Design and Implementation of Gamification Strategies for Enterprise Data Management Systems

Master's Thesis
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In cooperation with:

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Abstract

This master's thesis aims to provide a possible solution for adding a gamification layer to an Enterprise Data Management Software, in this particular case, to the MUM Software. This software, developed at Netconomy Software & Consulting GmbH, provides a solution for handling complex and extensive companies' data. Due to the huge amount of available data, MUM provides a solution for Master Data Management, Organization Management and Human Resource Management, to name only a few. However, there are two issues regarding the existing client of the software: a shortcoming with regard to its usability and a lack of motivation on part of its customers to maintain its data. To address the issue regarding the usability, a newly designed prototype is developed from Netconomy Software & Consulting GmbH using Vaadin. Based on these two software versions, the first usability study is conducted with 10 real customers of the software. To address the second issue, another gamified mockup prototype is developed based on the new design. The added gamification layer includes points, progress bars, badges and a leaderboard. With a second usability study, conducted with 20 employees from Netconomy Software & Consulting GmbH, the proposed gamification process and its game elements are evaluated. The System Usability Scale is compared for all three different software versions, showing that the gamified mockup prototype reaches the highest score in terms of usability.

Kurzfassung

Diese Masterarbeit zielt darauf ab, eine Lösung für das Hinzufügen einer Gamification-Schicht zu einer Enterprise Data Management Software, in diesem speziellen Fall der MUM Software, bereitzustellen. Diese von der Netconomy Software & Consulting GmbH entwickelte Software bietet eine Lösung für den Umgang mit komplexen und umfangreichen Unternehmensdaten. Aufgrund der großen Menge verfügbarer Daten bietet MUM eine Lösung für Stammdatenmanagement, Organisationsmanagement und Personalmanagement, um nur einige zu nennen. Es gibt jedoch zwei Probleme in Bezug auf den bestehenden Client der Software: ein Mangel in Bezug auf seine Benutzerfreundlichkeit und eine geringe Motivation seitens seiner Kunden, Daten darin zu pflegen. Um dem Thema Usability gerecht zu werden, wurde mit Vaadin ein neu konzipierter Prototyp von Netconomy Software & Consulting GmbH entwickelt. Basierend auf diesen beiden Softwareversionen wird die erste Usability-Studie mit 10 Echtkunden der Software durchgeführt. Um das zweite Problem anzugehen, wird ein weiterer Gamified Mockup Prototyp, basierend auf dem neuen Design, entwickelt. Die hinzugefügte Gamification Ebene enthält Punkte, Fortschrittsbalken, Badges und eine Rangliste. Anhand einer zweiten Usability Studie, die mit 20 Mitarbeitern der Netconomy Software & Consulting GmbH durchgeführt wurde, werden der vorgeschlagene Gamification-Prozess und seine Spielelemente evaluiert. Darüber hinaus wird der System Usability Scale für alle drei verschiedenen Software-Versionen verglichen, was zeigt, dass der amified mockup Prototyp die höchste Benutzerfreundlichkeit erreicht.

Acknowledgements

As this Master's Thesis was developed in cooperation with Technical University of Graz and Netconomy Software & Consulting GmbH, I would like to express my deep gratitude to my supervisors on both sides. Christian Gütl and Johanna Pirker from the Institute of Interactive Systems and Data Science (ISDS) were constant contact persons throughout this work. Without their steady will of giving valuable feedback, patient guidance and support, none of this would have been feasible. Gernot Lepuschitz and Stefan Dorner from the MUM team in Netconomy Software & Consulting GmbH were willing to help at any time. Whenever questions aroused, I was not only provided with the appropriate resources to clarify and solve them, they also took their time to support me using personal meetings if needed.

Moreover, I would like to thank every Netconomy Software & Consulting GmbH employee, who offered his/her precious time and took part in the usability studies. I would like to express my special thanks to the two employees who participated in both usability studies and therefore revealed interesting and valuable findings.

Finally, I would like to express my deep gratitude to my whole family and friends, who supported me not only during this work but my whole studies. Without their steady support, patience, motivation and love, nothing of this would have been possible.

Contents

1 Introduction

Designing software interfaces can be challenging. One main aspect, which should be considered, is the software's usability. Usability tests aim at the development of easy and intuitively usable software. In addition, usability tests do not only offer benefits for the customer of the software, but also for the software publisher, such as a reduction of development, training and maintenance costs (Donahue, 2001).

Once the users understand how to use the software and its functionalities, it is important to keep them engaged and the software interesting. This is where gamification needs to be considered, which becomes more and more promising recently. Gamification, as "*the use of game design elements in non-game contexts*", evolved within a few years to a well-known concept (Deterding, Dixon, Khaled, & Nacke, 2011). The use of game elements, such as points, badges or leaderboards entails a huge amount of advantages. The main benefit of game elements in non-gaming contexts is the increase of motivation and engagement and already used in various application areas such as health or apps like LinkedIn (Rimon, 2013). On the other hand, the usage of game elements "*to engage users of business applications in data quality, is new and promising*", according to Perera (2011).

In this thesis, these two concepts usability and gamification are applied to the so-called MUM Software, an Enterprise Data Management Software developed by Netconomy Software & Consulting GmbH. Due to the high range of functionalities and configuration options the usability and general design of the software suffered. The amount of buttons, menus and submenus lead to the customers experiencing difficulties in getting skilled regarding the software. This and the fact that data maintenance is said to be a rather monotonous working task caused motivational issues on part of the customers.

To address these issues, a new prototype was designed by Netconomy Software & Consulting GmbH. A more modern and intuitive design approach was followed, based on the Vaadin theme Valo[1]. This work will provide a possible solution for adding a gamification layer to this newly designed prototype. Therefore, a gamified mockup prototype will be implemented, following the new design. In addition, two usability studies will be conducted and the three different software versions compared regarding their usability and the users change in motivation due to the added game elements.

[1] Valo represents one possible design theme which Vaadin, a framework that eases the development of user interface components for web applications provides (Vaadin website, 2017).

1.1 Goals and Objectives

The main goal of this thesis is the comparison of three versions of the same software. The first version is the existing and currently used client of the MUM Software. The second version is the newly developed prototype PT1, which introduces a completely new interface and design. The third version, the mockup prototype PT2, will introduce game elements to the working process of data maintenance into a recreation of prototype PT1. In order to compare these three versions, two usability studies are conducted. The first user study focuses on the existing client and prototype PT1 including the improved interface, while the second refers to the gamified approach PT2 (see Figure 2). To gain insight into the usability of all three types of software, the standardized questionnaire System Usability Scale is used in both experiments. Additionally, selected items of the standardized Isonorm 9241/10 questionnaire, open end and questions regarding gamification are added. Comparing the results of all three different approaches (existing software, new designed software, gamified software) aims not only at identifying possible design flaws or improvements but mainly at identifying the best solution and which approach should be followed in the future.

1.2 Methodology and Structure

This thesis can be structured into several different parts. First, the theoretical part, which again can be grouped in research done for the usability aspect but also for the gamification aspect of this work. Within this research, appropriate questionnaires were identified, selected and used for the evaluation part, in which a usability study was conducted regarding the known software and the newly developed prototype. Taking the results from this evaluation, a new gamified prototype was developed and evaluated. Figure 1 illustrates the general procedure within this thesis.

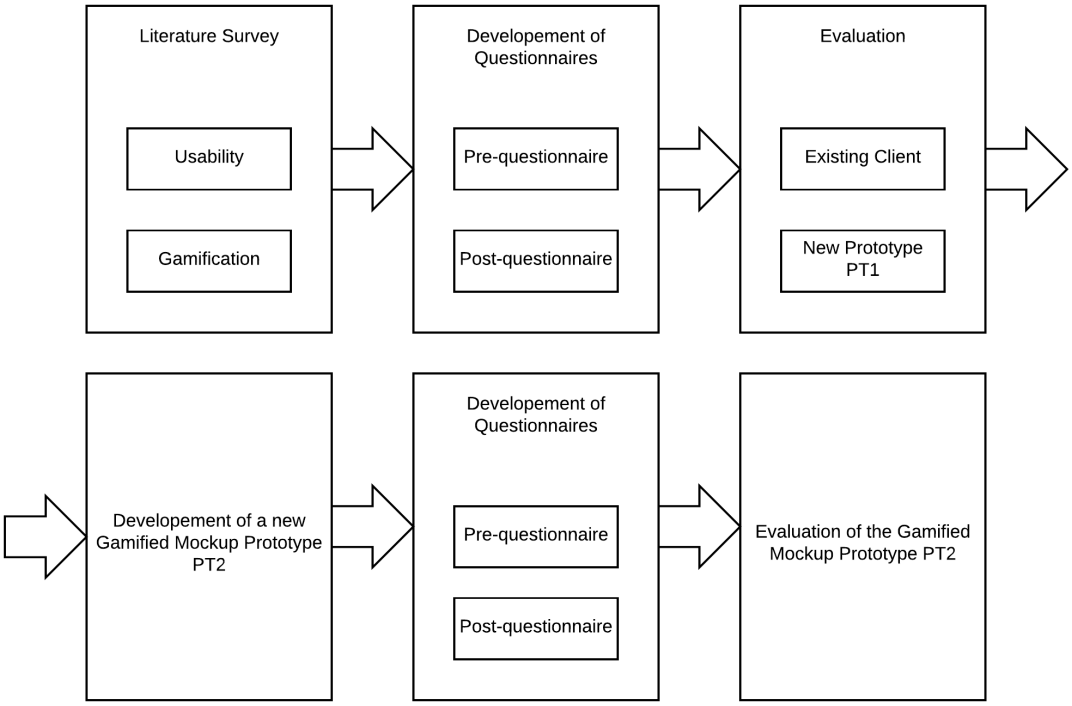

Figure 1: General procedure and steps within this thesis.

Three different versions of the MUM Software will be part of this work: the existing software, the existing new prototype and the newly developed gamified approach. The following Figure 2 illustrates these three approaches, their extensions and/or improvements and refers to the appropriate experiments in which they were evaluated.

Software Version	Modification	User Study
Existing Client	/	Experiment 1: Usability Study
Existing Prototype PT1	Improved Design	
New developed mockup Prototype PT2	Added Game Elements	Experiment 2: Evaluation of Gamification Concepts

Figure 2: Visualization of all three software versions, their modifications and the experiment in which the according software is evaluated.

The following chapter two covers the theoretical part of this work, which consists of the done research concerning usability (section 2.1) and gamification (section 2.2). The main aspect within the usability research was put on identifying and selecting standardized questionnaires which fit best into the goal of getting insight into the usability status of both, the existing software and the newly developed prototype. Therefore, section 2.1 will compare several examined standardized questionnaires and explain the two selected questionnaires, System Usability Scale and Isonorm 9241/10, in more detail. The research regarding gamification focuses on the motivational aspects of several game elements, such as points, leaderboards and badges. In addition, it outlines several areas within IT companies in which gamification is already in use and how game elements are used to increase the employees' engagement.

Chapter three will introduce the MUM Software. After a short introduction and the possible application areas for this software, the focus will be put on the data maintenance possibilities and explain some of them in more detail. Afterwards, an introduction to the newly designed prototype PT1 and the data maintaining within this version of the software will be given.

Chapter four focuses on the first usability study, which aimed at analyzing the first two software versions: the existing client and the newly designed prototype PT1. This usability study was conducted by ten participants, from four different companies, while three out of these four are current clients of the MUM Software. It outlines the general procedure of the study, the participants but mainly analyzes the results of the questionnaires. The scores of the System Usability Scale are compared for both software versions and possible additional design improvements are outlined, which were stated on part of the customers during the usability study.

Chapter five and six concentrate on the design and implementation of the gamified mockup prototype PT2 and its evaluation. The design of this prototype is derived from the prior prototype PT1. The developed gamified prototype will again be evaluated using an appropriate questionnaire, consisting of a pre- and post-questionnaire. While the pre-questionnaire aims at getting an overall impression on the participants attitude towards gamification, the post-questionnaire focuses on evaluating the design and implementation of the gamification layer, the respective game elements and the System Usability Scale. This evaluation is done with in total 20 employees from Netconomy Software & Consulting GmbH. The results of this evaluation will be presented in section 6.3.

Chapter seven outlines the lessons learned with regard to the research part as well as the design and implementation and the two usability studies which were conducted. Chapter eight highlights potential future steps based on this work, in particular regarding the gamification layer. The final chapter nine summarizes the work and its results.

The developed and used questionnaires for the evaluation of the existing software, the newly designed prototype and the gamified version of the software can be found in Appendix.

2 Background and Related Work

Conducting usability tests in order to receive feedback regarding software is a widespread method. Implementing the user's feedback into the software results in benefits for both, the users, by getting more intuitive software, and the software producer, such as a reduction of development, training and maintenance costs (Donahue, 2001). Despite possible usability flaws, a user can have another reason to use a software reluctantly: a lack of motivation. In order to address this issue, gamification can be applied. By using rewards such as badges, levels and points an immediate peak in the user's motivation can be noticed (Nicholson, 2015).

These two concepts make up the background and related work. The main focus regarding usability tests is on research of appropriate questionnaires for the conducted study, but will also describe different approaches regarding the amount of users to test and the general procedure. The gamification research on the other hand will focus on different game elements, their motivational aspects and their application in business and IT companies.

2.1 Usability

According to ISO-Norm 9241/11 usability is defined as how „*effective, efficient and satisfying*" a user can reach his goals using a technical object in order to solve tasks (Usability.de website, 2016; Frøkjær, Hertzum, & Hornbæk, 2000). Designing software with regard to these three aspects is essential for its success. To achieve best possible effectiveness, efficiency and satisfaction it is necessary to perform usability tests. Pointing out the majority of issues of most of the software's users, usability tests are an important possibility to increase the user's experience of the software. This can for instance not only lead to users being more likely to use the software but also to a recommendation of the software to friends or colleagues. To perform useful usability tests several aspects need to be taken care of that will be discussed in the following sections.

2.1.1 Goals and Benefits

Testing software with regard to its usability will not only result in the previously mentioned increased user experience. Instead, the software can be delivered in higher quality in terms of error reduction and an easier operation. These benefits aim primarily at the software's end user. But benefits of performing usability tests cannot only be seen at customer-side but also on business-side. The website experienceux.co.uk (2016) states the following three business advantages:

1. *"it increases the likelihood of usage and repeat usage*
2. *it minimises the risk of the product failing*
3. *users are better able to reach their goals, which results in the business meeting its targets"*

Donahue (2001) states several other appreciable business advantages, for instance:

- Reduction of development, training and maintenance costs
- Improvement of productivity and efficiency

2.1.2 Procedure of Usability Tests

Usability problems can be found through several different approaches. Jakob Nielsen (1994) states „*Usability inspection is the generic name for a set of cost-effective ways of evaluating user interfaces to find usability problems."* These cost-effective methods include heuristic evaluation, cognitive walkthroughs, formal usability inspections, pluralistic walkthroughs, feature inspection, consistency inspection and standard inspection. In addition to finding usability problems in a design, some of these approaches also find out the severity of the identified problems. Nevertheless, the most commonly used method of evaluating user interfaces in order to identify usability problems is the empirical method, which includes users that are testing the interface (Nielsen, 1994). The procedure of an empirical usability testing method, also called user-based testing, follows a special sequence of steps, such as:

- **Recruiting of test persons:** usability participants need to be recruited who best represent the software its target group. In addition, this aspect is crucial especially in terms of recruiting the appropriate number of test persons (see section 2.1.4).
- **Decision on how the data will be recorded**: recording the data or rather the whole usability test per se can be for instance done using a video camera. In addition, with a well-placed mirror it is possible to not only record the user but also his/her facial expressions while testing. To gain even more insight on where the person is looking at exactly, Eyetracking hard- and software is an important additional tool.
- **Preparation of the usability laboratory:** this step includes the arrangement of the used test materials and the test environment.
- **Designing or selecting of appropriate questionnaires:** it is common to use a pre- and post-questionnaire. Due to the high number of available questionnaires, this aspect is not trivial (see section 2.1.3).
- **Analysis and presentation of the results:** the completed questionnaires but also the recording or taken notes need to be analyzed.

This process can be, if needed, enhanced with the selection and description of tasks that test persons need to perform during the usability test (Bastien, 2010).

2.1.3 Questionnaires

Using questionnaires in order to assess the usability of software is one of the most important opinion-based evaluation methods (Figl, 2009). The usage of standardized questionnaires is anything but limited in the area of usability. Depending on the desired language different questionnaires are classified as influential. In English-speaking regions, the Questionnaire for User Interface Satisfaction (QUIS) and the Software Usability Measurement Inventory (SUMI) questionnaire are said to be the most important. As translated versions of these have hardly established in German-speaking areas, other questionnaires such as the Isonorm 9241/10 questionnaire and the Isometrics questionnaire became significant (Figl, 2010).

In order a questionnaire can be called „standardized“ a special process needs to be performed. In general, the candidate questions of the questionnaire that needs to be standardized are answered by a representative group of participants with regard to different interfaces. This pool of possible questions is then diminished to the most reliable, valid and sensitive ones. Sauro (2012) describes the benefits that standardized questionnaires provide:

- **Reliability**: describes the consistency of answers if the questionnaire is repeated several times. It is expected that the answers given by the same or similar users evaluating the same interface again be of similar results. Reliability is mainly measured using the so-called Cronbach’s alpha, which ranges from 0 (poor reliability) to 1 (perfect reliability). In terms of usability, a questionnaire is said to be reliable if a rate above 0.70 is achieved.
- **Validity**: describes whether a questionnaire measures what it is expected to measure. Validity can either be measured by correlating the results of the questionnaire being investigated with results of other established questionnaires, or via task time and completion rates.

In addition to these two most important advantages, standardized questionnaires provide the following further advantages: sensitivity, objectivity, quantification, economy, communication and norms (Sauro, 2012).

As an elaboration of pre- and post-questionnaire was essential for this work, several standardized questionnaires were analyzed. These include the mentioned QUIS, SUMI, Isonorm 9241/10 and Isometrics^{S} and furthermore the System Usability Scale (SUS), the Post Study Usability Questionnaire (PSSUQ) and the Computer Emotion Scale (CES) for learning new software, see Table 1.

Questionnaire	Number of questions	Assessment scheme	Duration	Language	Reference
QUIS	21	10 point scale		English & German	HP repository website (2012)
SUMI	50	3 point scale	>5 minutes	English & German	Kugelmeier (2005); Kirakowski, (1996)
Isonorm 9241/10	35	7 point Likert-scale	10-20 minutes	German	Prümper & Anft (1993)
Isometrics^{s}	75	5 point Likert-scale	30-60 minutes	German	Figl (2010)
SUS	10	5 point Likert-scale		English & German	Brooke (2013)
PSSUQ	19	7 point scale		English	Lewis (2002)
CES	12	4 point Likert-Scale		English	Kay and Loverock (2008)

Table 1: Overview of analyzed questionnaires for usability.

Due to specified requirements (see chapter 4 Usability Study) regarding the elaboration of the used questionnaires in the practical part of this work, it was decided to use the two standardized questionnaires System Usability Scale and Isonorm 9241/10 These two will be described in more detail in the following sections.

2.1.3.1 System Usability Scale

Originally developed by John Brooke in 1986 with the aim of improving the usability of the ALL-IN-1 system[2], the System Usability Scale represents one of the most important and most frequently used standardized English questionnaires. Consisting of ten alternating items with a five point Likert-scale it gives a quick insight into a user's perceived usability of the system the user is currently using. The reason for alternating the questions in positively and negatively worded statements is the attempt of avoiding response biases and force users to read each statement carefully. This alternation also affects the way the questionnaire has to be evaluated. For the positively formulated statements 1,3,5,7 and 9 the score contribution is

[2] A system developed by Digital Equipment Corporation's Integrated Office System Group providing features such as integrated email, word processing and task and time management.

the user's given scale minus 1. For the negatively stated items 2,4,6,8 and 10 the user's scale has to be subtracted from 5. The sum of these has then to be multiplied by 2.5 to receive the final SUS value, which will always lead to a score between 0 – 100. The reason behind this scoring mechanism is nothing scientific but a marketing strategy within the company DEC, as it is assumed that project managers etc. are more likely to understand a scale ranging between 0 – 100 than a scale from 10 – 50. The disadvantage of the described scoring mechanism and the resulting range is the tendency to interpret any value between 0 – 100 as percentages rather than percentiles (Brooke, 2013). Figure 3 illustrates how an overall SUS score can be interpreted and how the user's perceived usability of the system can be described.

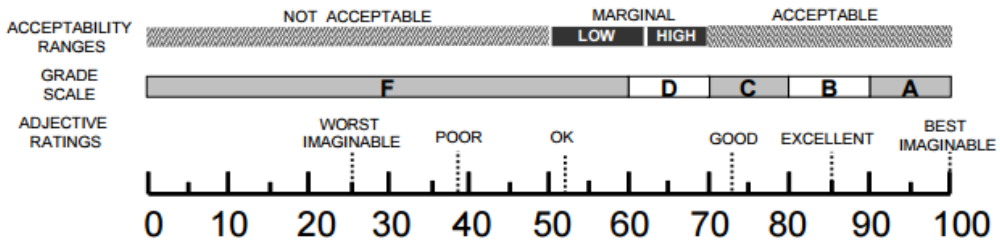

Figure 3: Proposed interpretation of SUS scores by Bangor, Kortum, & Miller (2009).

