs and goals. That is something this study aimed to avoid by using a user-centred design thinking process and user-centred methods for focusing on the user needs, goals and motivations during the whole process. Adapting a user-centred approach worked well for creating understanding for the users and use context, while finding ways of integrating game inspiration and connecting it to the motivation theory was harder. While creating the theoretical framework, some guidelines were highlighted for each of the areas studied, which were used as guidance and inspiration when using the user-centred design methods. But instead of creating a process of methods only from the user-centred design area, methodology from game design could have been studied and used in the process, to embrace the game thinking more.

Defining what gamification really is and what it includes has been a huge part of deciding how to use it in the design process. The gamification theory did not define this clearly enough, so an own interpretation is made during the work. Werbach & Hunter (2015) describe a gamification framework acting as a toolkit of game dynamics, mechanics and components to combine for creating a gamified experience. This matches the definition by Deterding et al (2011) that gamification is the use of game elements and mechanics in non-game contexts. Chou (2015) presents a more humanistic approach to gamification, focusing on the motivational drivers behind the mechanics and elements found in games to find ways of satisfying them, that not necessarily include the mechanics and elements. And it is the later approach that this work aims at, through defining the user needs and motivations up-front
and create a design that reflects those. But using user-centred design methods in doing that creates the question of what the difference is between user experience design and gamification in the thesis work. Is gamification the use of mechanics and elements? Or is it the use of game design methods for receiving the motivational effect of games? Or is it the aim of creating an experience that makes the user feel the same enjoyment as playing a game? The interpretation made is to have gamification, game design and motivation theory in mind during the whole process for creating engaging experiences inspired by games, but built from the user motivations. Because if the focus is primarily on the tools, you may miss the actual needs and design possibilities.

Another challenging aspect when planning the case study was that the studied product was being developed at Sigholm in parallel to the thesis work. Because it was a product in development, many usability needs and implementation issues were identified during the site visits. This made it hard to focus on the core needs and motivations of the users, because it was hard trying not to include and solve the other product issues in the case study. Because the tool was still under development, all users were rather new in using it, which made it hard to define what needs were connected to the learning process of using the tool, what were usability needs and what were the basic needs that the product aimed at fulfilling. If the product development had been more in the starting phase, or if the product had been on the market for a longer time, it may have been easier to focus on identifying needs, goals and motivations. Now, the field studies became a way for the users to evaluate the product and talk about how they would like it to be or not to be. If the product had been used for a longer time, statistical data could have been generated from the tool for analysing the use pattern and behaviour of the product. Which could also have been an appropriate measure when validating new ideas.

5.1.2. Discover

In the Discover phase of the case study, the literature studies are included because they were conducted in iterations between other activities. To not have an initial literature study prior to starting the case study had both positive and negative aspects. It was valuable to be able to perform field studies early on, because discovering and empathizing could be made during a longer period to get to know the target users and context well. But because new theory was discovered between every site visit, the character of the visits changed and the questions focused on different areas and perspectives. This was positive in the aspect that every visit gave new insights that could be used in the literature research so that the next visit could be conducted in a better way or studying a different area of interest. The varying character and information from the visits generated data that was hard to compare between sites. But altogether, the material gave a comprehensive image of the users and use context that worked well as foundation for the work.

A strategy used when conducting the site visits was not to tell the users that the work aimed at studying gamification. Instead the users were told that the work aimed at creating a better use experience for them. Maybe it was this approach that made the users focus on how the product could be improved. Maybe another approach would have generated more valuable data for the gamification work by removing the focus from the tool. But the questions asked were still covering both the use of the tool, how the overall work was performed, and what
made them happy and motivated at work. By always having gamification and motivation in mind, those aspects were included in the observation of the work tasks and on general behaviour and relations.

5.1.3. Define
For concretising and visualising the user data gathered, the user persona and user journey worked well as tools. Both tools acted like frames that allowed to be filled with information for the specific case. By customising the content of the tools for the study aim, they helped in focusing on the user needs, goals and both the usability aspects and the motivational aspects in work tasks. How the user journey was created may have limited the focus on how the tool is integrated in the work tasks today. Maybe, instead of focusing on the tasks performed with the tool, it could have covered other aspects of the work that were identified as motivating and engaging, so inspiration from those could have been used in the work. The way the user journey was used was still valuable for identifying both issues and positive moments in the interaction with the tool.

5.1.4. Ideate
Conducting an ideation session with the employees at the thesis company, Sigholm, had both positive and negative effects. The employees have good understanding of the tool, the users and the context which made it possible to generate realistic and useful ideas. Limiting the ideation to a group of people with similar perspective may though have been a restrictive factor. Many of the ideas generated were based on things that were currently being discussed or developed at the company. Even though facilitators were used so that the user perspective was considered, it may have been good to either have users present in the session, or to have a separate ideation session with users. Ideating with company employees made it possible to integrate the work with the development of the tool, which created better requisites for the possible implementation of the ideas, but was limiting in taking the users perspective. As the literature in user-centred design and user experience emphasis, even if the users are not present during all stages of the design process, it needs to be iterated with them in different stages (Segelström, 2010; Benyon, 2010). So, because the users were not present during the ideation phase, the ideas should not directly be implemented but tested and iterated with the users to see if the solutions really fulfil the interpreted needs and motivations, which is also done later in the case study work process.

Since no actual users were present during the ideation phase it was emphasised, both during field studies and later in the prototype evaluations, that the users should share their thoughts and ideas, which led to user input being considered in the concepts. The usability of the settings was a user aspect that could not be ignored, since it seemed to be an issue and a limitation in using the tool. As Mooreman (2012) describes in the theory of the Kano Model, there are one-dimensional features that when only partly present create dissatisfaction, but when well implemented can create high user satisfaction. The settings seemed to be such a feature, where its overall function is positive to the product, but because it is designed in a way that creates frustration for the users, it creates an overall dissatisfaction of the product. So finding a better solution for the settings may be the requisite for creating an overall product satisfaction and engaging experience where the user can reach mastery. This is why
the settings was included as a concept, even though the concept lacked inspiration from games and gamification.

5.1.5. Prototype

From sketching interfaces, the concepts are already after one iteration with the development team turned into a high-fidelity prototype, even though the theory suggests testing many ideas in low-fidelity before creating a more detailed prototype. There are two reasons behind this decision. Since the case considers an existing product, there is already an interface design that could be used in prototyping. By using and manipulating the current design in prototyping, a decent hi-fi prototype was created quickly. Also, because the product is already being used, the users are used to the current interface. By presenting the new ideas in the current interface, it was believed that the users could focus on the design changes and not be confused by the interface being different. It helped in creating a realistic looking prototype which made the users believe that they were actually using the tool, and not just looking at the prototype. This made the users naturally want to interact with things, which may not be as natural in a paper prototype. But there may have been better ways of testing the ideas, without creating a digital prototype early on. The ideas could have been presented and discussed in workshops with users, for encouraging more ideas and modifications, creating a greater feeling of co-creation.

One goal with the prototype was to test and evaluate multiple ideas at the same time, both for time and resource efficiency, but also to be able to analyse the difference in how the various concepts were perceived by the users. Therefore, all the chosen concepts were integrated in the same prototype, for studying the user reaction to the different concepts in the same context. The concepts had different characteristics and were built on different needs and motivational drivers, containing both purely usability improving solutions, which are rather incremental changes, and very game inspired solutions, that were more radical changes. It was interesting to study which of the concepts gave the best reactions. But having so much new information presented at once showed to have a negative effect on the test results. Adapting the testing procedure proposed by Retting (1994) may in this case not have been suited for studying the user experience in a high-fidelity prototype. The tasks made the user focus on trying to solve them instead of reflecting on the interaction experience. It worked well for studying where the attention landed, and what actions were performed for trying to solve the task, but the tests generated little feedback on the design solutions. So again, finding another way of testing or verifying the user experience, not necessarily as a prototype and prototype test, could give more valuable feedback to the designer about the design solution.

5.1.6. Test

One more negative aspect of the method used for prototype testing is that it may not have given a fair evaluation of the use experience. The situation did, as mentioned, not give the user much freedom of exploring and reflecting on the design but could rather be experienced as a stressed situation for the user, trying to solve a task while being observed. Since many users, during the site visits, showed insecurity in working and making decisions on their own, this was also considered in the tests where the individual test person is in a rather exposed
situation. That is one reason why the same users were chosen for the test that were already familiar with the thesis work and test performer. Already having established a brief relation was believed to make the users feel more confident in the test situation.

Overall, testing concepts of variating character showed that the users were drawn to features and functions that they could relate to. The small incremental changes got the most attention and reactions, like the changes in how the settings were displayed and the guide for easing the use. Maybe because they were directly linked to needs that the users were aware of and that they had enough experience about the functions to have an opinion about them. Both the new pages, the start page and the personal page for the onboarding process, made the users go silent while studying the page. This made the reaction hard to interpret, because when the users were asked for the reaction they responded very differently, even though they all acted the same way. Small incremental changes generated the most feedback during the tests, while the bigger changes were harder to take and the reactions harder to interpret.

5.2. Result Discussion

The ideas and prototype of this work is just a first attempt of approaching a solution of working with gamification in a user-centred process. Those are not the main result of the work, but rather tools for experimenting and testing solutions and methods. The result is what the study has shown and what can be learnt and used for further studies. The result contains at least three aspects to discuss, which were the foundation of the concepts tested.

Firstly, gamification can be built on extrinsic motivation, which is often seen in gamified examples. By adding rewards and incentives, the users of a system can be motivated into performing activities that create value for the individual or in an organization and help in motivating users towards a goal (Burke, 2014; Chou, 2015). As Pink (2011) claims, incentives and rewards are not good for the creativity, but can be efficient in simple routine tasks. A study on incentives as motivation by Farzan et al. (2008) also showed that incentives can create short term engagement and motivation which can transfer into meaningful activities triggered by the initial behaviour. Based on this theory, the idea emerged of creating an onboarding process as one concept, that was partly built upon extrinsic motivators in form of points, rewards and progress. The idea is based on the user needs of more control, ownership and understanding. So, by assisting and encouraging the user through a learning process of the tool, the user could learn to control and feel ownership of the tool and develop meaning through learning, understanding and generating the feeling of mastery. This sounds good in theory, but the prototype tests showed that the idea of using points and progress did not awake satisfaction and engagement for all users. The game references used did in this case not work well, because mainly the users representing the millennials generation related to the elements. As interpreted from the work of Prensky (2001), integrating games and gamification in work and educations is a strategy of motivating and engaging the millennials. And that the millennials are the main target group for gamification was also a part of what the prototype tests of this study showed. But this does not mean that gamification could not work for other generations. Extrinsic motivators and game elements can be designed to better reflect something that the whole user group can relate to and find motivating. Just because this thesis did not show a successful result of using game mechanics does not mean that it does
not work. More iterations are needed as well as more consideration to what works for the specific user group.

Secondly, gamification can be built on intrinsic motivators, which are harder to see and harder to create because they come from within a person (Deci & Ryan, 2000). For creating an experience built on intrinsic motivators a deeper understanding of the user motivations was needed. Since the user group consisted of multiple generations, personalities and attitudes, it was hard to find something that they all had in common. But one thing discovered was the importance of collaboration and social relations at work. Based on that, the social feed, the comments in settings and the team challenges were created as concepts. By embracing the social relations and collaboration found in the work and reflect it in the tool, the intrinsic motivation of relatedness and need to feel included can be strengthened, creating more meaning to the work done in the tool. The prototype testing did not show a clear response to the features, but positive comments were made by the users towards a more collaborative and social tool which eases both the use of the tool and the work in general. The prototype tests were not sufficient of proving if the concepts create motivation and engagement in the use of the tool. But the users seemed to have a positive attitude towards the social features.