Sauro (2011) also worked on finding a relationship between SUS and another questionnaire called "Net Promoter Score". The NPS inquires user whether they would suggest a system/product to a friend or colleague. A SUS score of 82 (± 5) indicates user would also recommend the system to others.

Because of the great success of SUS but also because of issues that non-native English speakers had regarding the word "cumbersome" in statement eight, there were also attempts to translate it into other languages such as Spanish, French and German (Brooke, 2013).

2.1.3.2 Isonorm 9241/10

Designing software according to software-ergonomic principles should result in a more efficient system commitment, a limitation of stress for the user and low training costs due to easier learnability. The Isonorm 9241/10 questionnaire, developed in 1993 by Prümper and Anft, aims at evaluating software with regard to the seven defined design principles in Ergonomics of human-system interaction DIN EN ISO 9241 part 110: Dialogue Principles. These seven design principles and their original German title are given in the following list (Iso.org website, 2009; Prümper, 1997):

1. **Suitable of task (“Aufgabenangemessenheit”)**: whether the software supports the user regarding the execution of his/her working tasks
2. **Self-descriptiveness (“Selbstbeschreibungsfähigkeit”)**: whether the software provides sufficient explanation and is sufficiently comprehensible
3. **Controllability (“Steuerbarkeit”)**: if a user can influence the way of working with the software
4. **Expectation conformity (“Erwartungskonformität”)**: whether the software serves the user’s habits and expectations due to a consistent and an understandable design
5. **Fault tolerance (“Fehlertoleranz”)**: whether the software offers the possibility to finish tasks without or minimal correction effort in case of erroneous input on the part of the user
6. **Individualization (“Individualisierbarkeit”)**: whether the screen representation can be adapted easily to the user’s needs
7. **Suitability for learning (“Lernförderlichkeit”):** whether the software is designed in such a way that it is easy for the user to familiarize himself/herself with the software and if the software provides support in case new features need to be acquired

Each design principle is evaluated using five questions and a seven point-Likert scale in the range of ‘---‘ to ‘+++’ (Prümper & Anft, 1993). One example question, which is also used in the customer interviews, from the first design principle “suitable of task” illustrates the general structure.

The Software	**---**	**--**	**-**	**-/+**	**+**	**++**	**+++**	
is complicated to use								is uncomplicated to use

Table 2: One translated example question from Isonorm 9241/10 illustrating the questionnaire's general structure (Figl, 2009).

Each item of the questionnaire is made of bipolar statements (Figl, 2009). According to Prümper and Anft (1993) the main reason behind it is to encourage the user to think about each item in a more differentiated way then leading the user in a predefined direction by stating the item only in positively or negatively formulated manner.

The analysis of the questionnaire’s result is done by calculating the average over the users answers for each question separately. Additionally, the items can be summarized with regard to the belonging design principle, which will lead to a more compact overview of the results. This approach is shown in the following Figure 4.Another important aspect is that this 35 items questionnaire is not only suitable to evaluate software that is already in use, but also to evaluate prototypes with an iterative system design approach (Figl, 2009).

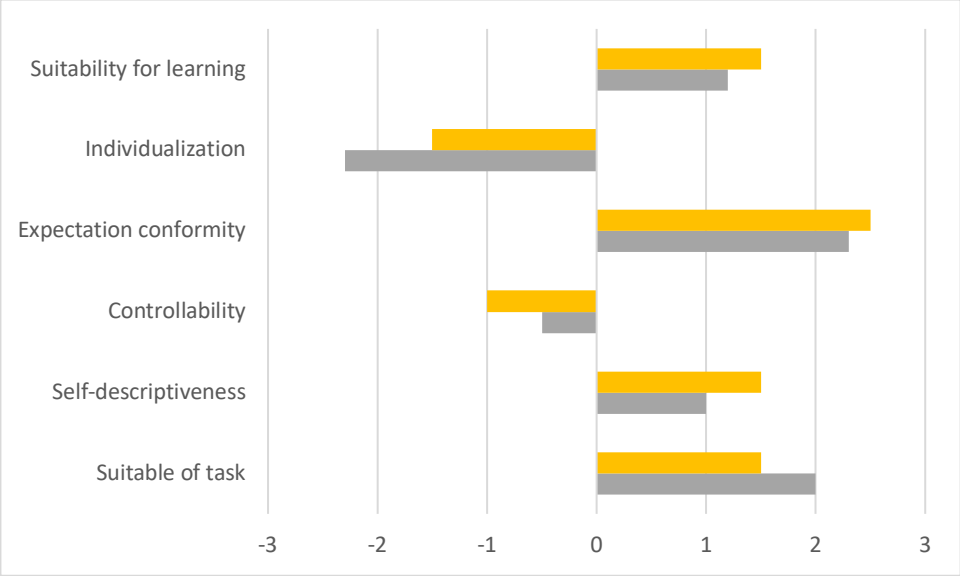

Figure 4: Example visualization of the results from two departments regarding the seven dialogue principles (translated and derived from Ergo Online website, 2016).

2.1.4 Number of Participants

Another essential part regarding usability testing is not only the number of users conducting the usability test but also the selection of participants in such a way that the most valuable outcome can be reached. It is a highly discussed topic in the literature of usability revealing a strong disagreement between several experts of this field.

Jakob Nielsen, one of the leading usability experts, indicates that five users are sufficient to reveal about 85% of all existing usability issues in a product. Aiming to find 100% of all existing usability issues needs the product to be tested by 15 users. These findings result in the following Figure 5.

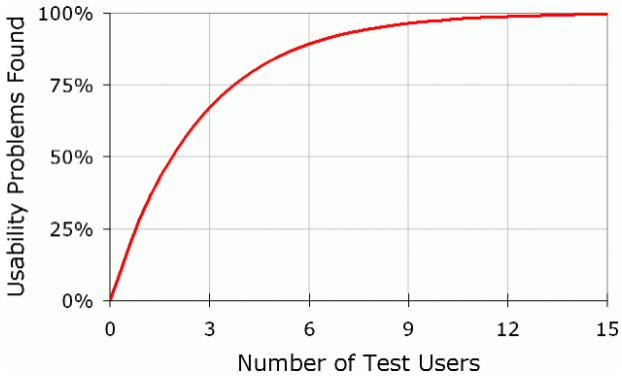

Figure 5: Jakob Nielsen's correlation between the amount of test users and the identified usability problems (Nielsen Norman Group website, 2000).

Nielsen also states, that testing an interface on part of only one user already reveals one third of all existing usability issues. In addition, "the more the better" does not apply within this approach, as each new participant indicates issues, which have already been found by other participants. Therefore, each additional participant does only contribute slightly regarding the identification of new usability flaws (Nielsen Norman Group website, 2000). Nevertheless, Nielsen also states one possible argument where it can be reasonable to test more than five users: if the software aims at several different target groups. In this case, 3-4 representatives of each target group should conduct the study (Nielsen Norman Group website, 2012).

Even though Nielsen's approach is often referred to, several other resources question the approach of five users being sufficient for informative usability testing. Faulkner (2003) for instance describes another possible approach in her work *"Beyond the five-user assumption: Benefits of increased sample sizes in usability testing*". She compared the amount of found usability issues between various randomly selected sets of five users (out of a pool of 60 users). The outcome of this study shows, that the percentage of found usability issues with five users testing a product ranges between 55%-99%. Increasing the sample size to 10 participants indicated a percentage of minimal 80% of found issues while a sample size consisting of 20 participants raised the amount of found usability issues to at least 95% (Faulkner, 2003).

This demonstrates both, the dependency between the amount of users and the valuable outcome but also the choice of users per se and the outcome. Testing a product with five participants is possible to reveal a high amount of usability flaws but is also highly dependent on the choice of users. Faulkner (2003) also proposes a general advice for products which will be fielded in a general population: "*one should run as many users of varying experience levels and abilities as possible*" and furthermore "*to run the maximum number of participants that schedules, budgets, and availability allow*".

2.2 Gamification

Even though the basic concept of gamification – using game elements in order to increase the user's engagement - is known for almost ten years now, an increasing trend can be noticed in the last few years. Back in 2008 the first usage of the term was documented. Beside, other terms were used such as "productivity games", "behavioral games" and "applied gaming". Nevertheless, "gamification" established as the most common used term (Deterding, Dixon, Khaled, & Nacke, 2011).

In 2011 Huotari and Hamari proposed a possible definition for the concept of gamification as follows: "*Gamification is a form of service packaging where a core service is enhanced by a rules-based service system that provides feedback and interaction mechanisms to the user with an aim to facilitate and support the users‟ overall value creation*" (Huotari, & Hamari, 2011). This definition does not only focus on non-games but also refer to games that can be further gamified. A more popular and therefore more often used definition is given by Deterding, Dixon, Khaled, & Nacke (2011) which is as follows: "*the use of game design elements in non-game contexts*". Here, the definition on the other hand is limited to non-games that make use of gaming elements (Deterding, Dixon, Khaled, & Nacke, 2011). Depending on the definition, the location-based service Foursquare is either a gamified service or not. Following the definition from Huotari and Hamari Foursquare is not seen as a gamified service in principal. It can be gamified using feedback and the opportunity of rewarding other services, for example restaurants and bars. Whereas the second definition indicates Foursquare as a gamified platform as it makes use of game design elements in a non-game context in order to motivate and increase the user's interaction with the service.

Gamification therefore aims in general at engaging and motivating people by making use of game elements found in games, such as points, badges and leaderboards in non-gaming contexts such as education, health and IT. Resulting from the motivation improvement, other aspects can be derived such as a performance and sales increase. Adding gamification can lead to an increase in sales from 5-15% (Rimon, 2013). This increasing trend can also be observed in the amount of papers that have been recently published on this topic. Hamari, Koivisto and Sarsa (2014) analyzed the growth on various academic search platforms, such as Google Scholar and Scopus. Figure 6 illustrates the amount of hits for the search term "*gamification*" from 2010 to 2013.

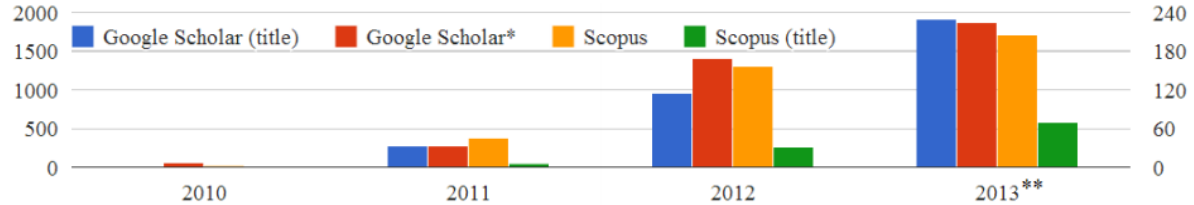

Figure 6: Amount of hits for the search term "*gamification*" from 2010 – 2013 (Hamari, Koivisto, & Sarsa, 2014).

To gain insight into the number of hits for the search term “*gamification*” from 2014 to 2017, an additional study was done. The following Figure 7 illustrates the results for the three search engines Google Scholar, IEEE Xplore and Microsoft Academic.

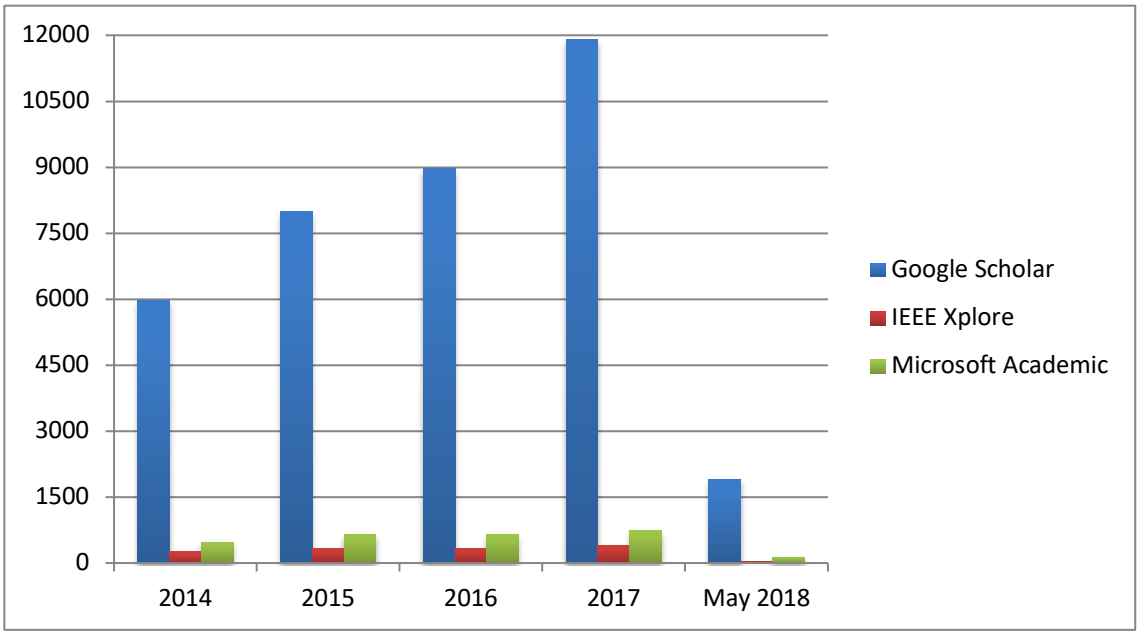

Figure 7: Amount of hits for the search term "*gamification*" from 2014 - 2018 (April 29, 2018) using Google Scholar, IEEE Xplore and Microsoft Academic.

Even though the amount of results appear to remain static regarding IEEE Xplore in Figure 7, an increase can be noticed from 263 hits in 2014 to almost 340 two years later. The same phenomenon can be observed within the search engine Microsoft Academic. From 2014 to 2016 an increase of almost 170 hits can be noticed. This trend is also predicted to keep rising. While in 2015 the gamification market grew to $1.7 billion, the market is forecasted to grow to $5.5 billion by the year 2018 (Townsend, 2017).

The following sections will give a deeper insight in the concept of gamification regarding the motivational affordances of various game elements but also an overview about different application areas with a primary focus on business and IT companies.

2.2.1 Motivational Affordances of Game Elements

Hamari, Koivisto, and Sarsa (2014) state some main benefits of gamification: "*supporting user engagement and enhancing positive patterns in service use, such as increasing user activity, social interaction, or quality and productivity of actions*". To be able to address as many people as possible using gamification, Bartle (2004) developed a classification of four player types. Nicholson (2015) puts these player types into the concept of gamification:

1. **Achievers**: "*like doing things that achieve defined goals*"
2. **Killers**: "*who challenge and compete against others*"
3. **Socializers**: "*who want to use the system to meet and engage with others*"
4. **Explorers**: "*who wish to engage with breadth of the gamification system*"

In order to address these four types with the gamification system it is possible to select within a high amount of various game elements. Xu (2011) classifies 24 different game mechanics. This list does not only include the well-known points, levels and achievements such as badges, but also more unknown ones such as free lunch ("…*getting something for free due to someone else having done work*"), lottery ("…*the winner is determined solely by chance*.") and combos ("*reward skill through doing a combination of things*"). Paharia (2013) on the other hand diminishes the number of valuable game mechanics to a list that he calls "The 10 Key Mechanics of Gamification": fast feedback, transparency, goals, badges, leveling up, onboarding, competition, collaboration, community and points.
These two lists do only have five items in common. Xu (2011) stated achievements, levels, community collaboration and points. These correspond to badges, leveling up, collaboration, community and points in the list of Paharia (2013). Xu (2011) also provides insight into the motivated player types that are addressed by these game mechanics. Table 3 shows the mentioned game mechanics and the affected player types.

Game element	Achievers	Killers	Socializers	Explorers
Achievements	x	x		x
Levels	x	x		x
Community Collaboration	x		x	x
Points	x	x		x

Table 3: List of five chosen game elements and the player types they address (Xu, 2011).

This also corresponds to the findings of Bartle (2004), which state that points and levels can be used in order to motivate achievers.

Antin and Churchill (2011) on the other hand analyzed possible motivating aspects of badges. The first and also most obvious aspect of badges is the goal-setting possibility. Users are motivated through badges as these challenge them to reach the defined requirements in order to receive the badge. In case the progress towards that goal is visible for the users, badges appear even more motivating. The second important aspect relates to the fact that badges can serve as an information tool. Gained badges can tell other users a lot about someone's skill-set and expertise and can therefore be an important possibility to determine for instance the trustworthiness or reliability of the user's content (Antin & Churchill, 2011).

Referring to the above Table 3 at least two game elements need to be used in order to increase the motivation of all four different player types, for instance the combination of levels and community collaboration can be used. Additionally, Xu (2011) mentions several game elements with which it is possible to motivate all four player types achievers, killers, socializers and explorers using only a single game element. These are for example the previously mentioned game mechanics lottery, bonus or combos.

Another approach developed by Yu-kai Chou (2015) is the so-called Octalysis framework. This framework defines eight core drives to which every of a user's action can be assigned to: (1) epic meaning and calling, (2) development and accomplishment, (3) empowerment of creativity & feedback, (4) ownership & possession, (5) social influence & relatedness, (6) scarcity & impatience, (7) unpredictability & curiosity and (8) loss & avoidance. Figure 8 illustrates the octagon shape of the framework and the related game elements in more detail. In contrast to Xu (2011) where each listed game element is associated to the appropriate player type that is motivated through the element, the Octalysis framework does not differ between player types but instead focuses on whether a person is more motivated through creativity or logical aspects. Yu-kai Chou (2015) therefore defines the so-called Left Brain Core Drives and Right Brain Core Drives.

- **Left Brain Core Drives**: Left Brain Core Drives are more related to logic, calculations, and ownership. These include the areas development & accomplishment, ownership & possession and scarcity & impatience.
- **Right Brain Core Drives**: Right Brain Core Drives are more related to creativity, self-expression, and social aspects. These include the areas empowerment of creativity & feedback, social influence & relatedness and unpredictability & curiosity.

Furthermore, Left Brain Core Drives are said to be more linked to extrinsic motivation, while Right Brain Core Drives are more linked to intrinsic motivation as no reward or goal is needed but creativity is used.

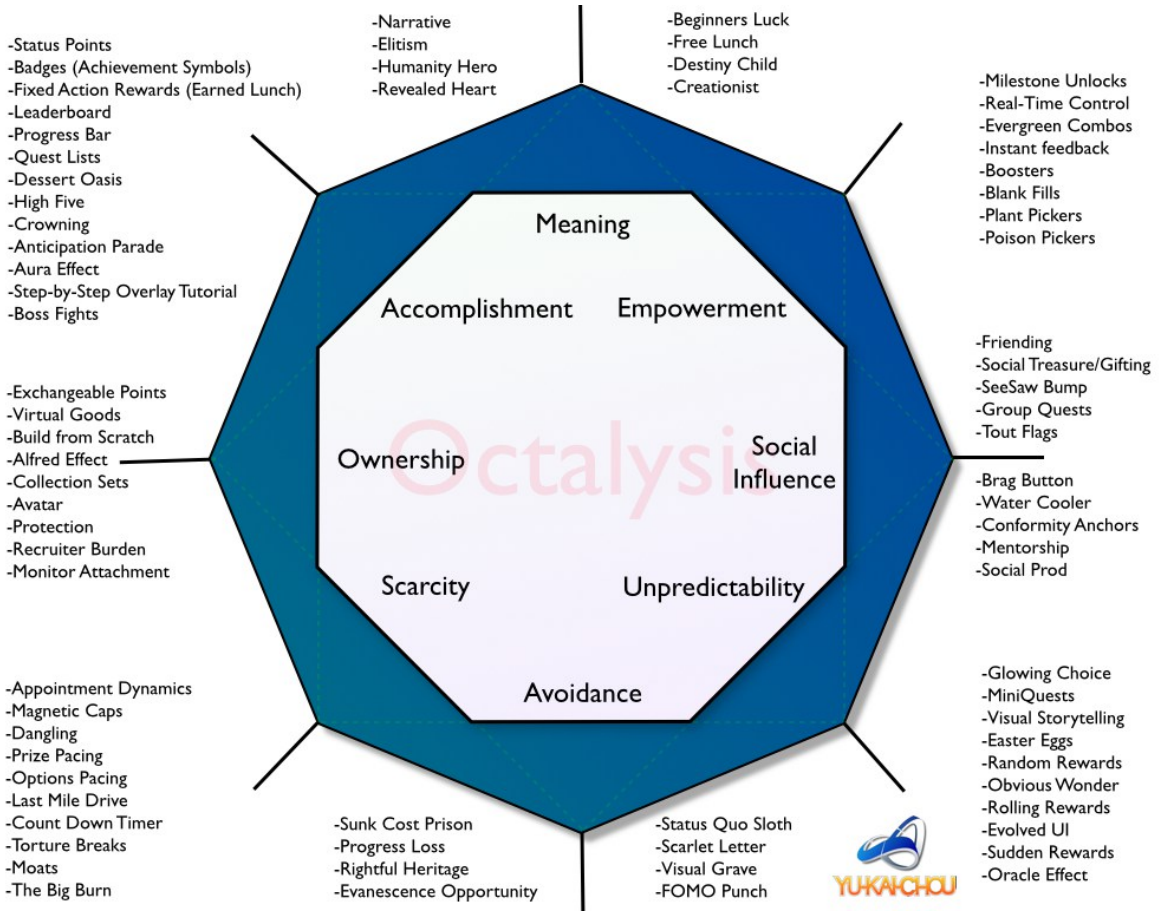

Figure 8: Octalysis Framework established by Yu-kai Chou (Chou, 2015).