Thirdly, the usability issues need to be discussed. The main focus in the gamification literature is on creating a motivating and engaging experience for the users (Deterding et al., 2011; Seaborn & Fels, 2014; Burke, 2014; Chou, 2015). But how is such a work initiated in a system where there are usability issues? The initial reaction when usability issues were encountered was that those needed to be fixed before starting to work with motivation. But no theory is found in this work that suggest how to handle usability issues of a product when working with gamification. Not handling issues and problems of use in an existing product will surely not make it more usable by adding motivating elements. A decision was made to include one usability issue identified, the bonus concept concerning the settings, and to see how this affected the work. The issue was that the tool settings were creating insecurity among the users and sometimes had negative effect on the result of the work that was performed. A solution to this was displaying the recent changed settings on the start page, and show when and by whom the change was made as well as adding the possibility to create comments to the settings. This generated the best user response and feedback during the prototype tests. So, for creating a usable product, focusing on the motivating gamification solutions should in this case not be the priority. But instead try to create higher usability and user satisfaction through identifying and adjusting the existing issues in a user-centred way. Ideally, the issues could be fixed having gamification and motivation in mind.
6. Conclusions

Conclusions are made by answering the research questions defined at the beginning of the thesis.

RQ1: **How can gamification theory be used in practice by including it in a design process?**

Studied literature did not give a mutual suggestion of how to include gamification in a design process. While some theory present gamification as a tool for applying game elements and mechanics onto a design, other literature suggests using inspiration from games in a human-centred design process to satisfy the user needs, goals and motivations. The case study has shown the later to be a suiting approach in the development of an optimization tool for production of district heating. By including gamification in a user-centred design process, it influenced the work by considering motivation theory and motivating aspects from games when studying the users and use context, as well as when creating and evaluating ideas. The process helped to focus on the users, while gamification created insights and awareness about user motivations.

RQ2: **How can gamification be applied with a user-centred approach in the development of an existing optimization tool for production of district heating?**

A user-centred approach is obtained by working with gamification and the case study in a user-centred design process. User-centred methods were used throughout the process which were influenced by considering gamification and motivation theory. The user needs, goals and motivations were always in the centre, while game elements and mechanics worked as an inspiration in the solutions. For the game mechanics and elements to create more motivation in this case, they needed to be built on the underlying motivational drivers of the users. Considering gamification helped to find them by focusing on what created an engaging experience for the users, by having games and motivation in mind. With the varying attitude of the broad user group in this case, not all users could relate to solutions including pure game elements. Solutions with higher focus on the intrinsic motivators of the users, discovered by having a user-centred approach, generated a more common appreciation.

RQ3: **How can a prototype be used to visualize and test gamification concepts in the development of an existing optimization tool for production of district heating?**

Prototyping was used in the case study by first sketching interfaces when starting to visualize the generated gamification concepts, and then creating a high-fidelity prototype for further visualization and user testing of the concepts. The tests with the high-fidelity prototype showed that the prototype in this case worked best for evaluating the user reactions on incremental changes in the design of the optimization tool. For the more radical changes in the prototype design, the test method did not generate enough feedback to evaluate the user experience. Other methods for visualizing and testing the concepts could give a better result, which is a subject for further studies.
7. Areas of Further Studies

The work of this thesis is only an explorative start of studying gamification in the design process of the optimization tool. More iterations and user inputs are needed for creating a user experience that satisfies the whole target group. The result chapter gives suggestions for how to proceed with the case. But some areas of further studies are stumbled upon during the work, which would benefit both this work and the area of gamification and user experience design. The areas are listed below.

**How can usability issues be handled when working with gamification?**
The work faced a problem when usability issues were identified in the tool, but the main work aimed at working with gamification for creating motivation and engagement.

**How is the management at a work place affecting the employees’ reaction on gamification? And how could the management be involved in the process of working with gamification?**
During field studies, it was observed that a transparent organisation, where the manager was working close to the technicians and allowing more freedom and responsibility, created a greater engagement, confidence and curiosity among the workers.

**How can a combination of extrinsic and intrinsic motivation be used for creating a boost of engagement which over time turns into meaningful interaction?**
Theory on motivation highlight that the use of extrinsic motivators can trigger a period of high engagement, but also that it can have a negative effect on creativity and productivity. To continue studying the idea of an onboarding process that triggers engagement for using a product, it is interesting to study if the effectiveness of extrinsic motivation can turn into intrinsic motivation over time. Can it help the user in the learning process and to see the positive outcomes of using the product? Or do its negative side effects ruin the chance of creating a meaningful interaction with the product?

**What is an appropriate way of testing and measuring user reactions early in the concept phase of working with gamification?**
The way of testing the user experience of the prototype in the case study was not the optimal way of evaluating a gamification concept. Maybe a combination of user-centred methods and play testing in game design could be used?

**How can co-creation with users be used in prototyping when working with gamification?**
In the case study, the users were involved during the initial phase and the testing phase. But how could the users have been involved during prototyping for creating a better user experience in the result? Using more co-creating methods in prototyping could maybe lead to better results faster, since it is hard to create a feeling or an experience when the actual users are not present.
Gamification in Energy Production
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Gamification in Energy Production


Gamification in Energy Production


Appendix I  Interview Questions

The interview questions formulated for the site visits acted as guidance and structure during the observations and interaction with the users.

Questions for Operating Technicians:

1. Different tasks are performed in the control room.
   a. How are the different tasks managed in the work team? Are you responsible for certain tasks or is the work rotated?

2. The work is conducted in work teams working in shifts.
   a. Are you always the same group working together?
   b. How is the work conducted among team members? Collaboration or more individual work tasks?
   c. How is the atmosphere between the work teams? Is it a competition of performance?
   d. How do you reflect upon your performances? How do you get feedback on it?
   e. How is a good performance perceived? Is it the own performance that matters, or the team effort?