Despite this vertical differentiation within this framework, also a horizontal distinction can be done between very positive motivators (White Hat Gamification) and more negative motivators (Black Hat Gamification):

- **White Hat Gamification**: White Hat Gamification characterizes very positive motivators. These include epic meaning & calling, development & accomplishment and empowerment of creativity & feedback in Figure 8.
- **Black Hat Gamification**: Black Hat Gamification describes more negative motivators. These contain scarcity & impatience, unpredictability & curiosity and loss & avoidance in Figure 8.

The positive aspect of the three Core Drives on top of the octagon relates to the fact that, expressing the own creativity results in a higher sense of meaning and therefore in a better feeling of the user. Black Hat Core Drives are not necessarily bad, but they contain the risk of leaving the user in a constant "*fear of losing something*" because of a lack of knowledge of the next steps on part of the user (Chou, 2015).

Despite the positive effects that game elements offer, Nicholson (2015) explains some drawbacks like the reduction of intrinsic motivation. Reward based systems, also called

BLAP gamification[3], have the effect of motivating user based on extrinsic motivation as the system is not used due to personal interest but because of the goal of getting various rewards. In addition, rewards should and can only be used in case an "*organization is looking for immediate and short-term change*", meaning rewards can only create a short-term peak in the user's engagement and generally only work as long as users are gaining rewards. As soon as the system does not offer any more rewards, a user will probably stop using the system unless he/she found another reason to keep using it.

In case the goal is a long-term change of the user's behavior instead of a short peak, meaningful gamification should be used. Nicholson (2015) therefore introduces six concepts derived from game design:

1. **Reflection**: to assist participants in order to find other interests
2. **Exposition**: including a narrative layer inside the system through game design elements
3. **Choice**: participants should have the choice of how to interact with the system
4. **Information**: participants should learn more about the real-world setting using game design concepts
5. **Play**: provide the possibility of exploring but also failing
6. **Engagement**: to encourage participants to learn from others who are interested in the real-world setting

2.2.2 Measuring Gamification

Measuring gamification is even more challenging than measuring the usability of a software. Even though questionnaires such as the Academic Motivation Scale (AMS) are available to evaluate user's engagement, several other aspects need to be considered (Vallerand et al., 1992). Kumar, Herger & Dam (2017) propose the following four metrics and possible measurements:

1. **Engagement**: average number of actions per user; progress of users
2. **Time**: retention of players; decreasing response time regarding system demands
3. **Return on investment**: performance increasing, cost reduction; sales increase
4. **Quality**: ratings; accuracy of the captured data

To measure the performance increasing inside a business, Rimon (2013) proposes a certain process. First, the business' KPI's (Key Performance Indicators) that are relevant to the process, which will be gamified, need to be identified. Then, the KPIs should be measured before and after the gamification being included in the process. Additionally, the correlation

[3] BLAP gamification describes „*the concept of adding badges, levels/leaderboards, achievements and points to a real-world setting*" (Nicholson, 2012).

between the Key Performance Indicators and the gamification activity performance should be compared. This is based on two effects of gamification:

1. Gamification should modify the user's behavior, for example by an increased motivation.
2. This modified behavior should affect the business results.

Meaning, applying gamification to a process will first result in a changed user behavior and this will lead to an increase regarding the business' KPIs. Figure 9 illustrates the possible outcomes of the combination of changed behavior due to added game elements and business results.

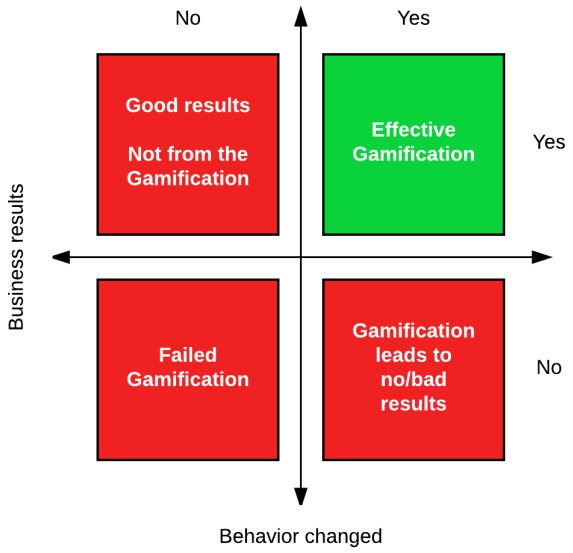

Figure 9: Possible outcomes of added gamification with regard to a business' results (derived from Rimon, 2013).

Furthermore, it is proposed to use control groups who do not use the gamified process and therefore represent a good reference for the possible improvement due to added gamification (Rimon, 2013).

2.2.3 Gamification in Business and IT

As already mentioned, gamification is applied in various areas. Viriyapong, Yosyingyong, Nakrang & Harfield (2014) for example used gamification elements to increase the motivation of high school students to learn polynomial functions and therefore implemented an application for mobile devices. The field of health and fitness represents another application area of gamification. Nike developed the app called Nike+, which allows to track speed, distance and the needed time if you run. These information are stored and then used in various game elements such as leaderboards (Kuo, 2015). Even IT companies such as

Facebook and Google make use of game elements. Facebook for example uses progress bars on the user's timeline in order to motivate the user to provide more personal information such as the working place or the timeframe the user was or is enrolled at a university.

The above-mentioned application areas represent gamification in systems that are used by customers. Each customer can decide for him- or herself whether he/she likes or wants to use the gamified system. In case of "*gamifying*" business processes or systems - in general known as Gamification of Enterprise – this should be similar. Employees should not be forced to use or work with the gamified aspects of the business process but should rather be able to enable or disable the gamification layer dependent on his/her interest.

In order to develop a design with regard to a business process or system, several game mechanics and elements can be used and connected to the business' goals. Herger and Kumar (2013) propose for instance the following: points, badges, leaderboards, challenges. Engaging employees by using game elements offers several benefits. First, the productivity is increased which is based on the employees being more involved in activities that are the reasons for the company's success. Referring to the market research company Hay Group, this productivity can increase up to 43%. Additionally, engaged employees are in contrast to unengaged less likely to switch jobs, according to a Gallup poll (Webb, 2013).

Various well-known IT companies such as Microsoft, Oracle, Cisco and SAP rely on the positive effects of gamification and do therefore use it in order to increase adoption and engagement (Uskov & Sekar, 2014). The following sections will give insight into the different applications of game elements within the mentioned IT companies.

2.2.3.1 Microsoft

The usage of gamification within Microsoft is widespread and applied in three different areas. The following list provides one example application of game elements in these three fields:

1. **For other companies**: Microsoft Dynamics 365 – Gamification (Microsoft website, 2017)
2. **For customers**: Microsoft Ribbon Hero (Pieniazek, 2015)
3. **Inside the company**: Windows Language Quality Game (Smith, Bean, & Moeur, 2015)

Microsoft Dynamics 365 – Gamification

Microsoft Dynamics 365 – Gamification is a tool, which aims at motivating employees by offering the possibility to participate in individual or team-based competitions. The goal of these competitions is to reach defined KPI's using award based gamification (Microsoft website, 2017). Using Microsoft Dynamics 365 – Gamification, a company can design a

“game” and define metrics itself. Depending on the success of the employee, points are awarded. Each employee can access the overall current scoring (Schindler, 2015). Figure 10 shows the designed leaderboard, including points and a progress bar, within Microsoft Dynamics 365 – Gamification.

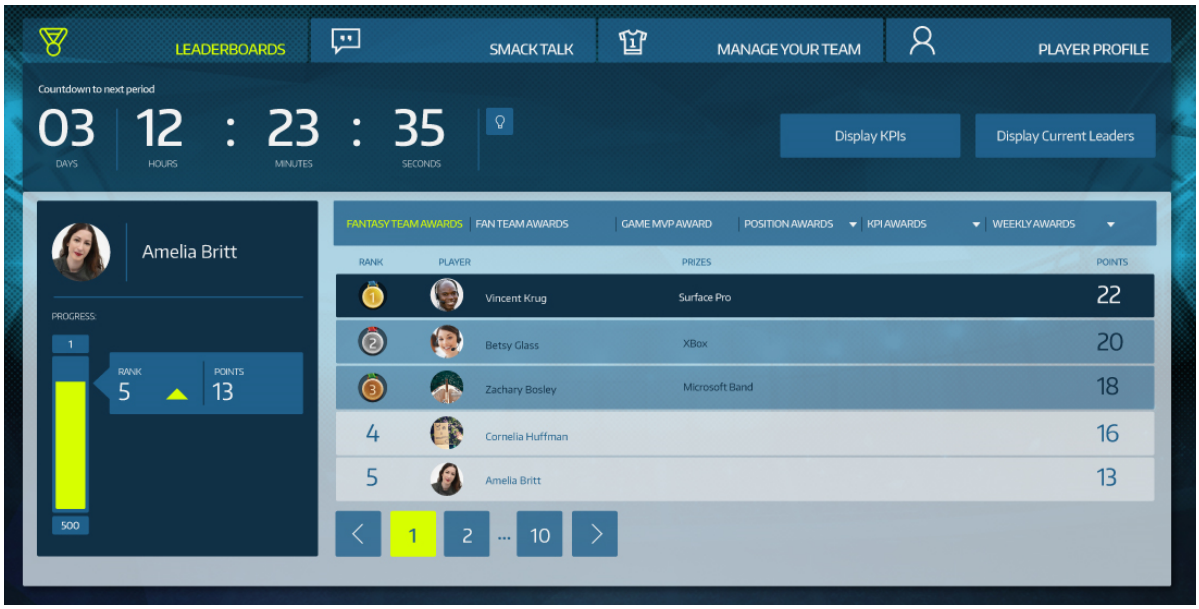

Figure 10: Gamification design inside Microsoft Dynamics 365 - Gamification. (Microsoft website, 2017)

It is not only integrated with other Dynamics 365 business applications such as Sales, Customer Service, Field Service and Project Service Automation, but can also be integrated with other systems using an API (Microsoft website, 2017; Schindler, 2015).

Microsoft Ribbon Hero

Microsoft Ribbon Hero on the other hand aims at teaching skills in Excel, Word, Powerpoint and OneNote (Pieniazek, 2015; Schacht, & Schacht, 2012; Xu, 2011). Even though it is a game which can be downloaded, it can also be seen as a gamified version of these three tools due to the definition of gamification and as the game generally visualizes the appropriate tool and includes game elements such as points, badges and progress bars. Microsoft wanted to test if users are more motivated to learn new features of Office 2007/ 2010 and probably also work more efficiently if these game elements are integrated (Quandt, 2010). Resulting of a high acceptance of Ribbon Hero the sequel Ribbon Hero 2 was released, which is in addition applicable for OneNote (Pieniazek, 2015; Shane, 2013).

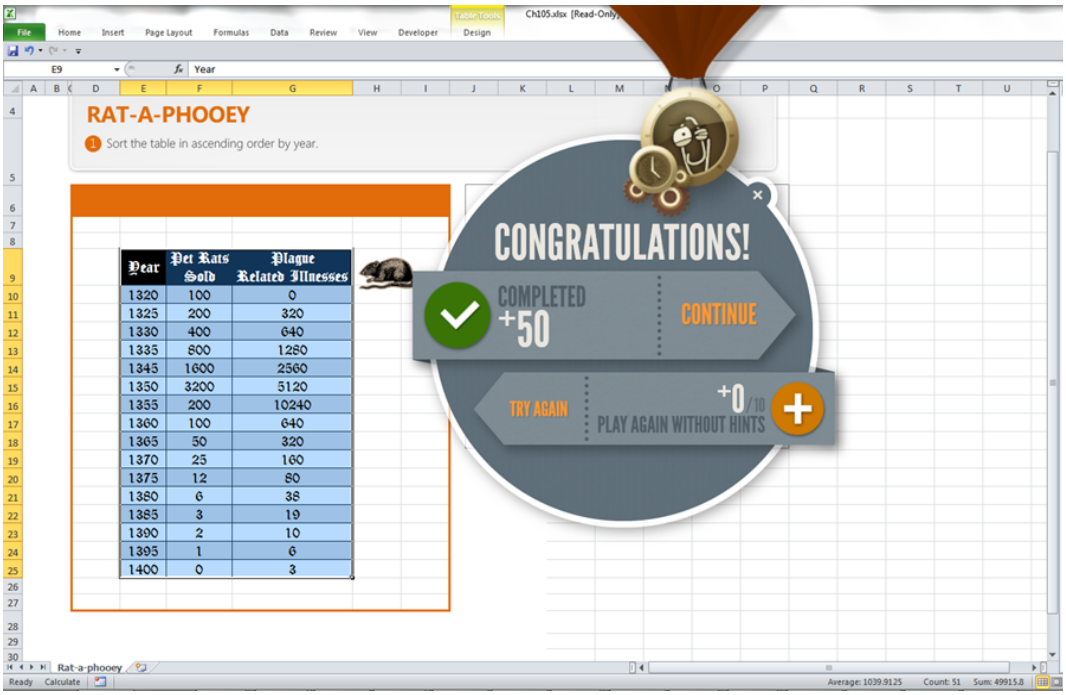

Figure 11: Example of Ribbon Hero 2 used in Excel to teach the sorting of tables. (Shane, 2013)

Windows Language Quality Game

The third mentioned application is used inside the company. Microsoft sells its products in many different countries, which results in the software needed to be translated into the appropriate languages. Several language vendors who do not only perform the translation but also assess the quality of other vendors' translations usually do this translation process. This business process is generally time consuming and costly. To address these issues, the Windows Language Quality Game was developed in order to include at Microsoft working native speakers into the translation activity. These native speakers were encouraged and motivated to participate using game elements such as points, feedback and leaderboards (Smith, Bean, & Moeur, 2015; Coy, 2015).

Figure 12 is exemplary for the design, which is shown to each participating employee. In the middle, an actual Windows section is displayed which needs to be examined regarding possible language or translation issues. Each employee can mark the screen as correct – using the green checkmark – or highlight and mention identified flaws – using the red cross (Microsoft TechNet, 2013). Using the shown arrows in the top area of the screen, each employee can switch between the 25 images that each level consists of. Additionally, points, feedback and leaderboards are used to encourage the participation of employees (Enterprise Gamification Consultancy, 2014; Smith, Bean, & Moeur, 2015). In total, 900 employees took part in the translation process and reviews were done for all the 36 requested languages. About 15% (130) of these 900 participated in the same language, while the language with the lowest participation rate consisted of only three employees. After a recheck of the transmitted translations it was found, that an average of 71% dialogues was submitted correctly. Even

tough Microsoft intentionally inserted poor translations at some points, in order to check if the participants are paying attention, 170 ‘real’ bugs across all languages were identified (Coy, 2015; Smith, Bean, & Moeur, 2015).

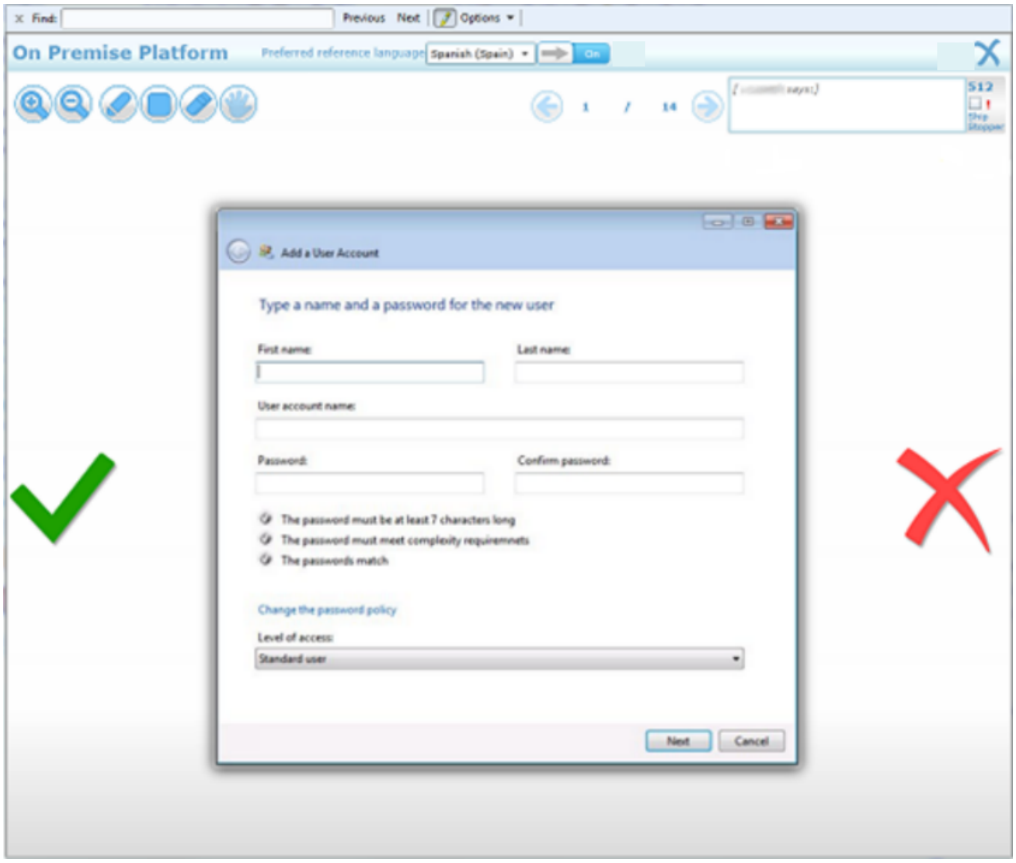

Figure 12: A screenshot of the general design from Microsoft’s LQG (modified from Microsoft TechNet, 2013).

2.2.3.2 Oracle

Compared to Microsoft (see section 2.2.3.1) Oracle follows another approach. Not only that there is the so-called Oracle gamification team within the company, special events are hold to include employees in the gamification process. In 2012 a design event was hold by the Oracle gamification team where 150 people who were both, working inside the company and invited guests. After splitting the group into 15 teams, application workflows were handed out to the teams with the goal of gamifying these workflows. In addition, the event itself was gamified by awarding badges, giving points and showing leaderboards. The developed gamified version of the Oracle’s onboarding process won the “*competition*”. While gamifying this process, the team also found unmet business goals, such as the possibility to increase the new employee’s engagement with his/her future new team or to secure resources for the new employee and assist the manager with it. Since then, Oracle is trying to add game elements in a broad spectrum of workflows and tools, for instance in Human Capital

Management, CRM and Financials (Webb, 2013). One example for a gamified tool is Oracle Sales Cloud Sales Performance Management, which aims at improving sales effectiveness and productivity of companies. Dashboards are used to show sales representatives their performing process and sales manager know the performance of their team regarding special goals. Using the game elements leaderboards and scorecards desired behavior is rewarded by the tool (Oracle Datasheet, 2016).

In general, the importance of gamification for Oracle is also reflected in the high amount of blog entries which can be found when searching for the term "*gamification*" on Oracle's website. In total, 956 blog entries can be found (at the time of researching) which represent the time that employees of Oracle invest into the concept of gamification (Oracle website, 2017).

2.2.3.3 Cisco

Leslie Lau (2014), Senior Manager of Global Social Media at Cisco, states that the usage of gamification within Cisco is used across a broad number of key programs. The following sections will describe two gamified approaches within Cisco in more detail.

Social Media Training Program

One of these programs where gamification is used is the Social Media Training Program, which consists of 46 courses employees can attend. Several job roles such as sales account managers or employees of the human resource team can benefit through increasing their knowledge regarding social media, for instance by using LinkedIn in order to get in touch with possible new applicants. Nevertheless, the high amount off available courses can overextend people due to the lack of knowledge where to start. Therefore, gamification was introduced. To be able to directly address the special needs of certain working areas, four sub-specializations were presented: Social Media for HR, Social Media for Sales, Social Media for Executive Communication Managers and Social Media for Partner Teams. Additionally, three levels of certification are available: Specialist, Strategist, and Master. In order to progress throughout these levels, a defined amount of courses need to be accomplished but also blog posts or the creation of a social media strategy needs to be done. To increase the employees' motivation even more, another game element was introduced: badges. Badges can be earned by participating in team challenges.

Figure 13 illustrates the mentioned levels that are included. The first row represents the three levels of certification, the second row shows the four different specialization areas and the third row the three levels in which team challenges can be completed. The result of this gamified Social Media Training Program is, that in total 650 persons received a certification and more than 13.000 courses were taken (Lau, 2014).

Figure 13: Included levels within Cisco's Social Media Training Program (Lau, 2014).

Cisco Social Rewards program

Another program that Cisco invented and is not restricted to Cisco employees is the so-called Cisco Social Rewards program. Readers of the Cisco blog can sign up to this program and earn rewards by participating. By performing activities such as reading and sharing blog posts, watching videos and commenting on blog posts but also for completing the rewards profile, points and badges can be earned. In addition, levels are introduced. To progress throughout these levels, a special amount of points need to be earned first, for example to reach the second level 500 points need to be earned by conducting the mentioned activities (Belle, 2011). Furthermore, another game element is included: leaderboards. Three different leaderboards can be seen that are calculated over different timeframes:

1. **Members**: showing the top Social Rewards contributors over the current week (Cisco Blog, n.d.)
2. **Bloggers**: showing the top Social Rewards bloggers over the current week (Cisco Blog, n.d.)
3. **All participants**: showing the top Social Rewards contributors over the current month (Cisco Blog, n.d.)

Badges, the reached level of each badge, the overall received points and the resulting overall levels are included in each user's profile who signed up to this program. The following Figure 14 shows the current rewards which Deanna Belle, a social media marketing manager at Cisco and co-developer of the Cisco Social Rewards program, earned so far (Cisco Blog, n.d.).

Figure 14: The visualization of reached points, badges and levels on the user's profile within the Cisco Social Rewards program. (Cisco Blog, n.d.)

2.2.3.4 SAP

The software developer SAP relies on gamification in various aspects. Comparable to Oracle (see section 2.2.3.2), SAP also holds events in which gamified prototypes are developed. In 2011 for instance the so-called SAP Gamification Cup was hold within the employees of Palo Alto SAP. Split up in teams several prototypes were implemented and presented to a jury consisting of SAP managers and external experts. The winning team presented an invoice software which made use of game elements such as levels and rankings (Koch, Ott, & Oertelt, 2013).

The general use of gamification inside SAP started with a virtual golf game, which was integrated into the company's software. Whishes from customers where putt to the responsible employee via a virtual golf ball. In this manner, external requests should be moved forward faster.

SAP Community Network

By now, SAP is using more complex gamification applications, for example the SAP Community Network (SCN) (Pieniazek, 2015). SCN is an online network, which is used by three different parties: (1) SAP employees, (2) SAP customers and (3) SAP partners. The main goal of this network is to share knowledge and educate oneself to an expert (Lankheim, 2012; Pieniazek, 2015). To increase the participation of the participating parties, three game elements were added: points, badges and leaderboards (Herger, & Kumar, 2013; Yung, 2014):

- **Points**: Writing a blog post in general earns the author 40 points. In case of exceptional blog posts additional points were awarded. On the other hand, points can also be deducted in case of a post with short-comings. Answering a stated question can earn the responder between 2 – 10 points. Again, additional points are awarded in case the answer is an excellent help for solving a problem. The third part in which points can be earned is for editing wiki entries. The amount of earned points depends on the amount of contribution. Earning more points will lead the community member

to level up throughout the process. The points a member has reached and the according level is shown on the member's profile.

- **Badges**: Badges on the other hand were mainly introduced in order to distinguish SAP employees. Consequentially, members of the SCN community have the option of directly addressing SAP employees to get more information about a topic. A second type of badges, Moderator badges, are given to SCN members who have administrative authority. In addition, badges can be earned by completing missions in SCN, which are also shown in the member's profile. Figure 15 illustrates possible badges that can be earned by completing missions.
- **Leaderboards:** In addition to points and badges, leaderboards are used to demonstrate the expertise within the community. The leaderboard is based on the earned points of each participant and tracks them in life-time.

Figure 15: Possible badges within the SAP Community Network SCN that can be collected by accomplishing missions (Yung, 2014).

Despite of an increased engagement on part of the community members, additional apsects were noticed, which resulted of the reached points, levels and badges being visible on the profiles. Human Resources Managers can use the network to find possible new employees due to the amount of points the member has earned (Pieniazek, 2015). The use of badges can furthermore help to find appropriate staff setting for projects (Chou, 2017). The following Figure 16 shows an example profile including points and the according level.

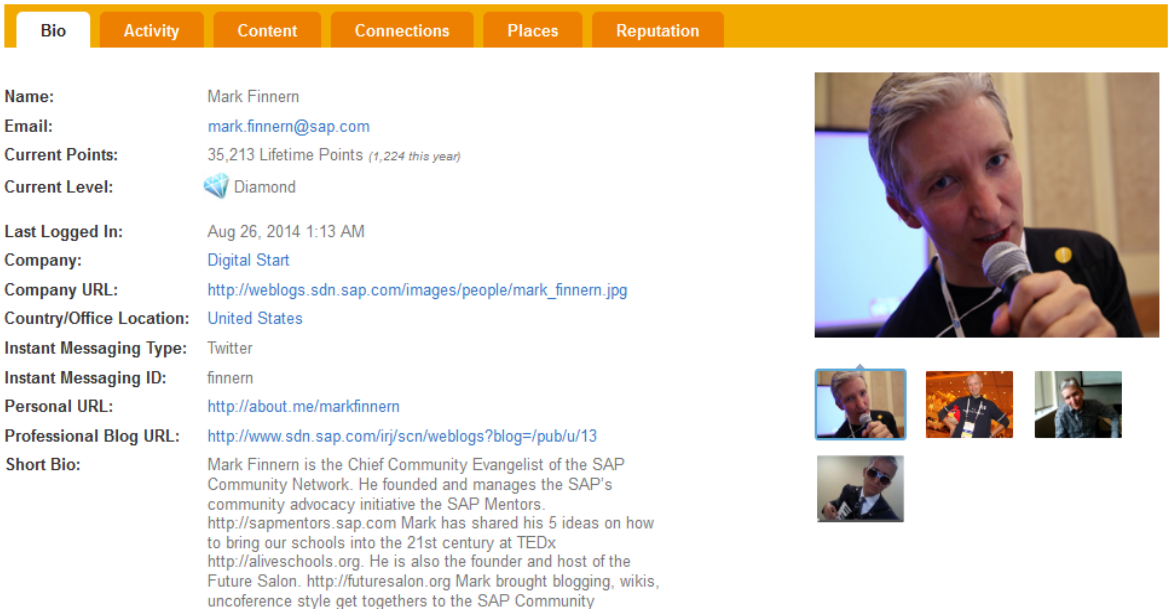

Figure 16: An example profile from a SAP employee using the Community Network (Yung, 2014).

Gamification within Master Data Management Software

In the previously mentioned SAP Gamification Cup, another gamified approach was presented by a team dubbed "*Data Scrubbers*": the possible gamification of Master Data Management Software. Especially in terms of master data it is nowadays crucial to have correct data stored, which can be a challenge as "*Master data is in a constant state of deterioration*" due to new data being entered, imported or merged. Keeping the data in a correct state is therefore necessary for the company's success. Each "*player*" is engaged to increase the correctness of data by the added game elements points, progress bars, levels and badges. To gain these rewards, a player must go on a "*cleansing mission*" by selecting a package for instance a product area of which the player has a certain understanding. Depending on either how much data is cleansed or the complexity of cleansed data points and levels are awarded. As soon as a package is completed, points are awarded. A progress bar is included to illustrate their daily progress. In addition, a "*quality meter*" displays the amount of filled fields within the selected package. Moreover, each participant has the possibility of sharing their accomplishments on a social network. The quality of the cleansed packages can be rated by users of the package data (Chou, 2017; Herger, 2011).

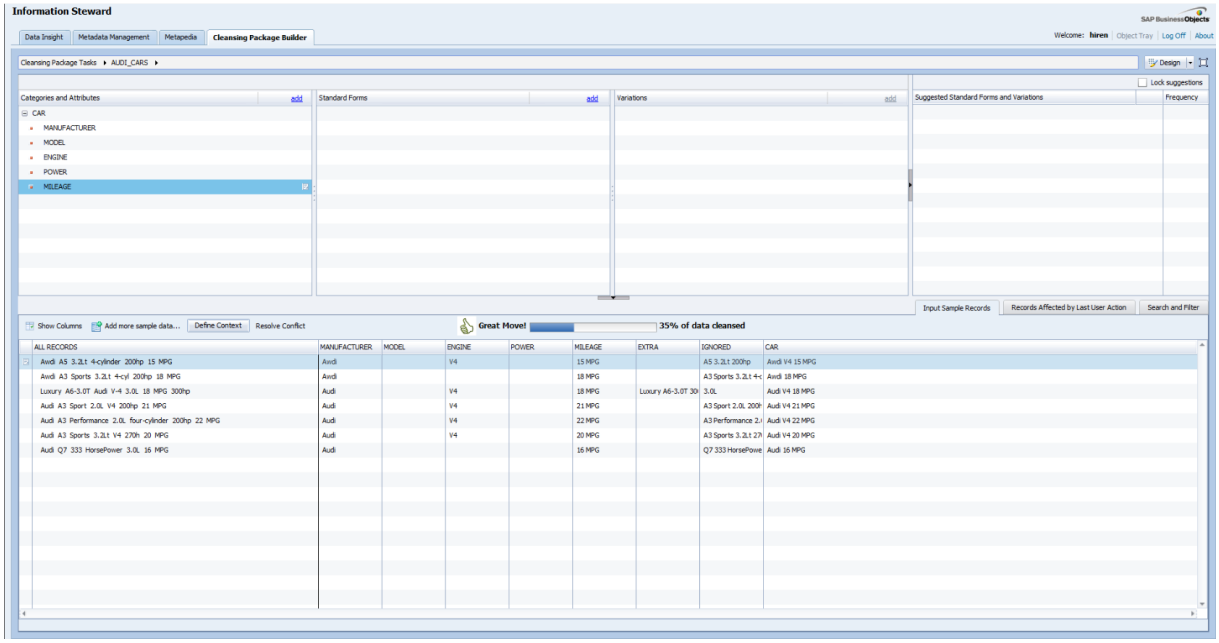

Figure 17: Gamified prototype of Master Data Management Software (Herger, 2011).

2.2.4 Future Trends of Gamification

The future of gamification is a highly discussed research topic. Nevertheless, there is one survey that is referred to frequently: the survey of Pew Research Center. This survey was conducted by 1,021 technology stakeholder and aimed at covering the following question: "*Will the use of gamification, game mechanics, feedback loops, and rewards to spur interaction and boost engagement, buy-in, loyalty, fun, and/or learning continue to gain ground and be implemented in many new ways in people's digital lives between now and 2020?*" (Anderson & Rainie, 2012).

A majority of 53% stated that the concept of gamification will be widespread and will be used in "*many new ways for education, health, work, and other aspects of human connection*". Furthermore, they believe that gamification will affect many people who are using communication networks on a daily basis. On the other hand, 42% stated that gamification will not advance regarding other aspects of communications but nevertheless stay an important part of communication and will be developed in new ways. The remaining 5% did not respond in the survey (Anderson & Rainie, 2012).

Due to the reason that gamification is based on game elements and therefore also depends and is influenced by the gaming industry, an additional possible application area can be identified: virtual reality (Townsend, 2017). This also corresponds to an article of the website Gamified UK in which the author states that virtual reality is "*certainly one future for gamification*" (Marczewski, 2016).

Regarding Gamification of Enterprise, a similar positive forecast exists. Smith (2011) states, that adding game mechanics to business processes will continue to increase productivity and furthermore "*that games can – and will – be an important component of the workplace of the future*" (Smith, 2011).

2.3 Summary

Designing interesting software, which is in addition intuitive to use is challenging. To overcome these issues, usability tests can to be conducted. Several aspects, such as the number of participants, the general process and the development of questionnaires need to be taken care of. Due to various different approaches regarding the number of participants but also the high amount of possible questionnaires, the development of the best-suitable process and questionnaires can be demanding. The usability test of this work will be done with regard to these recommendations of Faulkner (2003). More detailed information on the amount of participants, the general procedure and the test's outcome can be found in section 4.3.

Once software is improved with regard to the identified usability flaws and the user's likelihood of usage is increased, another concept can be applied. Gamification, as "*the use of game design elements in non-game contexts"*, aims at keeping users engaged (Deterding, Dixon, Khaled, & Nacke, 2011). Gamification of Enterprise is already applied inside a high amount of different sections, from recruiting to translation improvements within software that is developed and the process of keeping the company's data up-to-date and correct. Several game elements are used to increase employee's engagement to participate within these applications. The following Table 4 summarizes the used game elements in at least one described application of each company.

Gamified Application	Leaderboards	Levels	Badges	Points	Progress bar	Feedback	Scorecards
Windows LQG	x			x		x	
Oracle Sales Cloud Sales Performance Management	x						x
Cisco's Social Media Training Program		x	x				
SAP SCN	x	x	x	x			
Gamified Master Data Management		x	x	x	x		
	3	3	3	2	1	1	1

Table 4: Overview of the used game elements within the described IT companies.

3 MUM Software

The handling of complex and extensive data within an organization can be challenging. The MUM Software developed by Netconomy Software & Consulting GmbH[4] provides a solution for this issue. Data from different departments are combined at a central location and logically related. Data can not only be managed centrally but also prepared and enriched. The MUM Software covers several different organizational information:

- Employee data
- Customer data
- CRM and ERP data
- Organizational structure data
- Locations
- Operating resources
- Ownership structure
- Business processes

This information can be accessed via a system independent web 2.0 application. Each employee can therefore – depending on the assigned rights – retrieve data and work with the software location-independently. This high amount of available data provides the subsequent solutions based on the MUM Software (MUM Software website c, 2016).

Master Data Management: MUM Software offers a central database for all company-relevant information combined out of different resources or systems. Due to a special rights concept, a local maintenance of data is possible. In addition, all changes to data are logged automatically which offers the possibility of setting the status of the software and its data back to a special date and continue working at this state (MUM Software website g, 2016).

Corporate Investment Management: Investment relations, workflows and organizational structures become more visible using this software. Using workflows (processes) working processes are automatically distributed to the according user and its completion is guaranteed. Shareholding structures are visualized using organization charts, which hold the current data at the push of a button (MUM Software website a, 2016).

Identity Management: To manage rights of each user, so-called Identity-Management architectures are used. These manage the identities and the appropriate access rights of employees. In case an employee is leaving the company due to parental leave or moves to another department, rights are changed or even removed automatically (MUM Software website h, 2016).

[4] http://www.mum-software.com/

Organization Management: The MUM Organisation Manager offers historical and transparent information regarding the organization development. Relations between different departments, their amount and type of resources and the information who is responsible for which part are visualized. Users can one-time define the content, layout and the design of organigrams in which the organization should be displayed and the MUM Software will at the push of a button refresh the information and present the current state (MUM Software website f, 2016).

Human Resources Management: The amount of employee information can be comprehensive and is often stored and used in different applications, like time recording and active directory. MUM Software guarantees a consistent and up-to-date storage of all the employee related information centrally. These include for example the employee's skills, competences, trainings, goals et cetera. Using the self-service functionality employees can change and update their data on their own (MUM Software website b, 2016).

Audit Management: The MUM Enterprise Data Suite offers a central acquisition of audits and findings. In addition, it verifies that findings can only be edited within an audit period and forwards reminder automatically to the responsible employee. The evaluation can be done using Excel Pivot tables for the whole company (MUM Software website e, 2016).

3.1 Existing Client

The existing and used software version is a web application, which is based on the Google Web Toolkit[5] (GWT). The system requirements for the existing MUM client can be found in Table 5 below.

Java / Application server	Databases	Browser
• Java SE 7.0.75+ / • Apache Tomcat 7.0.59+	• from Oracle 10g / 11g • from MS SQL Server 2008 R1	• Firefox 3.0 • MS Internet Explorer 8.0 • Safari • Google Chrome

Table 5: System requirements for the MUM Software (MUM Software website d, 2016).

The following Figure 18 visualizes a simplified system model of the software. As can be seen, two external engines are included in the software: the Reporting Engine Birt[6] and the Process Engine Camunda[7].

[5] The Google Web Toolkit allows the user to write AJAX applications in Java and compiles the source code to highly optimized JavaScript, which runs browser independent including mobile browser (GWT website, n.d.).

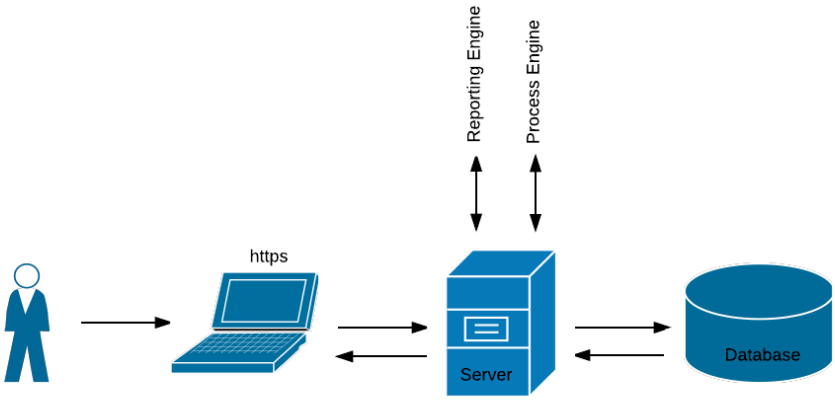

Figure 18: Simplified System Model of the MUM Software.

The application can in general be separated into two parts: the frontend Object Manager and the administration surface Object Designer. These two will be discussed in the following sections with a focus on the process of data maintenance.

3.1.1 MUM Object Manager

The MUM Object Manager represents the user interface of the MUM Software, which can in general be separated into four parts, see Figure 19 (Netconomy Software & Consulting GmbH o, 2016). These include:

1. **Navigation tree (top left corner):** depending on the to the user assigned rights, different kinds of business information, called channel, are shown (Netconomy Software & Consulting GmbH f, 2015).
2. **Results section (top right corner):** the results of a selected channel or a search are shown in this area. Within this section, several columns and their associated attributes are displayed. In addition, the amount of date sets per page and the total amount of data sets are shown in the top right corner (Netconomy Software & Consulting GmbH k, 2016).
3. **Personalized MUM area (bottom left corner):** users can quickly access recently viewed data sets, often used and therefore stored search queries, favorites and drafts. New created objects can be stored as drafts (only seen from creator) to continue editing in the future in case not all necessary information is available yet. If these information cannot be maintained by a single person but instead needs input

[6] The Birt Engine offers data visualization and reporting technologies (Eclipse website, 2014).
[7] The Camunda Engine covers the handling of "*workflow and business process management*" (Camunda website, 2016).

from another person within another department, drafts can be made publicly available and other employees can continue editing this object (Netconomy Software & Consulting GmbH h, 2015).

4. **Detail view (bottom right corner):** by selecting a data set within the results section, the detailed view of this is shown in the top right corner. Here, also the relations between different departments, locations or employees can be seen. Within MUM Software, three relations are supported: n:1, 1:n and n:m (Netconomy Software & Consulting GmbH b, 2015).

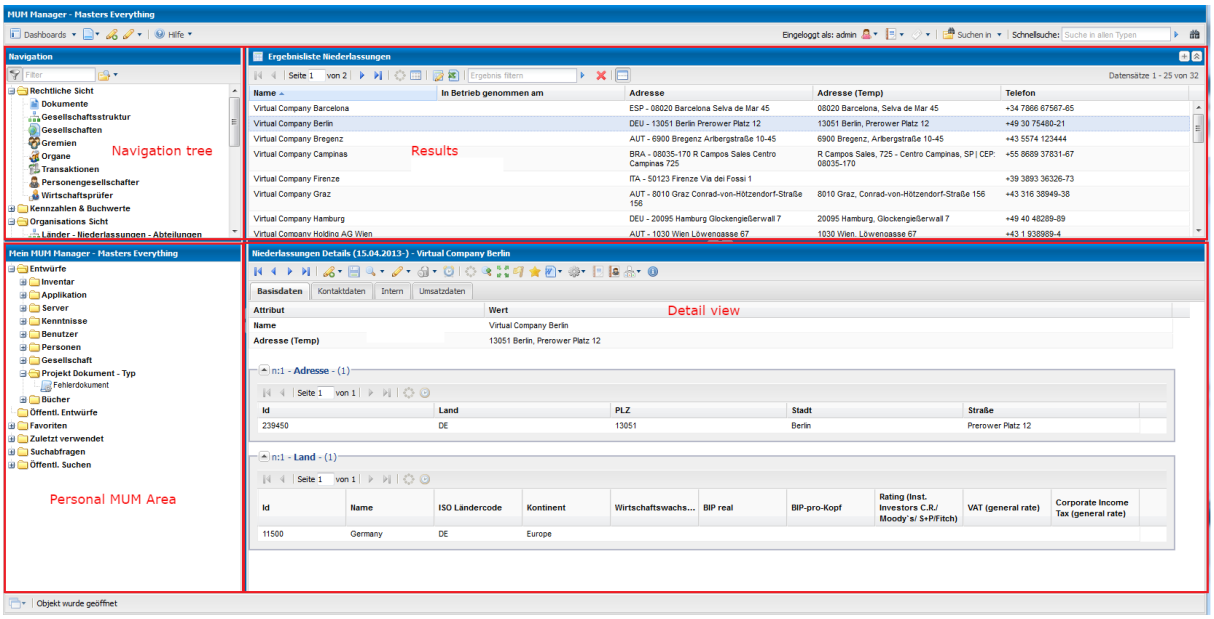

Figure 19: General structure of the four sections within the MUM Object Manager (derived from Netconomy Software & Consulting GmbH j, 2015).

The various options regarding data maintenance within the MUM Object Manager will be discussed in the following section, while the backend part of maintaining data will be described within section 3.1.2 MUM Designer.

3.1.1.1 Data Maintenance

Maintaining data via the user interface MUM Object Manager can be done in the following four different ways: (1) inline editing, (2) manually creating new objects, (3) update existing data via excel import and (4) import new data via integration services.

Inline editing

A general and easy way of data maintenance is via the inline editing option. Data can be added or changed either within the results view (see the section on the top right corner in Figure 19) or within the details view in the bottom right corner in Figure 19. If a user wants to edit data within the results view, the inline editing needs to be activated first, using a special button in this section. Once this is done, simply clicking inside the field and start editing can change the desired attribute(s). In case, more than one attribute was changed, all changes can be stored by either clicking “Save all” or saving all attributes successively by clicking a “Save” button. If no additional changes should be made, the inline editing mode needs to be ended again.

Making modifications within the details view does not require the enabling and disabling of the inline editing mode. Instead, simply clicking inside the desired attribute is sufficient to change or add information. Nevertheless, it is necessary to store these modifications using the “Save” button (Netconomy Software & Consulting GmbH a, 2015).