3. The optimization tool shows optimal plans for production and outcome of production to compare with optimal outcome.
   a. What did you think when you first started using the tool?
   b. How do you use the tool now?
   c. Who is using the tool?
      i. Is someone responsible for generating the optimal production plans?
   d. Why do you think the new tool is going to be used here?
   e. How was this handled before?
   f. Has the tool made it easier? How?
   g. What problems and negative aspects do you see with the new tool?
      i. How could this be solved in a better way?
   h. What would you like to add? What would you like to remove? What would you like to improve?
   i. What do you want the tool to improve?
Questions for key user and power plant managers:

1. Tell me about your role at the power plant.
   a. What has been your role in the implementation of the optimization tool?

2. How has the tool been introduced to the operating technicians?
   a. Has everyone been involved? A meeting/education?

3. How is it used now?
   a. Who is using it?
   b. How do you decide what is a good plan? Who is doing that?

4. Is this a tool that has been missing in your organisation?
   a. How is it going to be used here? What will be improved by using it?
   b. Has something improved by using it? What?
   c. How was this handled before?

5. Questions while looking at the tool:
   a. What was your reaction when you first started using the tool? Positive/negative?
   b. What is your experience of optimization in energy production? Have you previously used another tool for this?
   c. When looking at the calculated optimal plan, do you think this gives a realistic image of how a power plant works?
      i. How does it work for your plant?
   d. What is an appropriate time span for planning and creating an overview for production?
   e. What are the important affecting factors when planning how to operate the energy production?
      i. Do you think the tool considers this?
   f. What overall problems and negative aspects do you see in the tool today?
      i. How could this be solved in another way?
   g. What would you like to add? What would you like to remove? What would you like to improve?
   h. Something that I have seen is that the technicians do not feel comfortable in playing and testing the tool, because it affects the plan that is used in the daily production. How do you think we could solve this?
   i. What do you want the tool to improve?
Appendix II: Empathy Map

- It is usually already decided by someone else what values to write
- The tool helps in creating a common ground between the shift teams
- Managers want to see how many times the optimization has been run
- Want to be able to make comments on deviations in the outcome graph
- Want to use the tool for planning and evaluation of production
- Want the option to see the plan on both a shorter and longer time period
- Want to have a separate screen in the control room for using the tool
- If you play and test things in the tool, there is a risk of distroying what everyone else sees
- A test tool or function would help in learning and playing with the tool
- Want to know what the original plan was after making changes in settings
- Offer simplicity for the operating technicians with no unnessecary features that do not affect the daily work
- The system should be able to improve itself by learning from its own data
- What are real values and what are prognostic values?
- Want an accuracy measure to see how accurate the prognostics are
- Would like the tool to more reflect the real world conditions
- Want to have more flexibility in what values to use in settings
- Meeting the other shifts and colleagues creates a positive exchange of experience and information
- More responsibility and clear rules can create more engagement

- Want to be able to control the settings more
- Everyone following the plan should result in a more uniform view and operation
- Do not want to be acknowledged or destroy for others by changing settings or generating an inaccurate plan
- Do not understand/recognize all labels and settings in the tool
- Wish to see stronger connections to the production control system
- Stronger connections to weather and values used in operation
- Don’t want to be responsible if something is destroyed or wrong
- The tool results in one additional screen to look at
- Managers want to be able to track how the optimization is used and followed
- Want to be able to change values in tool to match the real world conditions so that the plan will match the performance
- Easier to operate according to plan if it shows a time interval closer to the own work hours
- Want to gather all important information in one place
- The technicians want direct help from the tool and don’t accept complications, while the menagers want the long term benefit
- Worried that the tool will be adjusted depending on the operation and not the other way around

Change the values and settings assigned and generate plan on routine
Interpret how previous shift has worked by studying their optimal plan
Generate a optimal plan at beginning of work shift and follows it
Have many screens to look at in the control room
Before using the tool, the weather prognostic helped in planning production
Validates the tool by generating a plan and then comparing it to the outcome
Different parameters and variables are written down on a whiteboard that are helping in planning how to operate
Deviations are noted in a log/diary
A monthly report is created of outcome and deviations of production
Some users are curious and want to use and learn more about the tool, while others are careful and rather peek over the shoulder of another user
The users are not testing and “playing” with the tool
Rather focus on the moment (hour) instead of looking at the whole (day/week)
Optimize because they have to, but sometimes forget
It is often the shift leader that generates the optimal plan in the tool
Print the plan to be able to check it during the day by following it hour by hour

SAID

- Limited power - in the own work
- Fear - of making mistakes
- Lack of control - because the tool does not reflect the real conditions
- Insecurity - when inadequate Information is given
- Dejection - because there is no point in using the tool if you do not have the conditions to follow the plan
- Reluctance - if the tool is not working as it should
- Competition - want to follow plan as well as possible
- Fear - for being made responsible for destroying for others
- Lack of interest and reliability - when you don’t see the benefits
- Excluded - when information is not shared with everyone
- Messy - with many tools and screens to keep track of
- Lack of trust - when the tool shows strange numbers
- Some feel curiosity and want to explore
- When information is shared and the tool is used while gathered in meetings, a higher confidence and acceptance is shown
- Engagement - for the environment, economy and own accomplishments

DID

- Want to be able to control the settings more
- Everyone following the plan should result in a more uniform view and operation
- Do not want to be acknowledged or destroy for others by changing settings or generating an inaccurate plan
- Do not understand/recognize all labels and settings in the tool
- Wish to see stronger connections to the production control system
- Stronger connections to weather and values used in operation
- Don’t want to be responsible if something is destroyed or wrong
- The tool results in one additional screen to look at
- Managers want to be able to track how the optimization is used and followed
- Want to be able to change values in tool to match the real world conditions so that the plan will match the performance
- Easier to operate according to plan if it shows a time interval closer to the own work hours
- Want to gather all important information in one place
- The technicians want direct help from the tool and don’t accept complications, while the menagers want the long term benefit
- Worried that the tool will be adjusted depending on the operation and not the other way around