Manually creating new objects

Creating new objects, for instance a new employee within the company, can be done in four different approaches within the MUM Object Manager. First, a new object can be created within the navigation tree section by right clicking on the required object type and selecting “Create new object”, see Figure 20.

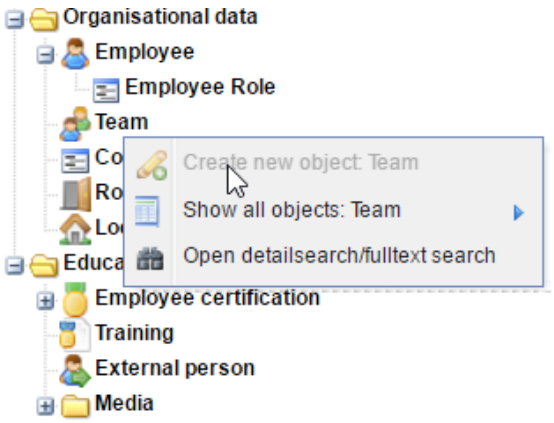

Figure 20: Creating a new object within the navigation tree.

Second, a new object can be created within the main menu (top bar). Creating an object within this section does not preselect the object type, but instead shows a list of possible types that can be generated, see Figure 21.

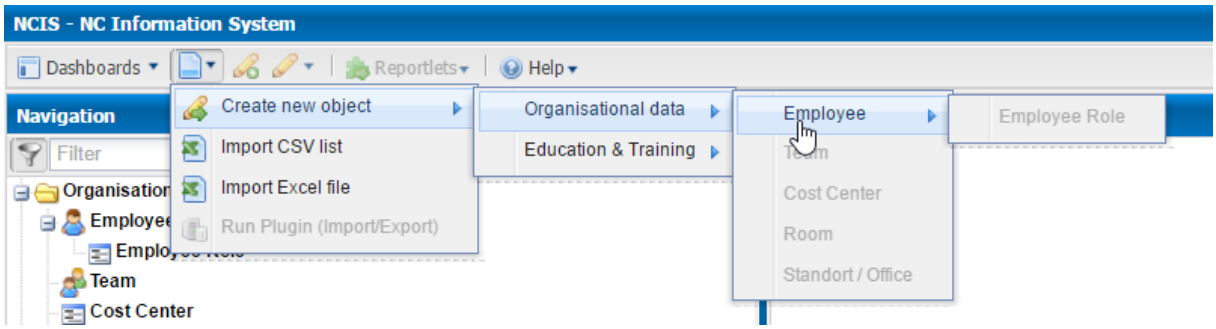

Figure 21: Creating an object using the main menu.

The third and fourth options to create new objects are within the results or the detail view section. Both options use the same icon for indicating this possibility. Additionally, it is possible to create a "duplicate" of the viewed data set within the details view. This reduces the amount of needed data maintenance, especially if the majority of attributes are identical to the one that is created. Figure 22 illustrates the general process of a duplicate creation (Netconomy Software & Consulting GmbH a, 2015).

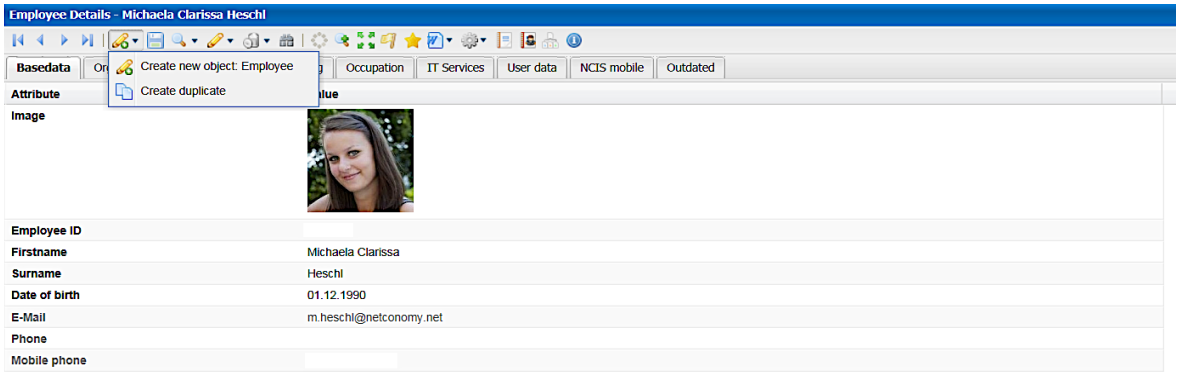

Figure 22: Creating a duplicate within the detailed view section.

Update existing data

In case a high amount of data needs to be updated, a more efficient approach can be followed. Therefore, the required data that has to be changed needs to be exported first. Within the export, the option "for editing/upload" can be selected. This offers the possibility of importing the exact same file again as soon as the required changes are made. In addition, the file format can be set to an Excel file (.xlsx) or to Comma Separated Values (.csv). The changed data can then be reimported, which can be seen in Figure 23. For .xlsx files, there is an additional option of simulating the import first. Here, the data is validated first and checked whether an import is in general possible. In case, an error occurs, an additional Excel file can be downloaded including a detailed error description. The process for importing .csv files is similar. The only difference is, that the according file type needs to be selected when importing, see Figure 23 (Netconomy Software & Consulting GmbH c, 2015).

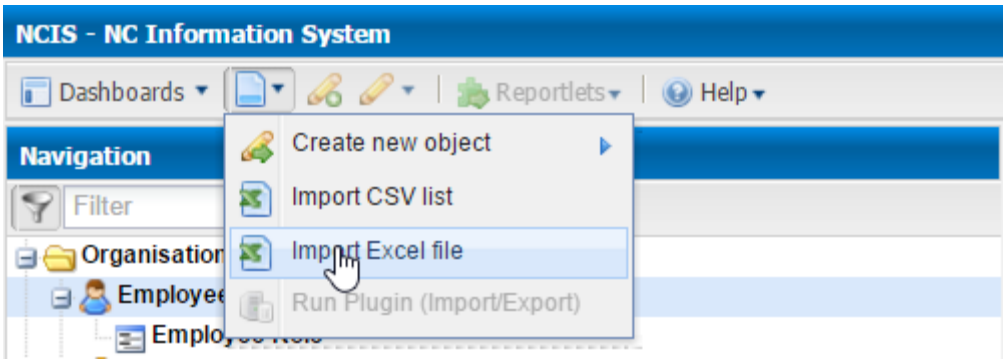

Figure 23: Importing Excel or CSV files.

Integration Services

The import of new data can be done via plugins. These can either be started in the same section as the previously described .csv and .xlsx imports, by selecting “Run Plugin (Import/Export)” (see Figure 23) or within the results section. There are different plugins available to import data either from an Excel file (ExcelReadPlugin) or from a database server (GenericDbReadPlugin). For instance, when importing an Excel file which contains employee information, the template can define “firstname”, “surname”, “email”, “birthdate”, “department” etc. These fields should further define what kind of information will be imported, for example date for “birthdate” and text for “firstname” and “surname”. The order of fields within this template does not have to match the order of the actually imported file. The so-called “GenericDbReadPlugin” can be used to import data from a database server. Using a special field, it is possible to distinguish whether data from an Oracle or a SQL server will be imported (Netconomy Software & Consulting GmbH d, 2015).

3.1.2 MUM Designer

The MUM Designer offers the possibility of adjustment and extension of the master data to the corporate requirements. Administrators of the software can not only maintain access rights for employees or employee groups, add or delete a data language but also change/add processes as for instance the process of the onboarding of new employees (Netconomy Software & Consulting GmbH p, 2016; Netconomy Software & Consulting GmbH e, 2015). The MUM Designer can be opened within the MUM Object Manager, see Figure 24.

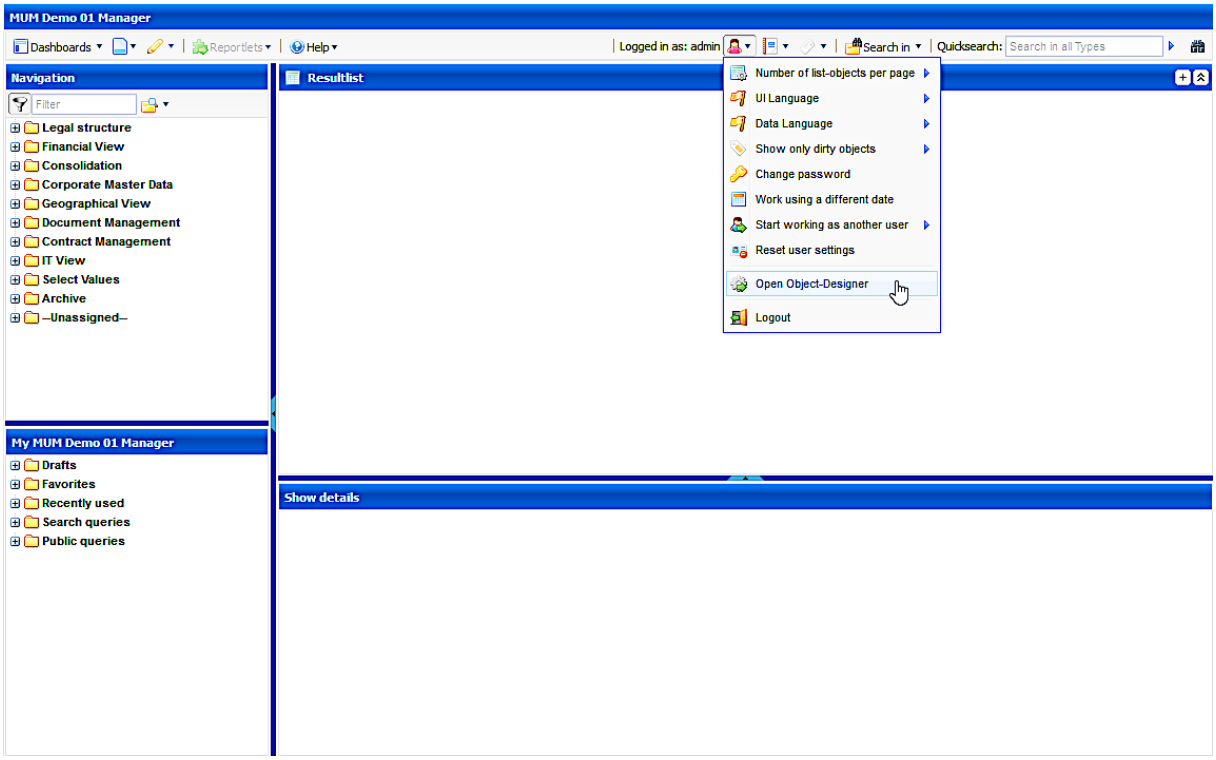

Figure 24: Opening the MUM Designer within the MUM Object Manager.

In addition to the previously mentioned configuration possibilities, also the integration services are part of the MUM Designer. After the basic installation of the MUM Software, a list of several plugin types is available within the integration service, such as an “ExchangeAppointmentImportPlugin”, a “GenericMailPlugin” and the already mentioned ExcelReadPlugin and the GenericDbReadPlugin. These plugins can be installed independently.

3.2 Newly Designed Prototype PT1

Providing a new designed client that is not only more intuitive and attractive to use, but also a client that should supply an abbreviation for experienced users and the possibility of providing a reduced view of the client for users who only use parts of the software, were the main reasons for developing a new designed prototype. To increase the usability and introduce a modern look & feel, the so-called Valo theme from the Vaadin framework is used (Vaadin website, 2017; Netconomy Software & Consulting GmbH n, 2016).

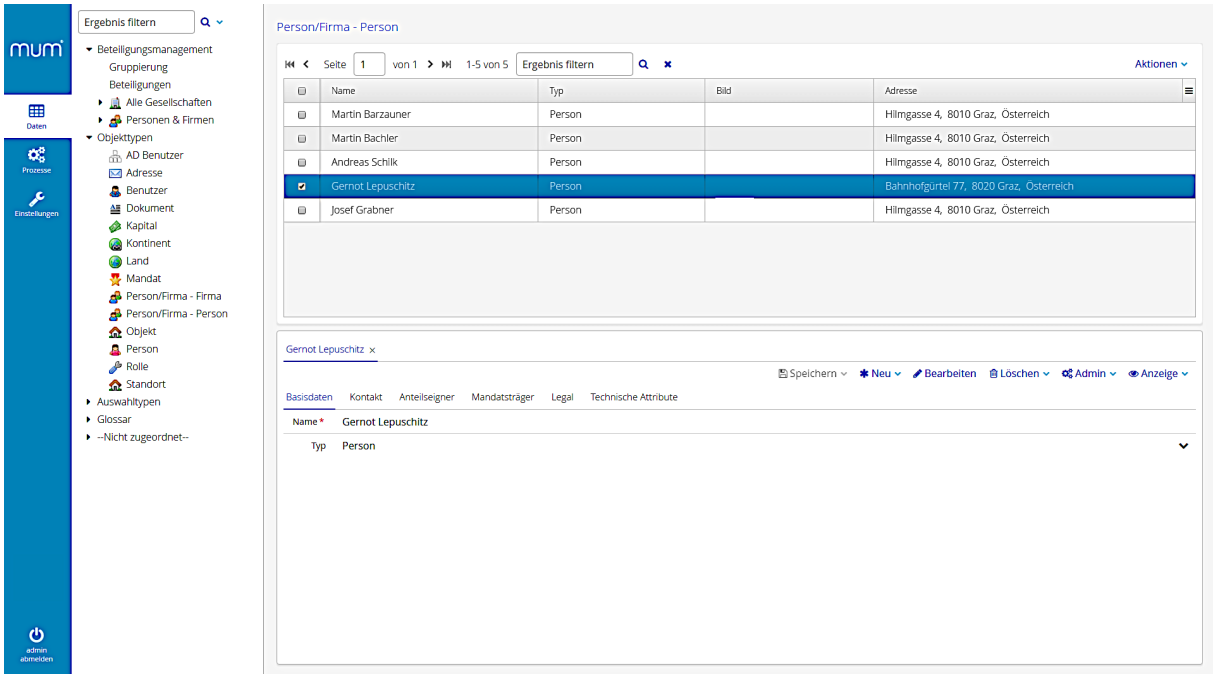

Figure 25: General interface of the new prototype when navigating through the navigation tree.

As can be seen in Figure 25, there is no separation into four sections within the new prototype, compared to Figure 19. The navigation tree is not shown anymore on every section, for instance when selecting “Prozesse” (processes) within the main navigation on the left (blue bar) this space is used for the visualization of processes. In case the section “Daten” (data) is selected, as in Figure 25, the display can be separated into the navigation tree area, the results and the details view area, similar to the existing client. Even though this prototype does not yet include all features of the existing client, it is obvious, that the general visualization is more modern and clearer structured as the amount of buttons and sections are reduced. Furthermore, additional changes are made to this prototype compared to the existing client. The following list focuses on the main five changes regarding the design and usability (Netconomy Software & Consulting GmbH n, 2016):

1. **Validation:** validation will be done when leaving a field instead of on saving
2. **Navigation:** prototype PT1 includes a new navigation, which offers an appropriate UI for each application case instead of showing the navigation tree permanently. The main navigation will be divided into dashboard, data, processes, import/export and settings section (see Figure 25)
3. **Buttons/Actions:** the label of buttons and actions will be configurable
4. **Customer Style:** each customer can adapt the interface styling to the company’s CI using a .css file
5. **Selection type:** to get a more compact interface, icons instead of option names can be set. A state for instance can be visualized using a checkbox or an image can be added to each employee, see Figure 25

At the point of conducting Experiment 1 and therefore evaluating these two versions of the software, the prototype's scope was limited. The process of data maintenance will be discussed within the next section.

3.2.1 Data Maintenance

Compared to the various data maintenance options in the existing client (see section 3.1.1.1 and section 3.1.2) the ways of maintaining data within prototype PT1 are limited, as the MUM Designer is not yet fully implemented. Instead, data maintenance can be done via the following three options:

1. **Inline editing:** the possibility of inline editing does, in comparison to the existing client, not (yet) work within the results section. Instead, inline editing is only feasible within the detailed view of a data set on the bottom. The general process of inline editing corresponds to the process within the existing client. Meaning, by simply clicking into the desired attribute the changes can be made and in contrast to the existing client, there is no need of storing the changes via a button click anymore. Instead, the changes are stored when leaving the field as described in point 1 in section 3.2.
2. **Edit:** in addition to the inline editing functionality, editing can also be done by activating the editing functionality via a click upon the "Edit" button within the detailed view section and the results section. Maintaining data this way, not yet prefilled attributes are shown as well, see section 4.3.5.3 for further explanation.
3. **Create:** in contrast to the existing client, where a creation of new objects is possible within the navigation tree section, the results section and the detailed view section, the new prototype PT1 offers (until now) two of these possibilities: creation of new objects via the results and the detailed view section. Figure 26 illustrates the possibility of creating a new object within the results section. In addition, the creation of duplicates compared to the process in section 3.1.1.1 is planned but not yet fully implemented.

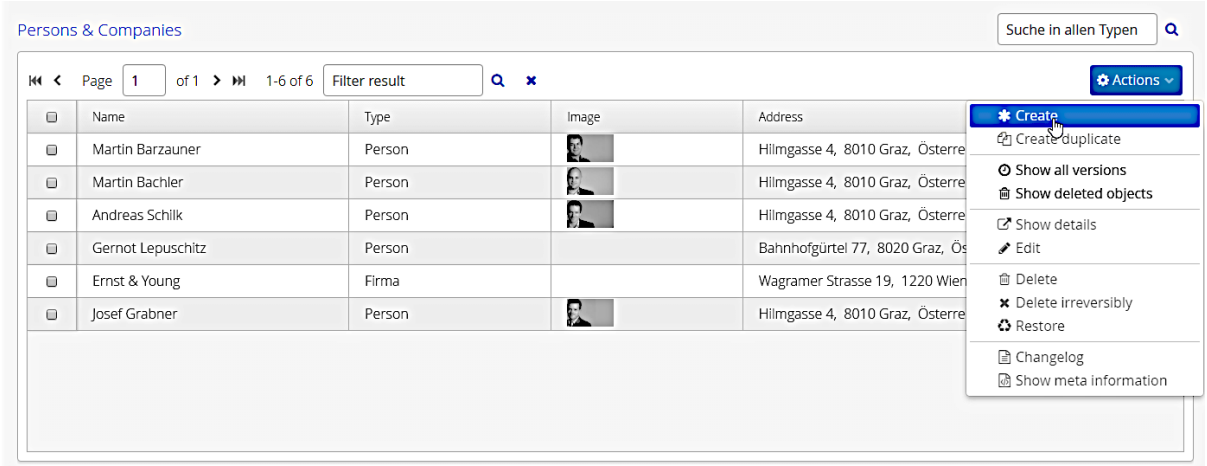

Figure 26: Creating a new object within the results section.

3.3 Summary

The MUM Software does not only store a high amount of different company-related information such as employee, customer, CRM and ERP data but instead also offers a high amount of different applications (MUM Software website c, 2016). Beside the possibility of storing and maintaining these information, the current structure of the company can be visualized by organigrams and special processes, for instance the onboarding process of new employees, can be mapped and processed faster (Netconomy Software & Consulting GmbH o, 2016 ; Netconomy Software & Consulting GmbH i, 2015).

Regarding data maintenance within the existing client, various different approaches exist. These reach from maintaining data within the MUM Object Manager by editing or creating new objects, to the possibility of updating existing data via an export/import method to importing new data by reading this data from an external server via a GenericDbReadPlugin (Netconomy Software & Consulting GmbH a, 2015 ; Netconomy Software & Consulting GmbH c, 2015 ; Netconomy Software & Consulting GmbH d, 2015).

In contrast to this high amount of different methods of keeping the company's master data up-to-date and consistent, the newly designed prototype PT1 does not yet cover all these functionalities. This is due to the MUM Designer being not yet in place to provide the update and import of data. Therefore, maintaining data is so far only possible via inline editing, editing via the button click and the creation of new objects within the results and the detailed view section. However, the main reason to implement this new prototype is to overcome usability issues and analyze the suggested design with real customers.

These two software versions were now analyzed via a conducted usability study. The results are presented within the next chapter 4 Usability Study.

4 Usability Study

The aim of this first usability study was to gain insight into the general usability of the newly developed and designed MUM Software. The following sections will cover all information regarding the participants, the procedure and the results of this study.
As already described in section 2.1.3 several questionnaires were analyzed and compared, but regarding the development of pre- and post-questionnaires the following restrictions were prescribed from company side:

- The questionnaires must be formulated in German. Therefore, a German version of the used standardized questionnaires needs to exist.
- The maximum time it takes a user to answer the questions should not exceed 20 minutes.

In addition, the main focus of the evaluation was put on the following aspects:

- Gain general insight into the usability of the MUM Software
- Presentation of the new prototype
- Detection of possible improvements and the overall usability of the new prototype
- Gain general insight into the customer's thoughts regarding gamification

Due to the above-defined requirements, to address the main aspects best possible and the issue with QUIS not being freely available and Sumi needing an administrator with psychological background, it was decided to use the System Usability Scale in both, pre- and post-questionnaire (HP repository website, 2012; Kirakowski, 1996). In the pre-questionnaire the SUS is used to gain insight into the user's perceived usability of the used software, while in the post-questionnaire the SUS focuses on the new designed prototype of the Enterprise Data Management Software MUM. The main reason to use it in each questionnaire is the resulting possibility of comparing the two systems directly by the concrete out coming scores. Additionally, one representative question from six out of seven dialogue principles are used from Isonorm 9241/10. At the time the study was conducted, the new prototype did not have enough scope such that questions from the dialogue principle "fault tolerance" would not have made sense and were therefore not included. The taken six items focus the most on the design of a system and therefore provide a lot of new insight into the user's thoughts about prototype's current design. This and the fact that it is a German-language standardized questionnaire make it a suitable approach for evaluation. Furthermore, open-ended and yes/no/maybe questions regarding the general use of the software but also regarding gamification to gain insight into the participants' thoughts about adding game elements to the software in future, were used. The complete questionnaires can be found in the

Appendix.

4.1 Participants

The study was conducted by *N = 10* (5 females, 5 male) participants from four different companies. Only about the half of the participants completed a technical study and have therefore a technical background. The participants of the survey differ regarding the fact whether the software was used in the past (and no longer) or if the software still used by the. Two employees (1 female, 1 male) of the Netconomy Software & Consulting GmbH took part in the study and will be named P1 and P2 from now on. These two participants do not use the software currently and therefore the questionnaires of these two participants were filled out with regard to the work that has been done with the software in the past. The remaining eight participants (4 females, 4 male) work in three different companies and are still using the software as part as their workflow. These participants will be named P3 to P10.

4.2 Procedure

The usability study itself was conducted on-site of the four different companies within their Austrian locations. The procedure of the conducted study was equal for all 10 participants and derived from the described procedure in section 2.1.2. First, the known software was shown in order to recall its design and structure. With regard to this software, the participants were asked to answer the pre-questionnaire that did not only consist of general questions regarding their usage of the software but also the System Usability Scale and four questions regarding gamification. After this first questionnaire was completed, the new prototype was shown to the participant. Furthermore, the possibility to interact with it was given to them to get a deeper insight into the structure and design of this new version. As soon as the participant had the impression to be able to answer the last questions the post-questionnaire was handed over. After the completion of this questionnaire the survey was closed. In average, this procedure took each participant around 30 minutes. During the whole study a supervisor took notes of participants' comments and the issues that were faced when working with the new prototype.

4.3 Results and Discussion

The following results include the analysis of both questionnaires and comments made during the study on the part of participants. The next sections will demonstrate the outcomes of open-end questions regarding the general use of the system on part of the participants, the

System Usability Scale, Isonorm 9241/10 and finally the results of the four included gamification related questions in the pre-questionnaire.

4.3.1 General Use of the Software

The first questions of the pre-questionnaire focused on getting insight into how many hours per week each participant of the study is using the software, the most frequently used software's features, which features are used reluctantly and what should be changed with regard to the software's design. It turned out, that six out of the eight participants are using the software on a daily basis and the hours per week of these vary between 4 to 20 hours. (M = 9.21, SD = 6.40). Participant P1 outlined the usage with the software in the past even more detailed: once a month for updating new employees and once half-yearly for updating the employees training possibilities. The following Figure 27 illustrates the number of hours per week the participants P3 to P9[8] estimated use the MUM Software.

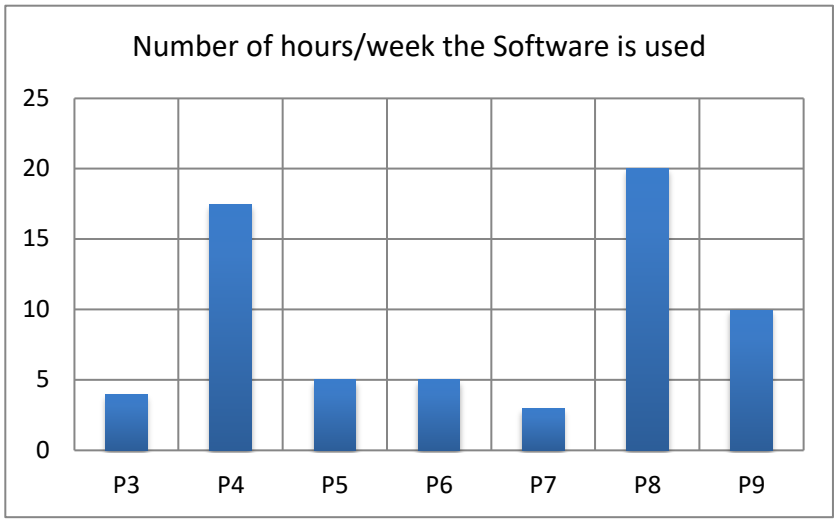

Figure 27: Number of hours per week the participants P3 to P9 estimated to use the MUM Software.

Even though the number of different features the software offers is remarkable, the interviewed participants mentioned these following five features as the most frequently used ones: (1) search and the definition of searches, (2) reports, (3) data maintenance, (4) processes and (5) the general usage of the software as an information tool. Simultaneously, three out of these five features are listed as the most unlikely used ones: (1) searches and the definition of searches, (2) reports and (3) data maintenance. A similar agreement between the participants can also be found in terms of the software's design flaws. The

[8] Participant P10 did not answer the question regarding the amount of hours/week with a numerical value, instead answered using a textual statement and is therefore not taken into account within this graphic. Furthermore, participant P3 answered the question with a range "15-20 hours". For demonstration reasons the average of 17,5 hours was used.

majority wants the software to have a clearer structure. Another frequent statement addresses the wish of a reduced GUI with regard to the user's working area. It should be possible to configure the software's scope in such a way, that each user is not distracted by other features that are not relevant for his/her work but instead only show these parts of the software that are relevant.

One main goal on part of the company was to reduce the number of popups in the new prototype, as these have been felt to be disruptive. Interestingly the participants did not mention this issue. Upon request by the supervisor the majority declared the popups to be "unclear but not disruptive". Only one participant, P3 agreed with the company's proposal of reducing the amount of popups and stated: "… definitely need to vanish".

4.3.2 System Usability Scale

The System Usability Scale was used in both questionnaires:

- **Pre-questionnaire**: to address possible usability flaws of the current software
- **Post-questionnaire**: to address possible usability flaws of the new prototype

Thus, it is possible to receive a numerical value to compare the usability of both systems. The analysis of the SUS has been done according to the process described in section 2.1.3. In general, each participant rated the usability of the new prototype better than the usability of the software that is currently in use. The highest improvement can be seen in P2 with an increase of 27.5 from a SUS score of 30 in the pre-questionnaire and a score of 57.5 in the pre-questionnaire. A similar high growth can be seen in P3 (increase of 25) who rated the usability of the current software with a score of 25 and the new prototype's usability with 50. The highest values for both questionnaires have been rated by P5, where the software has been assessed with a value of 85 and the prototype with a value of 90, which are more than triple the rate of P3. Figure 28 illustrates the detailed results of all participants.

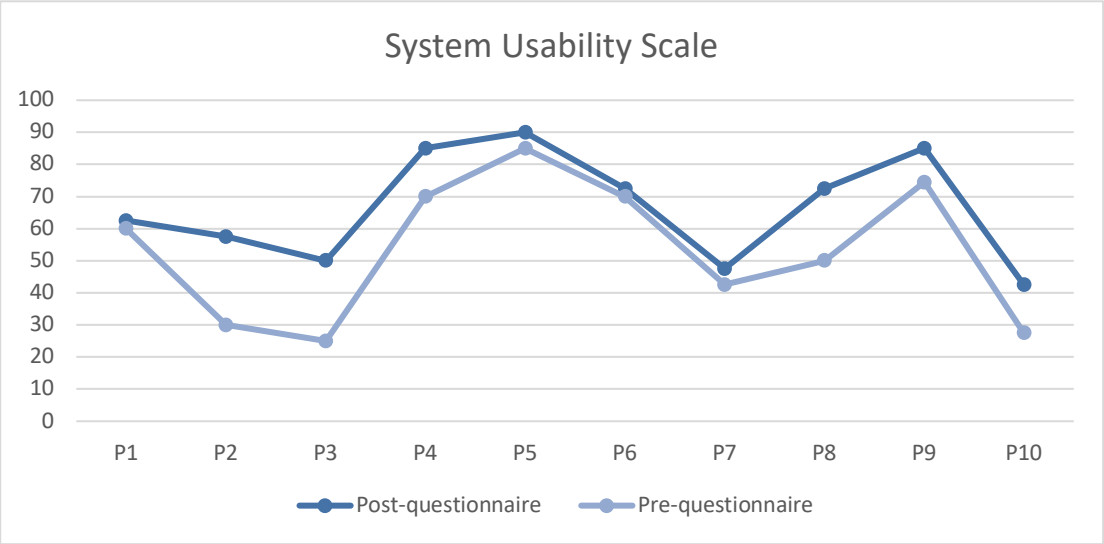

Figure 28: Results of the System Usability Scale for both questionnaires.

Additionally, the overall average of all participants was calculated. The used software received an average score of M = 53.45 (SD = 20.48) while the new prototype turned out to have an average score of M = 66.5 (SD = 16.17).

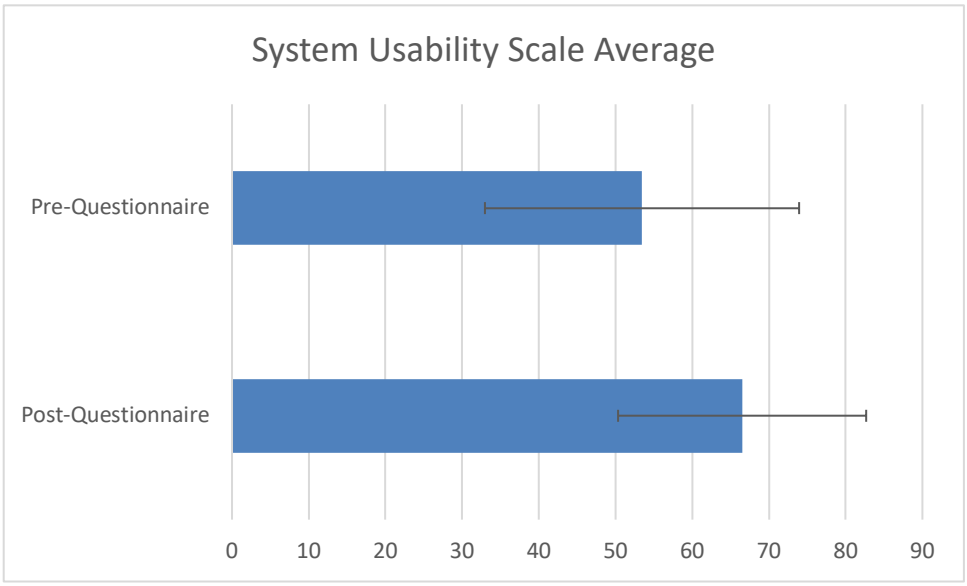

Figure 29: Average result of the System Usability Scale.

Referring to the proposed interpretation of the System Usability Scale in section 2.1.3 Questionnaires, this leads to the result that the usability of the new prototype is approximately in the middle of the “high marginal” area while the current software is rated at the beginning of the “low marginal” area. The mentioned graphic got extended with the results of Figure 29 to illustrate the improvement.

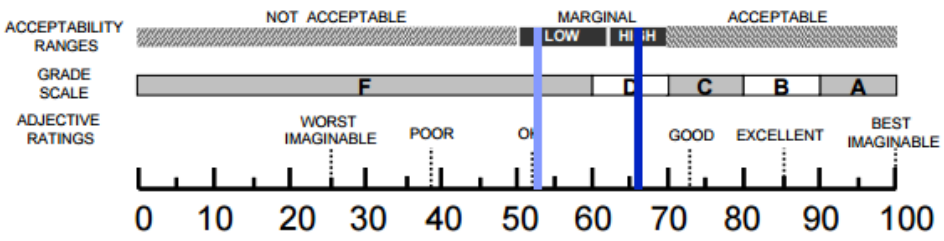

Figure 30: Proposed interpretation of overall SUS scores including marks to visualize the increase from pre- to post-questionnaire (Bangor, Kortum, & Miller, 2009).

4.3.3 ISONORM 9241/10

In total, six questions were taken from the 35 items standardized questionnaire. These six questions mainly focused on the current design of the new prototype. Figure 31 shows the overall results of all 10 participants with regard to the six design principles the questions were taken from.

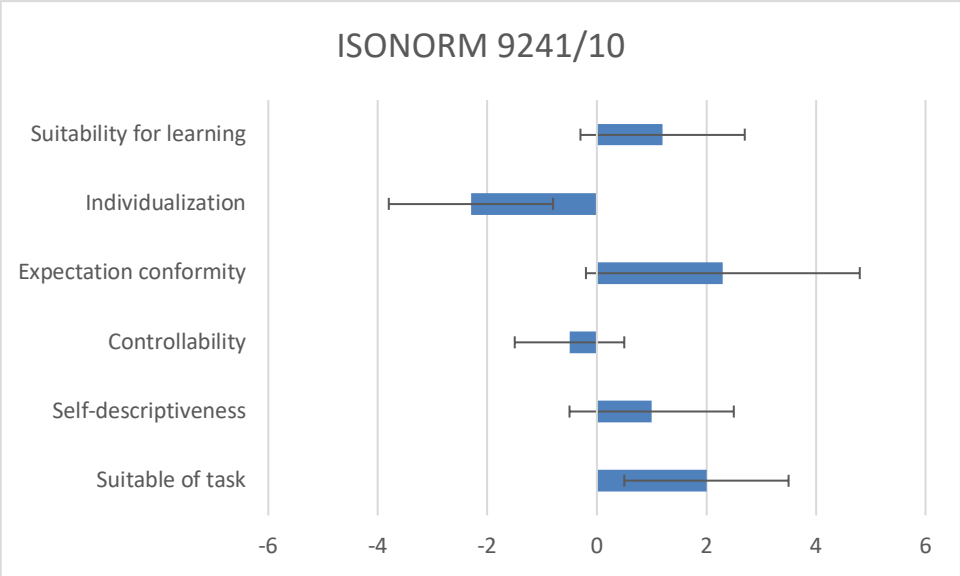

Figure 31: Results of the six selected items from Isonorm 9241/10.

It can be seen, that the only question that resulted in a slightly negative value (M = -0.1, SD = 1.22) is the first which aimed at asking for all necessary features being present such that tasks can be completed using the software. This result can be explained due to the fact, that not all features have been present yet at the time the study has been conducted.

The other five questions concentrated on gaining insight into possible design flaws, such as:

- **Self-descriptiveness**: whether the prototype provides a bad overview about its features (M = 1.2, SD = 1.08)
- **Controllability**: whether the prototype provides an easy switch between menus and masks (M = 1.9, SD = 0.83)
- **Expectation conformity**: whether the orientation is complicated due to an inconsistent design (M = 1.8, SD = 0.75)
- **Individualization**: whether the screen representation can be adapted easily to the user's needs (M = 0.5, SD = 0.63)
- **Suitability for learning**: whether something that has been learnt can be easily memorized (M = 1.1, SD = 0.94)

The low result regarding the possibility of adapting of the screen representation to the user's needs can be linked to the customers' wishes of a reduced GUI. Many participants mentioned this at the time this question needed to be answered. Although the prototype provides an additional option to configure the screen representation, which is not present in the known software, this question was rated lower than expected due to the issue that the GUI cannot be reduced to the user's daily work. Figure 32 shows one possible screen configurations the prototype provided at the time the study was conducted.

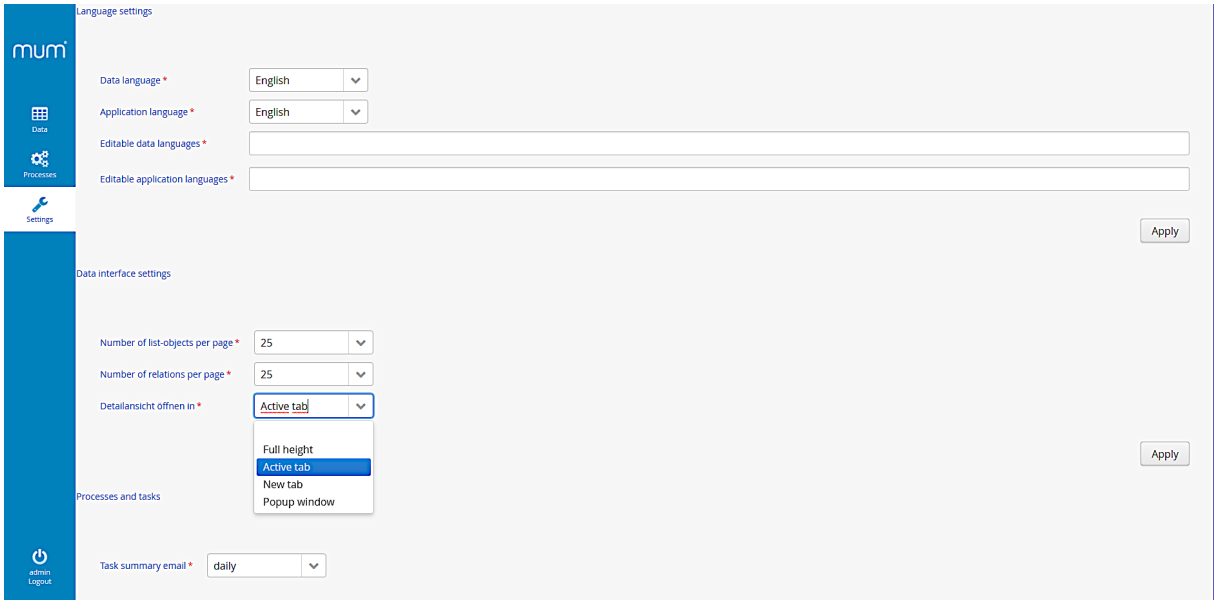

Figure 32: Configuration possibilities in the new prototype.

The "Detailansicht öffnen in" section is new in the prototype (and not yet translated correctly). It is possible to configure whether the detail view should be opened over the full height, as active tab, new tab or as a pop-up.

4.3.4 Gamification

In addition to these standardized questionnaires, the pre-questionnaire contained four items regarding gamification. These four questions aimed at gaining insight into the participant's thoughts of adding game elements to the software in order to increase the user's motivation. Gamified Platforms such as StackOverflow, LinkedIn or Foursquare are used by 80% of all participants. Regarding the consciousness of the platforms using game elements to increase their user's engagement, the results were different. Only five out of the eight that are using gamified platforms knew about the existence and usage of game elements inside these platforms. Again, four of these five stated that the existence of game elements would not increase their motivation to prefer the software. The detailed results can be retrieved from Table 6.

Participant	Yes	No	Maybe	Game element
P1		x		
P2			x	Badges
P3		x		
P4		x		
P5		x		
P6		x		
P7		x		
P8	x			Rankings
P9			x	Rankings
P10		x		

Table 6: Detailed results of the participants thinking regarding a possible motivation increase due to the existence of game elements in the software.

This listing also states the game element that the participant would prefer the software to have in the future. In general, the participants' feeling about adding gamification to the software was torn. One participant for instance stated, that the addition of game elements such as progress bars etc. would rather lead to a demotivation instead of an engagement increase. This assumption was based on the fact, that most of the time, not all information is already available when creating a new employee for instance. Some data will be available later or needs to be added from another employee. Therefore, even though all available information at the point of the object creation is maintained, maybe only 50% of all information is stored and employees may get demotivated due to this visual representation as there may be no way of increasing the percentage within the progress bar. On the other hand, one participant was sure about the possible motivation improvement that the usage of game elements could lead to. This certainty was based on another experience inside the company where the use of game elements already increased the employees' motivation which did also result in a faster execution of work.

4.3.5 Suggestions for Improvements

During the interviews, several improvements regarding the new prototype were proposed by the participants. Below, the three most valuable and most often suggested improvements will be outlined and explained in detail.

4.3.5.1 Page turning section

During the conduction of the study it was suggested to make page turning less prominent by moving it for example to the right next to “Actions”. Figure 33 shows its current position and where it was proposed to place it in the future.

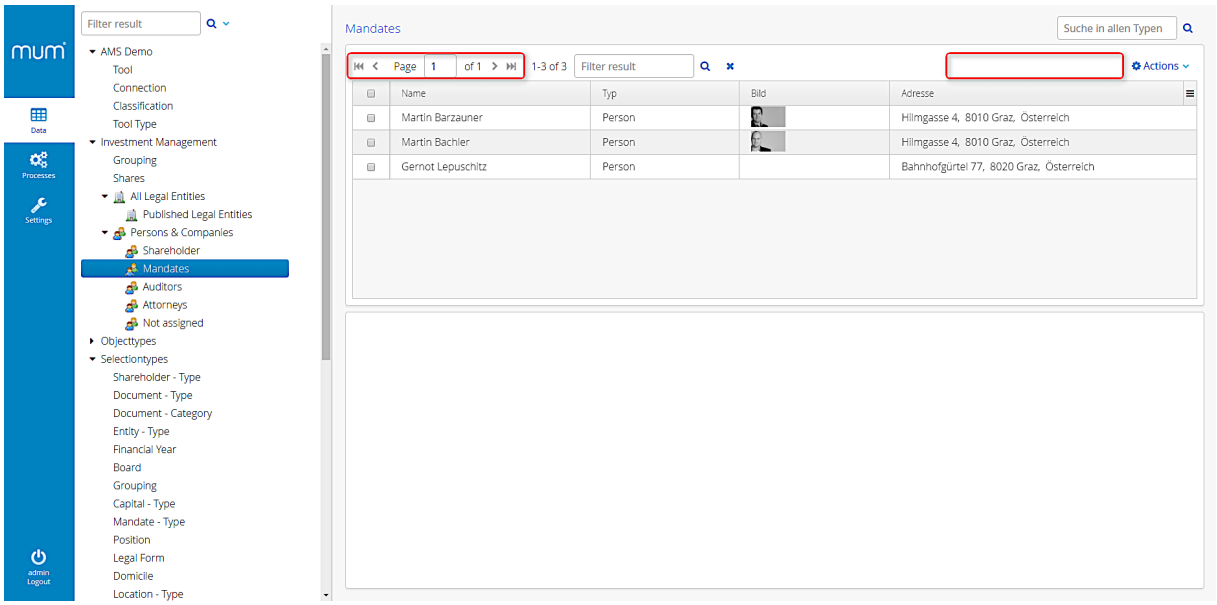

Figure 33: Proposed improvement regarding page turning.