THOUGHT

FELT

- Change the values and settings assigned and generate plan on routine
- Interpret how previous shift has worked by studying their optimal plan
- Generate a optimal plan at beginning of work shift and follows it
- Have many screens to look at in the control room
- Before using the tool, the weather prognostic helped in planning production
- Validates the tool by generating a plan and then comparing it to the outcome
- Different parameters and variables are written down on a whiteboard that are helping in planning how to operate
- Deviations are noted in a log/diary
- A monthly report is created of outcome and deviations of production
- Some users are curious and want to use and learn more about the tool, while others are careful and rather peek over the shoulder of another user
- The users are not testing and “playing” with the tool
- Rather focus on the moment (hour) instead of looking at the whole (day/week)
- Optimize because they have to, but sometimes forget
- It is often the shift leader that generates the optimal plan in the tool
- Print the plan to be able to check it during the day by following it hour by hour
Appendix III  User Personas

Klas Ström
The Optimistic Youngster

“I feel good about seeing positive results of my work, and the variating tasks can be thrilling when not knowing what to expect.”

ABOUT
Klas works in shifts together with a group of other men in different ages. He most often looks forward going to work, because of the social relations and excitement in not knowing what will happen that day. But it can also be hard to work during the night or weekend and have to go out to fix a problem all by himself. Working together with the colleagues makes him feel self confident and many laughs are shared during a work day. Klas feels good and confident when he sees positive results of his work, which motivates him to continue to work hard.

AGE 29
OCCUPATION Operating Technician
LOCATION Heby, Sweden
FAMILY Girlfriend

TECHNOLOGY EXPERIENCE

<table>
<thead>
<tr>
<th>IT and Internet</th>
<th>Software</th>
<th>Mobile Apps</th>
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</thead>
</table>

WORK CULTURE

<table>
<thead>
<tr>
<th>Formal</th>
<th>Informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive</td>
<td>Cooperative</td>
</tr>
<tr>
<td>Structured</td>
<td>Unstructured</td>
</tr>
<tr>
<td>Individual Achievement</td>
<td>Group Achievement</td>
</tr>
</tbody>
</table>

GOALS
See the results and get recognized for the own accomplishments
Feel secure in actions
Improve knowledge and skills

PAIN POINTS
Insecurity in decisions
Go to work to fix a problem in the night
Never time for co-workers to do something all together after work

MOTIVATORS

- Money
- Variation in Work
- Feel in Control
- Acknowledgement
- Social Relations
Gunnar Kraft
The Stubborn Senior

“Running the power plant makes me feel in control like a pilot in his cockpit.”

AGE 55
OCCUPATION Operating Technician
LOCATION Sala, Sweden
FAMILY Wife, kids, grandkids

ABOUT
Gunnar is a operating technician at a power plant. He feels confident about his work, but is refusing to believe that new technology could replace the intuition of the technicians. They know their plant and no computer could do their work as good. He likes the variety of the work, alternating physical labor with leaning back in the controller chair. The days fly by quickly while joking and laughing with the co-workers. Seeing and feeling that the plant is working as Gunnar wants to, makes him feel confident and motivated to keep up the good work.

TECHNOLOGY EXPERIENCE

IT and Internet
Software
Mobile Apps
Social Networks

WORK CULTURE

Formal
Informal
Competitive
Cooperative
Structured
Unstructured
Individual Achievement
Group Achievement

GOALS
Foresee and handle problems in a smooth way
Less maintenance work
Software that is easy to handle

PAIN POINTS
Struggle with technology
Equipment not working
Go to work to fix a problem in the night
Ola Stark
The Contradictive Leader

“I really like the operating technicians to take more responsibility and action, but I don’t want to give them too much power.”

About
Ola is head of operation at a power plant. He enjoys the problem solving and analytical thinking required in his job, but gets frustrated when problems occur that he has no control of. He struggles with motivating the operating technicians and believes in giving them more responsibility and power of the operation. But at the same time Ola is afraid of losing control if giving the workers too much power. Seeing results and success of his accomplishments makes him confident and motivated to keep working and trying to find a balance of power and control.

Technology Experience
- IT and Internet
- Software
- Mobile Apps
- Social Networks

Work Culture
- Formal
- Informal
- Competitive
- Cooperative
- Structured
- Unstructured
- Individual Achievement
- Group Achievement

Motivators
- Money
- Business Success
- Accomplishments
- Social Relations
- Feel in Control

Goals
- Transferring more responsibility and power to the technicians
- Motivate the workers
- Improving the operation of the power plant

Pain Points
- Unmotivated workers
- Operating problems generating costs
- Not feeling safe about entrusting the workers with enough power
## Appendix IV  Affinity Diagram