This suggestion was based on a theory learnt in the past, which states that a user scans an interface from the left top to the right bottom. Due to this and the participants’ impression of the page turning section not being that relevant, this improvement was suggested.

4.3.5.2 Logout Button

The second improvement affects the current position of the logout button in the left lower corner. Three participants (TP2, TP5, TP9) stated, that this position is not intuitive, as they would have rather looked for it in the top right corner. Even though TP2 and TP9 also mentioned that they in general do not use the logout function, as logging out of a web

application does not seem necessary to them, the position was stated as “definitely wrong”. Figure 34 shows the current and the proposed position of the logout button.

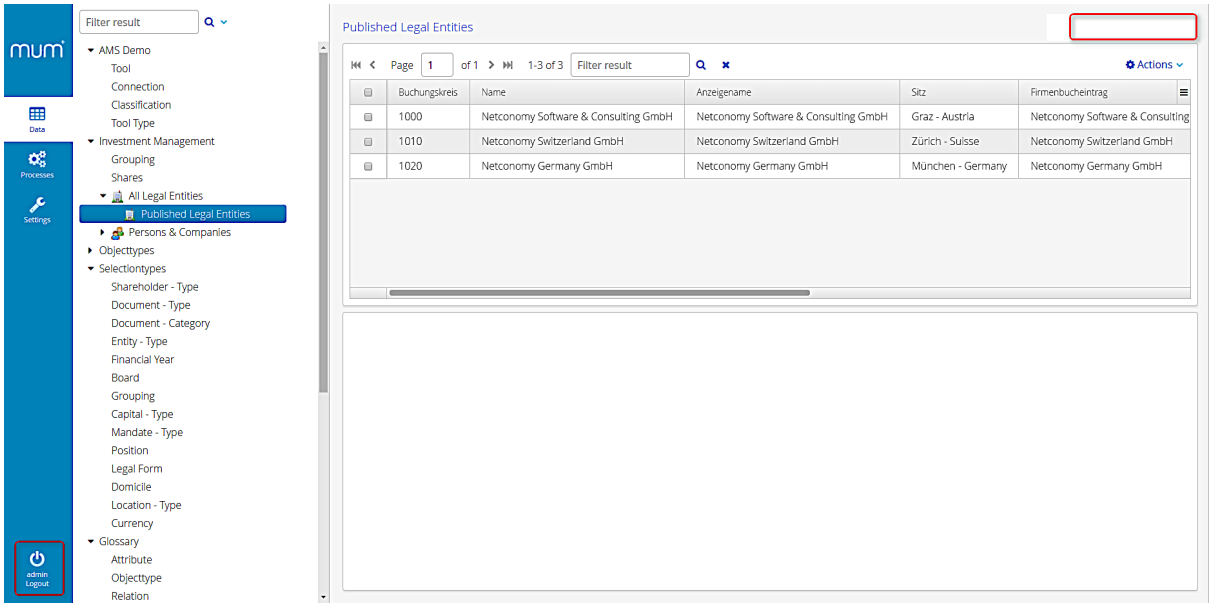

Figure 34: Proposed improvement regarding the position of the logout button.

4.3.5.3 Inline Editing vs. Edit Function

The new prototype provides the functionality of inline editing. Concerning Figure 35 it is possible to edit the name and type by clicking into the appropriate line and enter the required data. Due to this possibility, a participant stated the “Bearbeiten” button to be not needed, as the changes can be done without it as well. With the progression of the prototype the functionality increased and leaded to the possibility of editing more fields via the “Bearbeiten” button, see Figure 36.

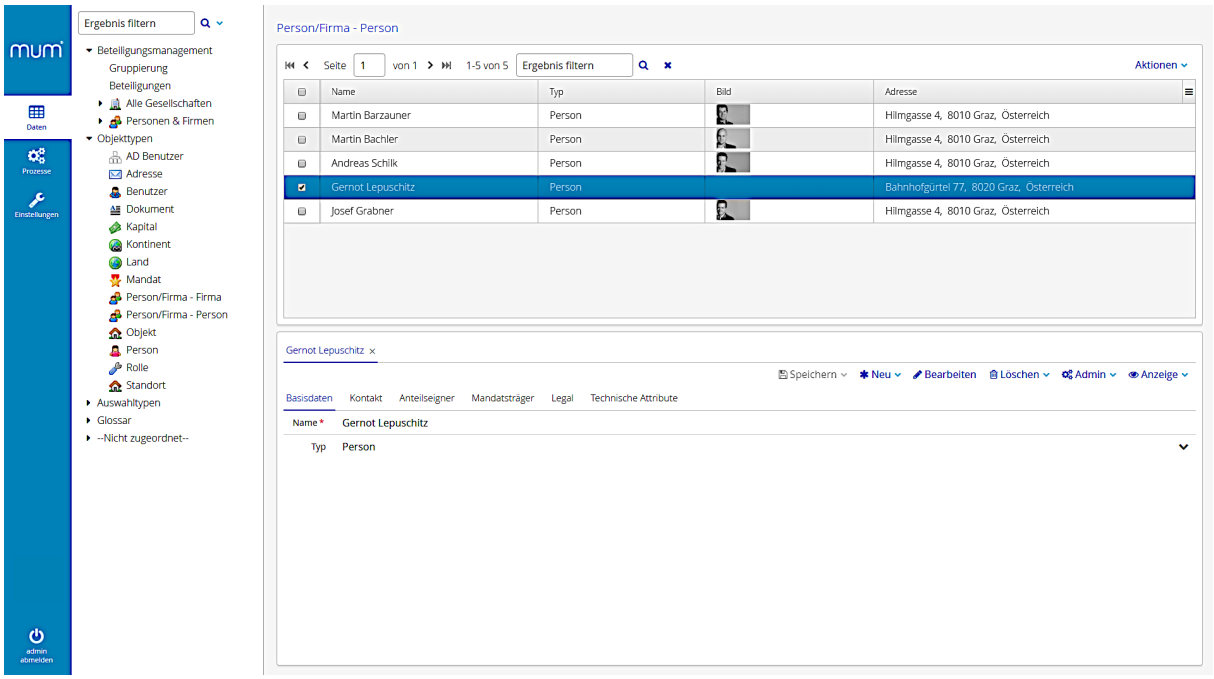

Figure 35: Inline editing inside the new prototype.

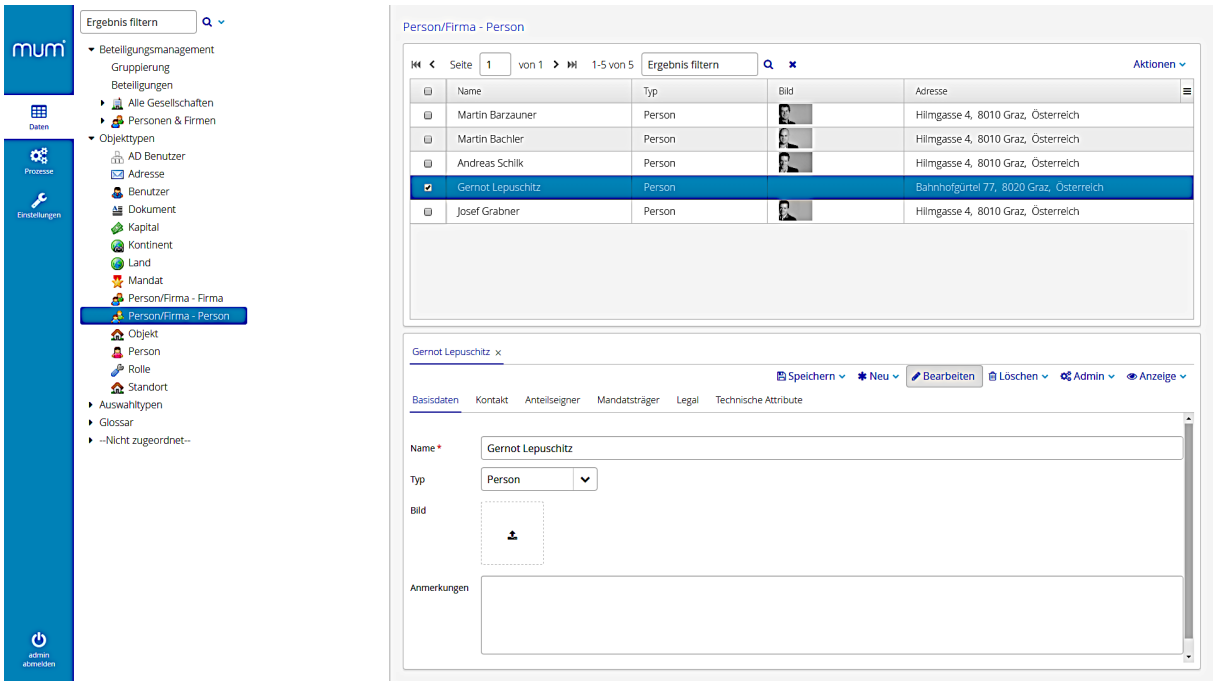

Figure 36: Editing using the “Bearbeiten” function.

As can be seen when comparing the two figures (Figure 35 and Figure 36) above, empty fields are only displayed when clicking the button. This was again an issue reported by several participants and the possible solution of adding a functionality in the designer section where the administrator of the software can configure if empty fields should also be displayed in the general view. This way it would also be possible to inline edit these fields directly without the need of clicking the button in advance.

4.4 Summary

Overall it can be said, that the prototype gained a high level of acceptance and 100% of the participants stated, that they like the design of the prototype better than the one of the known software. This is also reflected by the result of the System Usability Scale where an average increase from 53.45 to 66.5 can be found. Nevertheless, many different improvements were proposed regarding the prototype's design. These findings are consistent with the results of the selected items from Isonorm 9241/10. Only the first question with regard to suitable of task was rated negatively in average. This can be explained with the prototype not having included all necessary functions to allow the customers an execution of all their tasks that are done with the known software. Regarding gamification and the possibility of adding game elements to the software, seven out of 10 participants stated, that they do not think game elements would increase their motivation of working with the software. Only one participant would highly appreciate the existence of game elements, such as rankings, and is sure about the positive effects that rankings would have on the employees. Two other participants reported, that rankings and badges would "maybe" increase their engagement.

In general, it was suggested to exclude everything from the design that does not have an added value, such as borders. This was based on the feeling of having less space inside the new prototype, which can eventually be explained due to the study being conducted using a 13" laptop.

One company from which 4 participants took part in the study expressed the wish to try the prototype with the company's real data in order to improve the reliability of the study's results. Unfortunately, this was not possible at the time the study was conducted but this possibility will be provided.

A future approach regarding the prototype should be to not only focus on the design but also take care about the general functionality of the features that are not used that likely on part of the interviewed customers, such as the search and the search configurations.

5 Design and Implementation

As in the previous chapters described, gamification elements are included into the newly designed prototype in order to test if this results in an increase of engagement on part of the software's users. The selection of the used game elements is based on the results of the first usability study. Hereinafter the suggested process of a gamified Enterprise Data Management Software MUM is discussed in detail. Figure 37 illustrates the upfront designed wireframe which was taken as guideline for the implementation part.

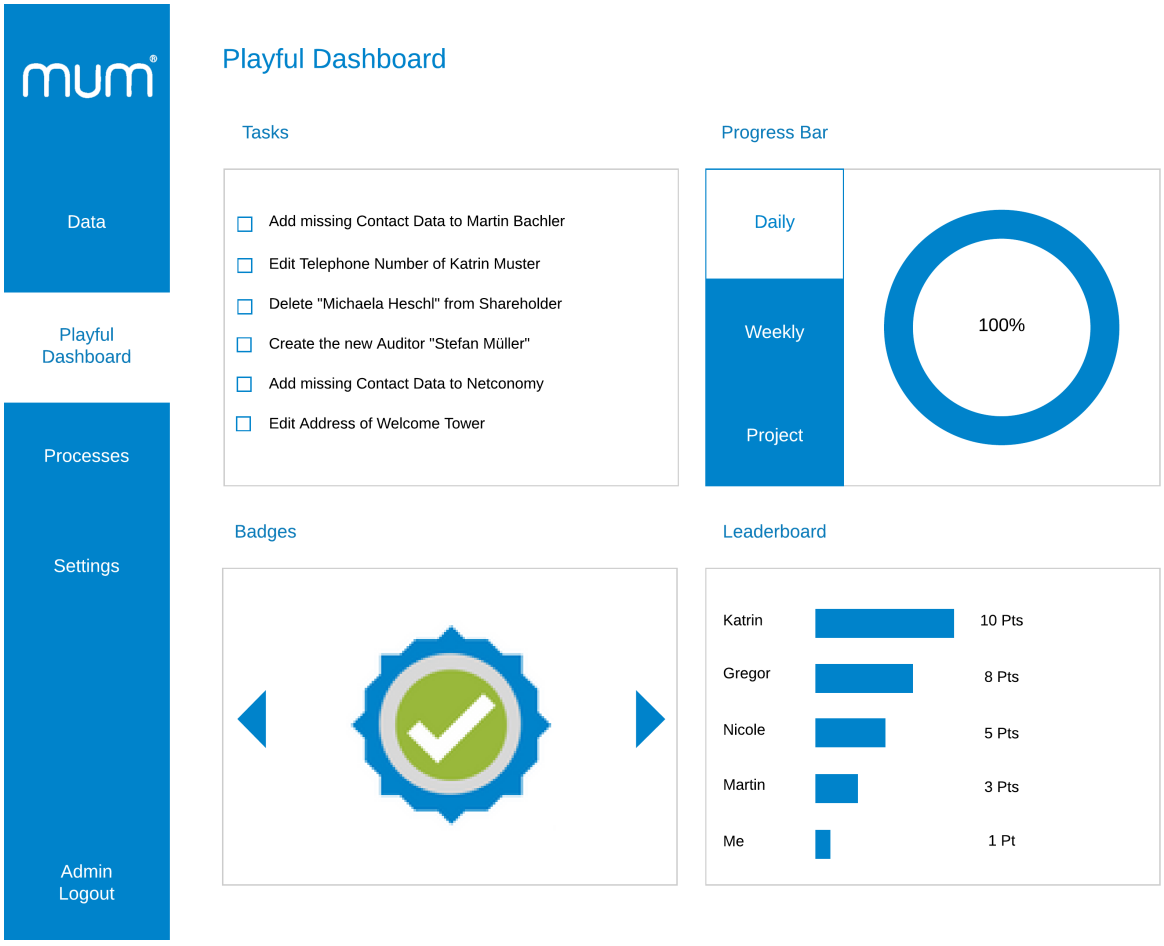

Figure 37: Designed wireframe of the playful dashboard illustrating all included game elements.

The following sections explain each implemented game element in detail as well as the tools and frameworks which were used in order to implement the gamification layer according to the above shown wireframe.

5.1 Gamification Layer

The newly developed gamified prototype PT2 is based and developed on Bootstrap v3.3.7[9]. Bootstrap offers a high variety of design themes which can be used to build an application on. The so-called “SB Admin 2” theme[10] for instance can be downloaded which is a dashboard template and in addition includes a variety of jQuery plugins to extend the functionality. For the development of the gamified prototype, the general “Kitchen Sink” table styling from the “SB Admin 2” design theme is used, as this matches the styling of the prior prototype best. In order to run the application a web server is needed. In this case the Google Chrome extension “Web Server for Chrome”[11] was used.

Figure 38 illustrates how the gamification layer needs to be integrated into the existing MUM architecture. As can be seen, the Playful Dashboard is added into the MUM Object Manager, which represents the User Interface the employees interact with mainly.

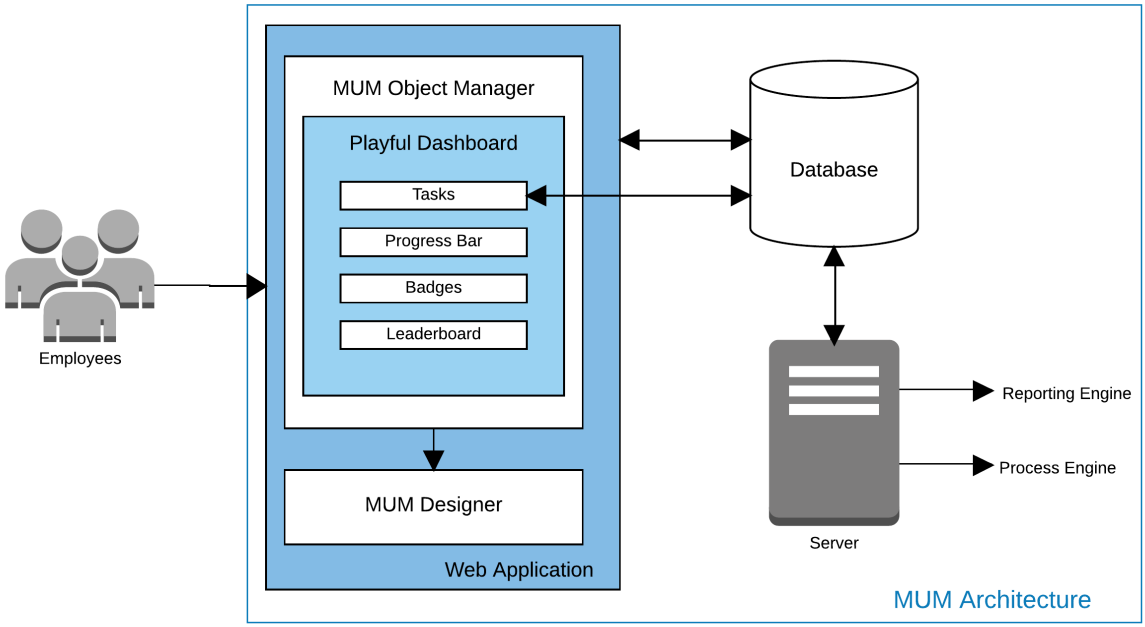

Figure 38: Architecture diagram of the MUM Software including the gamification layer.

[9] http://getbootstrap.com/getting-started/#download
[10] https://startbootstrap.com/template-overviews/sb-admin-2/
[11] https://chrome.google.com/webstore/detail/web-server-for-chrome/ofhbbkphhbklhfoeikjpcbhemlocgigb

Within the implemented mockup prototype, there are four different ways a user can maintain data:

1. **Adding Data:** several fields within the detail view were left empty so the participants of the subsequent usability study could add some data
2. **Editing Data:** editing of existing data via inline editing within the details view
3. **Creating a new entry:** a completely new entry, representing a new row in a table within the results view, can be created
4. **Deleting an existing entry:** the deletion of already existing entries (table rows) represents the fourth and last option to maintain data

The left upper part, called Tasks, in Figure 37 and Figure 39, illustrates a proposed process of the mentioned data maintaining approaches. Once a task is completed successfully, the representative checkbox of the specific task is checked.

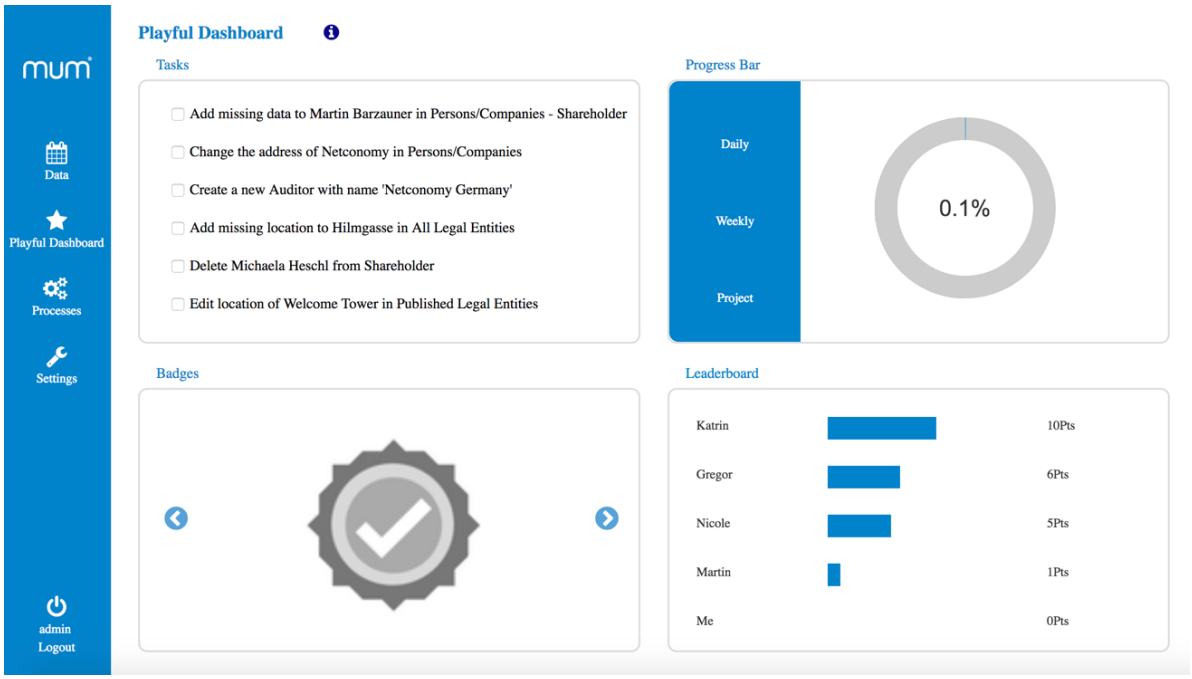

Figure 39: The design of playful dashboard in case no task is yet fulfilled by the user. This Figure also illustrates the starting point for the Usability Study (see chapter 6 Evaluation of Gamification Concepts).