<table>
<thead>
<tr>
<th>Social aspects</th>
<th>Learning</th>
<th>Feedback/information</th>
<th>Challenges</th>
<th>Reward system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibility to like/verify and comment on</td>
<td>Encouraging simple actions</td>
<td>Show what settings are changed and other important</td>
<td>Catch coins/stars in the production graph by following the optimal plan</td>
<td>Get different titles in the tool, the more you learn</td>
</tr>
<tr>
<td>things</td>
<td></td>
<td>information on the start page</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share information, like productions plans</td>
<td>Guide through the tool</td>
<td>Be able to compare different settings and results to</td>
<td>High-score in which team produces the lowest cost per MWh energy</td>
<td>Get more access to functions and setting the more you learn</td>
</tr>
<tr>
<td>and settings</td>
<td></td>
<td>learn and draw conclusions</td>
<td>produced</td>
<td></td>
</tr>
<tr>
<td>Chat-function</td>
<td>Get more access to functions and setting the</td>
<td>More feedback and information on settings, who changed</td>
<td>Competition between teams or between plants</td>
<td>Get rewarded for simple actions</td>
</tr>
<tr>
<td>more you learn</td>
<td></td>
<td>them and why</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social media news stream</td>
<td>“Sand box” where the users can try different</td>
<td>Progressbar showing in some measure how well the plan</td>
<td>Percentage on how well the team follows the optimal plan</td>
<td>Unlock a secret module in the tool when reaching a certain level or streak</td>
</tr>
<tr>
<td>setting without changing what everyone</td>
<td>setting without changing what everyone else</td>
<td>is followed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sees</td>
<td>sees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups that represent the work team</td>
<td>Videos and hints that help the user</td>
<td>Goals to reach and feedback on how the users are</td>
<td>Reaching different levels of experience in the tool</td>
<td>Point system based on costs (positive cost result is rewarded, negative is not)</td>
</tr>
<tr>
<td>See the performance of the team</td>
<td>Encouraging the users to analyze and comment</td>
<td>progressing against the goals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User can use gathered</td>
<td>on the plan and settings and results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forum for discussing what</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>settings should be used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be able to talk to technicians at</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share success stories both</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>internally at the plant and with</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourage rotating who does the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>optimization each day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re-set button so that all changes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A narrative that creates meaning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and understanding for how and why to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>optimize</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points/rewards are exchanges for new</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>things for the department/plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concepts</td>
<td>Mechanics</td>
<td>Motivators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Individual onboarding process</strong> - the user collects experience points by performing activities, like optimizing, changing and commenting settings, reflecting on results, etc. More experience generates more authority in the tool. Statistics showing individuals experiences, and personal page with stats.</td>
<td>Points, Badges, Leaderboards? Mastery, Gather experience Levels</td>
<td>Developing skills, Learning, Exclusivity, Acknowledgement, Feedback, Points, Surprises</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Team onboarding process</strong> - Collaboration in work is reflected in the tool. Reward system includes the whole team. Both individual and team efforts trigger rewards for the team - like collaborating, discussing, commenting etc.</td>
<td>Points, Leaderboards, Social aspects, Gather experience Levels</td>
<td>Developing skills, Feedback, Points, Relatedness, Meaning, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Individual reward</strong> - The user collects points/experience individually that can be exchanged for a personal reward or for the team.</td>
<td>Social aspects, Goals</td>
<td>Real-world reward, Relatedness, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. Team reward</strong> - Everything that the individual users perform is gathered in a team reward. Team effort and collaboration is needed for reaching goals and claiming rewards.</td>
<td>Social aspects, Goals</td>
<td>Physical reward, Relatedness, Meaning, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5. Forum/social feed</strong> - Social pages for the teams/plants/all users of the tool to share news, production plans, stories, best practices, skills or just for fun.</td>
<td>Social aspects, Gather experience</td>
<td>Learning, Relatedness, Feedback, Meaning, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6. More information on settings</strong> - Show more feedback on settings like who changed what and when, previous values etc. and possible to comment on the setting when changed.</td>
<td>Social aspects, Gather experience</td>
<td>Learning, Developing skills, Acknowledgement, Meaning, Feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>7. Guide/Instruction for the tool</strong> - On each page in the tool, there should be a way to find more information/help on what the page displays and possible actions. Narrative, fun illustrations and/or videos for guiding and informing the user and give more meaning to the tool and why to optimize.</td>
<td>Gather experience</td>
<td>Learning, Feedback, Relatedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>8. Team challenge: cost-saving</strong> - The team/plant gathers points/positive feedback by holding the production as optimal as possible (In an optimal zone) - a streak of optimal production during multiple hours give more points/extra positive. The team gets a reward when a certain goal or level is reached (like a cake).</td>
<td>Mastery, Mål, Bygga erfarenhet Sociala aspekter</td>
<td>Liderande, Utveckling, Belönning, Feedback, Tillhörighet, Erikkändande</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>9. Team challenge: optimal production</strong> - Teams are challenging each other in optimal production measured in costs/MWh. Team vs team internally or teams/plants against each other of all plants with the tool that want to participate. The best team ends up in the top of a high-score and the others have to &quot;push them down&quot;.</td>
<td>Mastery, Goals, Social aspects, Points, Leaderboards, Levels</td>
<td>Learning, Developing skills, Feedback, Relatedness, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>10. Informative startpage</strong> - Relevant information is displayed on the start page so the user can get a holistic view of the current conditions. Like news, latest settings changed, current weather and performance of the plant.</td>
<td>Gather experience, Social aspects</td>
<td>Feedback, Relatedness, Meaning</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>11. Collaboration/Including</strong> - The teams and the production managers are collaborating to create rules and guidelines for how to use the tool. A page/forum in the tool where the rules are set and everyone can comment and agree/disagree.</td>
<td>Goals, Gather experience, Social aspects</td>
<td>Learning, Feedback, Meaning, Acknowledgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>12. Free periods</strong> - Only the operating technicians are allowed to experiment with the tool during a period, for gathering experience and have the courage to &quot;play&quot; with the tool without feeling that they could do something wrong. The period is analyzed afterwards to learn and share insights and experiences.</td>
<td>Gather experience, Social aspects, Mastery</td>
<td>Learning, Developing skills, Feedback, Relatedness, Meaning, Acknowledgement, Autonomy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix VI  Concept Screening

In the concept elimination and concept selection of the case study, the procedure of using concept screening by Ulrich & Eppinger (2008) was used which is described in chapter 3.4.3. The twelve generated concepts were first evaluated against each other and against a number of selection criteria, which were generated from the user needs, goals and motivations identified during the site visits. The procedure was performed individually, but with the user and employee perspectives gathered during site visits and the idea generation held at Sigholm. The first screening results, seen in Table 1, were generated by evaluating all concepts against the reference concept, which in the first screening was concept 1.

After the first screening, the sums of +’s, -’s, and 0’s were calculated, and the ones with the highest net score were chosen to continue in the evaluation. The screening matrix was used again, only containing the remaining concepts and changing the reference concept to concept 2. After performing the screening a second time, as seen in Table 2, the three concepts with the highest net score were chosen to proceed with in the concept development.
Table 2. Second result of concept screening.

<table>
<thead>
<tr>
<th>Selection criteria</th>
<th>2</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Same</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Worse</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sum of +’s</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Sum of 0’s</td>
<td>14</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Sum of –’s</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Net score</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Continue</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>n</td>
</tr>
</tbody>
</table>
Appendix VII  Prototype Test Tasks

The tasks given to the users during the prototype tests are listed below.

Task 1: *Find out from the start page if there are any news since you were last online*

Task 2: *Go to the settings page and find out more about the latest changed setting. Find out who changed it, when and why.*

Task 3: *Go to the optimization page and find more information and help on how to use it.*

Task 4: *Find and go to the personal page.*

Task 5: *Find out how to reach the highest experience level.*

Task 6: *Find out how to get experience point for signing in to the tool.*

Task 7: *Find more information and help about the team page.*
Appendix VIII  Prototype Test Surveys

In prototype testing, the test users are asked to fill out a survey before and after the test. The first survey for collecting information about experience and perception of the current tool, and the second to create an indication of the prototype user experience in form of a SUS-measure.

Survey before prototype testing:

1. How often do you sign in to the optimization tool?
   - Daily
   - 1-3 times a week
   - Less often
   - Never

2. How fun is it to use the optimization tool?
   - Very fun
   - Quite fun
   - Quite boring
   - Very boring

3. How well do you think the optimization tool is working?
   - Very good
   - Quite good
   - Quite bad
   - Very bad

4. Do you think the optimization helps you in planning production?
   - Often
   - Sometimes
   - Seldom
   - Never

5. Do you think the optimization helps you get better results?
   - Often
   - Sometimes
   - Seldom
   - Never

6. What do you like the best about the optimization tool?

7. What do you like the least about the optimization tool?
SUS survey after prototype testing:

1. I think that I would like to use the new tool frequently
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

2. I found the new tool unnecessarily complex
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

3. I thought the new tool was simple to use
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

4. I think I would need support to be able to use the new tool
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

5. I found the functions in the new tool were well integrated
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

6. I thought there was too much inconsistency in the new tool
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

7. I think most people would learn to use the new tool quickly
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

8. I found the new tool very cumbersome to use
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

9. I felt very confident in using the new tool
   
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

10. I needed to learn a lot of things before I could use the new tool
    
    | Strongly Disagree | Strongly Agree |
    |-------------------|----------------|
    | [ ]               | [ ]            |
### Appendix IX  Prototype Test Result

<table>
<thead>
<tr>
<th>User</th>
<th>Task 1: <em>Find out from the start page if there are any news since you were last online.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>A (technician ≈40 years old)</td>
<td>Does not understand why there should be a social feed. Does not make the association to social media, and seems to be stressed and confused by all the information displayed.</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Immediately makes the association to social media and the red notation that something new has been posted.</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Scans the start page and then starts clicking on the tabs for the social feeds.</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>Interprets the task as to look for what is different in the design, and concludes that most of the things are new. Likes that the settings are displayed on the start page and comments that you also should be able to see why a change has been made.</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Quickly finds the tabs for the news feeds and starts clicking between them.</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>Finds it confusing with so many frames with different content on the same page, “you have a hard time to decide where to look”.</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Scans the page and comments on the various information, but does not interact with the page.</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>The settings immediately catch the attention, to see what has been changed there. Interprets the task as to look for all settings and news that had been added during the previous shift. The attention then wanders to the news feed and the tabs are clicked.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Scans the page quickly and the red notation quickly catches the eye.</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Starts comparing the different hours displayed with when he was latest online in the tool. When he finds the news feed he comments that the question became clear.</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Does not understand the task. Likes that you can see the status of the different plants and starts thinking about other measurements to display on the start page.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>Interprets the question, like many others, as what is new in the design. Does not react on the tabs of the social feed but lays the focus on the settings.</td>
</tr>
<tr>
<td>User</td>
<td>Task 2: Go to the settings page and find out more about the latest changed setting. Find out who changed it, when and why.</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈40 years old)</td>
<td>Comments that it is positive to see why a setting has been changed and that it is an improvement of the tool.</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Does not see what is new, but then finds the chat-symbol and clicks it.</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Looks at the date and time which has been last changed, and reads from one end of the line to the other until the symbol is found and clicks it.</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>Finds the symbol immediately and comments that this is something that the tool has been lacking. Believes that it will create more learning and understanding of why settings are changed, and will create more courage of changing it themselves.</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Finds the comment quickly and comments that it is a good change.</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>“Great with comments! It is valuable.”</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Looks for a long time and then finds and clicks the comment.</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>Immediately finds the comment, clicks it, reads it and smiles.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Finds the comment quickly and clicks it.</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Likes the comment-function, &quot;very straight forward&quot;</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Likes it. &quot;Eases the communication&quot;</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>Performs the task without leaving the start page, by looking at the settings displayed there and linking them to the posts in the news feed.</td>
</tr>
<tr>
<td>User</td>
<td>Task 3: Go to the optimization page and find more information and help on how to use it.</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈ 40 years old)</td>
<td>Did not find the question mark.</td>
</tr>
<tr>
<td>B (technician ≈ 27 years old)</td>
<td>Finds the question mark and clicks it. Reads the information and answers the question.</td>
</tr>
<tr>
<td>C (technician ≈ 50 years old)</td>
<td>Does not find the question mark. Looks for information and asks what information is meant. Thinks that the task is vague.</td>
</tr>
<tr>
<td>D (technician ≈ 30 years old)</td>
<td>Does not find the question mark. Task is not clear what to look for.</td>
</tr>
<tr>
<td>E (manager ≈ 50 years old)</td>
<td>Finds the question mark immediately. Reads the information smiling.</td>
</tr>
<tr>
<td>F (manager ≈ 45 years old)</td>
<td>Does not find the question mark.</td>
</tr>
<tr>
<td>G (technician ≈ 60 years old)</td>
<td>Does not find the question mark.</td>
</tr>
<tr>
<td>H (technician ≈ 27 years old)</td>
<td>Finds it not at first, but when he does he comments that it was the word “help” that is associated with the question mark.</td>
</tr>
<tr>
<td>I (technician ≈ 35 years old)</td>
<td>Looks for information on the page and explains the different functions and features with its values and labels. Does not see the question mark.</td>
</tr>
<tr>
<td>J (manager ≈ 45 years old)</td>
<td>Quickly finds the question mark, but comments that “more information” in the task confuses what to look for.</td>
</tr>
<tr>
<td>K (technician ≈ 40 years old, language issues)</td>
<td>Wants the function explained and comments that it is a good function. Wants there also to be a customer support chat.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈ 27 years old)</td>
<td>Finds the question mark quickly, comments that the question should be of an analysing character that makes the user feel more competent. Does not feel good to get points when the questions are too easy.</td>
</tr>
<tr>
<td>User</td>
<td>Task 4: <em>Find and go to the personal page.</em></td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈40 years old)</td>
<td>Did first not understand how to get to the personal page. First impression of the page “this is ok”</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Finds the page. Relates to XP and experience level. Likes the layout “it is nice and simple”. Does not play games himself but says that it is common knowledge to recognize this kind of interface.</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Finds the page</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Quickly finds the page.</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>Find the page after a while</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Gets help.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>Finds the page.</td>
</tr>
<tr>
<td>User</td>
<td>Task 5: Find out how to reach the highest experience level.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈40 years old)</td>
<td>Does not relate to XP and experience levels. Connects the word experience with his experience as operating technician.</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Immediately connects the task to the progress bar and clicks on the star for the highest level. “Points are fun. It gets more motivating when you can see your progress”</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Tries to go to the question mark on the left page. When that is not clickable, he turns to the question mark on the team page and tries to solve the task by reading there. Confusing that the personal page and the team page are next to each other.</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>Looks at the table of current activities and draws conclusions for what generates experience points.</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Immediately relates to the progress bar and clicks at the star on the right end.</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>Thinks that it is not clear what experience level means.</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Thinks that the task is too vague.</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>Enjoys clicking around on the page and looks what activities give experience points. Does not immediately connect the experience level to the progress bar, but when he finds out he comments that it was obvious afterwards.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Immediately looks at all the icons and interacts with them.</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Looks at the table and draws conclusions on what generates experience points.</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Thinks that points are not the right way of motivating because it takes away the focus from the meaning of using the tool.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>Scans the page. Tries clicking the question mark on the personal page and then turns to the question mark on the team page and reads the information and answers the question.</td>
</tr>
<tr>
<td>User</td>
<td>Task 6: Find out how to get experience point for signing in to the tool.</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈40 years old)</td>
<td>Laughs and says that he would sign in many times per day to get more points.</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Finds the icon quickly and clicks it. Feels comfortable in the interface.</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Goes to the question mark on the team page to try to find the answer there.</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>First scans the table and sees that you get points for signing in, but then finds the icon and clicks it.</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Finds the icon immediately.</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>Finds the icon immediately.</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Scans the page and finds the icon.</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>First goes towards the question mark, but then sees the icon and goes there instead.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Finds the icon immediately.</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Finds the icon immediately.</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Finds it stupid to reward such simple things as signing in to the tool. Believes it to create motivation for some to sign in more frequently, but thinks that it removes the purpose of those that already find meaning in using the tool.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>First scans the table and sees that you get points for signing in, and then goes to the question mark for the team page.</td>
</tr>
<tr>
<td>User</td>
<td>Task 7: Find more information and help about the team page.</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>A (technician ≈40 years old)</td>
<td>First goes to the icon on the personal site that says team challenge, but then goes to the question mark on the team page.</td>
</tr>
<tr>
<td>B (technician ≈27 years old)</td>
<td>Directly turns to the question mark on the team page. Believes that gamification can create more motivation for some of the operating technicians, but thinks that it does not fit all. He would like it and asks when it will be implemented in the tool.</td>
</tr>
<tr>
<td>C (technician ≈50 years old)</td>
<td>Recognizes the function from previous task and feels safety in turning to the help-function when not sure what to do.</td>
</tr>
<tr>
<td>D (technician ≈30 years old)</td>
<td>Directly turns to the question mark</td>
</tr>
<tr>
<td>E (manager ≈50 years old)</td>
<td>Directly turns to the question mark</td>
</tr>
<tr>
<td>F (manager ≈45 years old)</td>
<td>Directly turns to the question mark but thinks that the challenge is hard to understand.</td>
</tr>
<tr>
<td>G (technician ≈60 years old)</td>
<td>Directly turns to the question mark</td>
</tr>
<tr>
<td>H (technician ≈27 years old)</td>
<td>Directly turns to the question mark, but the challenge is not clear.</td>
</tr>
<tr>
<td>I (technician ≈35 years old)</td>
<td>Directly turns to the question mark</td>
</tr>
<tr>
<td>J (manager ≈45 years old)</td>
<td>Directly turns to the question mark and thinks it is good that it is found on the same place on all pages.</td>
</tr>
<tr>
<td>K (technician ≈40 years old, language issues)</td>
<td>Does not like the challenge. Says that you sometimes have no other choice than producing energy with oil, so using oil as a symbol of non-optimal production is not good.</td>
</tr>
<tr>
<td>L (Sigholm employee ≈27 years old)</td>
<td>Hard to understand the challenge, but good that you can get feedback like that, but it needs to be easier to interpret. Using two different point systems is confusing.</td>
</tr>
</tbody>
</table>