As can be seen in the above Figure 39, there is an additional section within the main navigation: the gamification section, called “Playful Dashboard”. The goal of this section is, to not only give the user an overview of the open tasks regarding data maintaining, but also about the earned badges, the current state within a leaderboard and a progress bar. Table 7 illustrates the player types that are motivated through these selected four game elements (points, progress bars, badges and leaderboard). It can be seen, that all four player types, achievers, killers, socializers and explorers could benefit from the included game elements.

	Achievers	Killers	Socializers	Explorers
Points	x	x		x
Progress bar	x	x		
Badges	x	x		x
Leaderboard (Status)	x	x	x	

Table 7: Engaged player types by the selected game elements according to Xu (2011).

The following sections will describe the proposed mechanisms behind the four game elements points, progress bars, badges (including surprise badges) and the leaderboard in detail.

5.1.1.1 Points

As the general basis of all implemented game elements, points are used. Depending on whether the user adds / edits data or creates / deletes entries, a different amount of points is suggested to be earned. Table 8 illustrates the concrete number of points the user receives for each of these data maintaining approaches.

	# of earned points
Add Data	1
Edit Data	1
Create Entry	3
Delete Entry	3

Table 8: Detailed list of the number of earned points for each data maintaining step.

With the suggested list of tasks to accomplish, which can be seen in the upper left part of Figure 37 and Figure 39, a total number of 10 points can be reached (see Table 9).

	# of earned points
2x Add Data	2
2x Edit Data	2
1x Create Entry	3
1x Delete Entry	3
Sum	10

Table 9: Overview of the earned points when accomplishing all proposed tasks.

The list of tasks is implemented using json. Listening 1 illustrates its general structure.

```
{
  "Tasks": [
    {
      "id": "1",
      "description": "Add missing data to Martin Barzauner in Persons/Companies -
      Shareholder",
      "completed": "0",
      "actionType": "ADD",
      "objectType": "PERSON_COMPANY",
      "objectId": "1"
    },
    { ... },
    { ... },
    { ... },
    { ... },
    { ... }
  ]
}
```

Listening 1: General structure of the task list in json.

5.1.1.2 Progress Bar

The upper right part of the Playful Dashboard illustrates the implemented progress bars. As can be seen, there are three different progress bars in place: daily, weekly and project. All of these should illustrate the reached percentage of the maintained data the logged in user is responsible for. In order to implement the weekly progress bar an assumption of six tasks per day was made. This ends up in a maximum value of 20% shown for the weekly progress for each user in case all suggested tasks shown in the wireframe are finished. The third implemented progress bar “Project” shows a static value of 33%, independent on the number of fulfilled tasks.

The website webseotips.com[12] proposes a way on how to include dynamic circled progress bars into a bootstrap project. In order to implement the three above mentioned progress bars to illustrate the user’s daily, weekly and project related progress, this proposed approach was used and included into the project. By setting the calculated percentage of the fulfilled tasks (with regards to the six tasks in total) into the tag “data-percent”. The visual progress adapts to this value dynamically, due to a provided .js file[13] from webseotips.com. Listening 2 illustrates the implemented approach of setting the calculated progress.

[12] http://webseotips.com/
[13] http://webseotips.com/add-bootstrap-circular-progress-bar-using-custom-css-js/

```
47      setProgressPercentage: function () {
48          var progressBar = $('.progress-bar1');
49          var progressId  = progressBar.attr('id');
50
51          var tasks          = ACC.progress.getNumberOfTasks();
52          var completedTasks = ACC.progress.getNumberOfCompletedTasks();
53          var calculatedPercentage;
54
55          if (progressId == 'progress-daily') {
56              calculatedPercentage = ACC.progress.calculateDailyPercentage(tasks,
                completedTasks);
57              progressBar.data('percent', calculatedPercentage);
58          } else if (progressId == 'progress-weekly') {
59              calculatedPercentage = ACC.progress.calculateWeeklyPercentage(tasks,
                completedTasks);
60              progressBar.data('percent', calculatedPercentage);
61          } else {
62              progressBar.data('percent', 33);
63          }
64          progressBar.loading();
65      }
```

Listening 2: Setting the calculated progress into the respective progress bar.

5.1.1.3 Badges

As can be seen in Figure 37 and Figure 39, the badges for the mockup prototype are positioned on the left bottom corner. On a horizontal line, a slider is suggested to navigate through the badges. In order to implement the functionality of the slider, six badges were designed and added to it. The following Figure 40 illustrates the six badges, which were prposed for the mockup prototype using Lucidchart[14].

Figure 40: The designed five badges for the mockup prototype.

[14] https://www.lucidchart.com/

Within the implemented gamification process, two out of six of these badges can be reached by the user in case all tasks were successfully fulfilled. The first badge is reached as soon as five points are earned, as can be seen in the flow diagram in Figure 41.

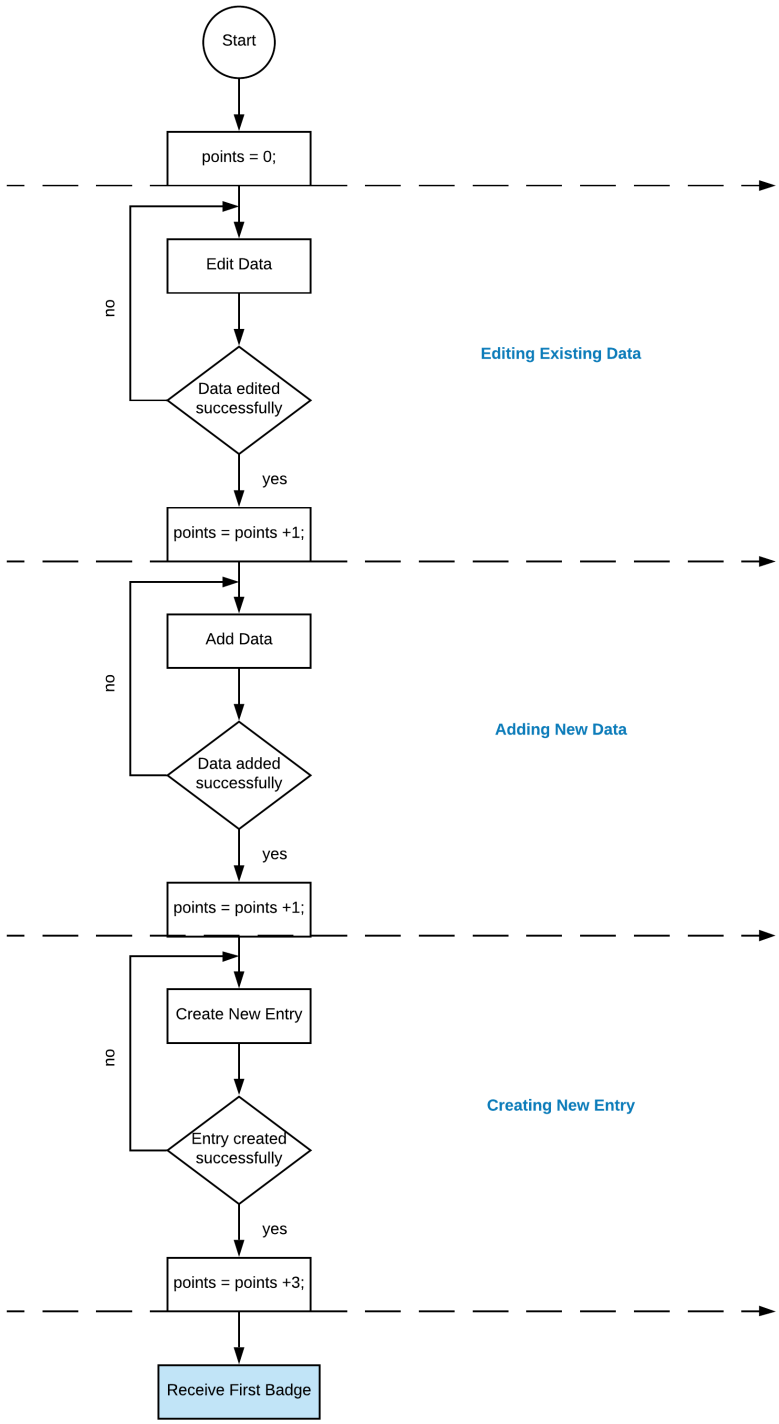

Figure 41: Flow Diagram to reach the first badge.

The second badge represents the surprise badge which is earned after all six tasks are successfully fulfilled. For each reached badge, the user is notified via a modal. The modals for both badges resemble one another, see Figure 42 and Figure 43.

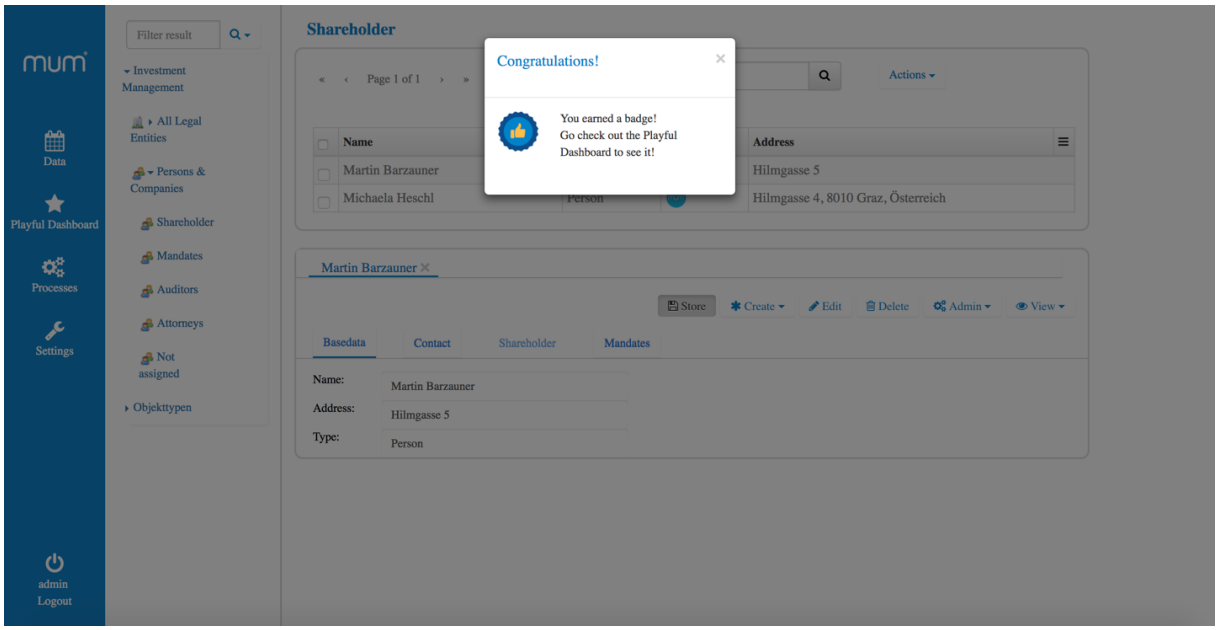

Figure 42: Modal to inform the user about an earned badge.

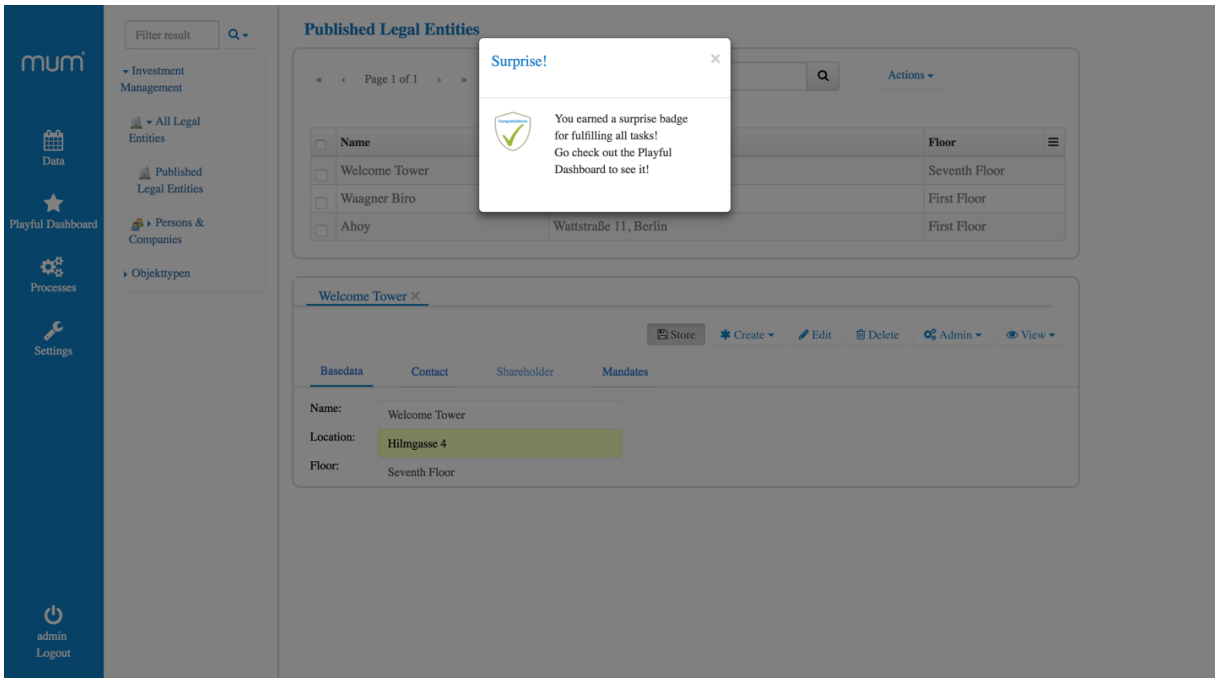

Figure 43: Modal to inform the user about earning a surprise badge.

Not yet received badges are per default greyed out. Once a user earned a badge, the grayscale is removed and the badge can be seen in color.

In order to implement the slider behavior, a framework called slick[15] is used. Slick provides a fully responsive, intuitive and easy-to-maintain technique which can be included to an application.

5.1.1.4 Leaderboard

The fourth designed and implemented game element represents the leaderboard on the bottom right corner on the Playful Dashboard. As can be seen, the user is ranked on the last place at the beginning with 0 points as there is no task accomplished. The ranking for the leaderboard was designed in such a way, that on equal amount of points, the user is positioned secondly. Figure 44 illustrates the user „Me“ having the same amount of points as the user „Katrin“, but is ranked lower. The main reason behind this, is to evaluate whether is ranking increases or decreases the user's motivation. Listening 3 gives insight into the implemented approach regarding sorting of the leaderboard entries.

```
38     bindRenderLeaderTable: function (leaders) {
39         function comparePoints(a, b) {
40             a = parseInt(a);
41             b = parseInt(b);
42 
43             return (a < b) ? 1 : (a > b) ? -1 : 0;
44         }
45 
46         var sortedLeaders = JSON.parse(leaders).sort(function(a, b) {
47             return comparePoints(a.points, b.points);
48         });
49 
50         var leaderTable = '';
51         sortedLeaders.forEach(function (leader) {
52             leaderTable += ACC.leaderboard.renderLeaderInfo(leader);
53         });
54         $('#leaderboard-list').html(leaderTable);
55     }
```

Listening 3: Implemented approach to update the Leaderboard with regards to the user's current amount of points.

In case a user increased his/her ranking, there is a similar notification to the user as can be seen in Figure 42 and Figure 43.

[15] http://kenwheeler.github.io/slick/

The following Figure 44 illustrates the Playful Dashboard once the user accomplished all tasks. It can be seen, that the respective fulfilled tasks are checked, the daily progress bar shows 100%, the second badge, the surprise badge, is colored and the leaderboard section ranks the user “Me” on second place nevertheless there is an equal amount of points reached to the first user “Katrin”.

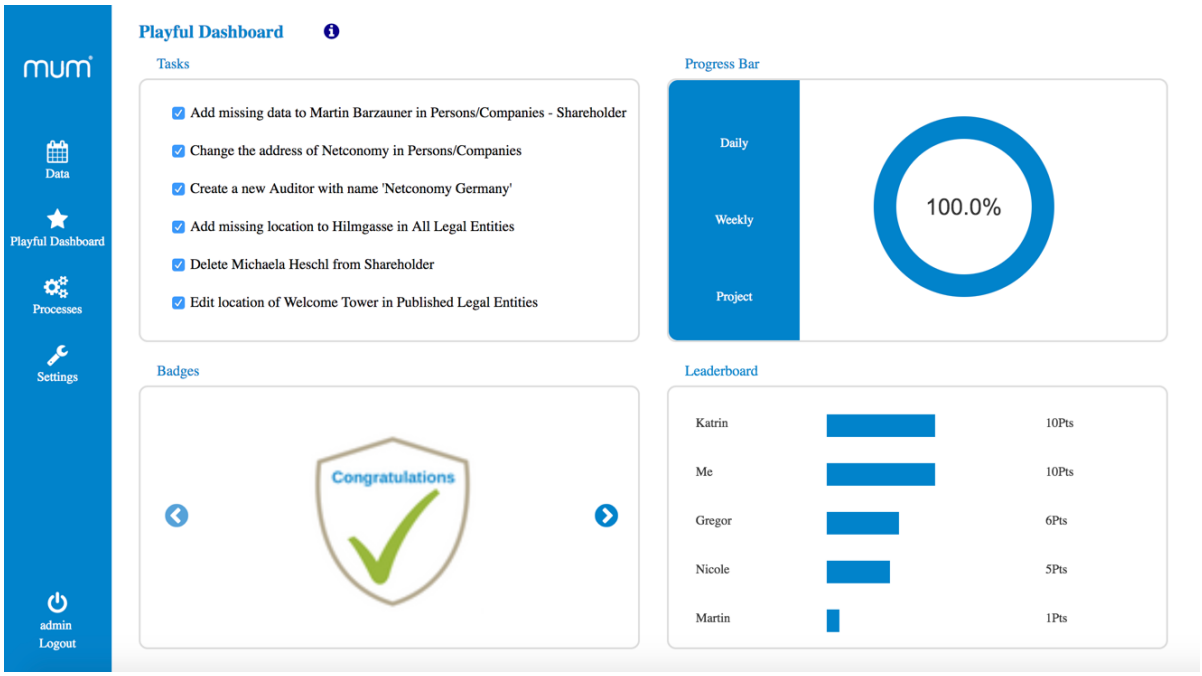

Figure 44: Playful Dashboard in case all tasks were completed

As mentioned in Table 8 the number of earned points depends on the type of the completed task. Therefore, the task type influences the user’s number of earned points. Depending on the number of earned points, (general) badges can be received and the ranking within the leaderboard is adapted. The three different progress bars and the surprise badges on the other hand depend on the number of completed tasks. Therefore, the in Figure 45 illustrated dependencies between the different sections of the Playful Dashboard are given.

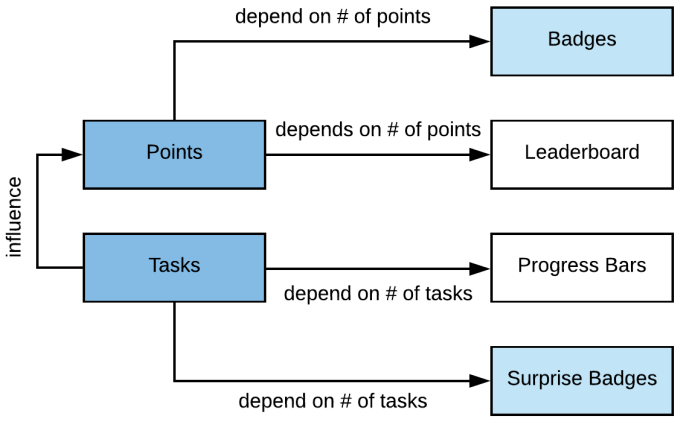

Figure 45: Interaction and dependencies between the different elements on the Playful Dashboard.

The following Table 10 demonstrates each action, whether a game element was reached, the progress bar and/or the ranking within the leaderboard increased, after each of the six listed tasks in more detail.

Task	Current Number of Points	Action
Add Data	1	Progress Bar Increase
Edit Data	2	Progress Bar & Ranking Increase
Create Entry	5	Progress Bar Increase, First Badge received
Add Data	6	Progress Bar & Ranking Increase
Delete Entry	9	Progress Bar & Ranking Increase
Edit Data	10	Daily Progress Bar completed, Surprise Badge received

Table 10: Changes on the Playful Dashboard depending on the number of points/tasks.

In addition to the implemented modals which pop up in case the user increased his/her ranking or earned a badge, tooltips were added to the Playful Dashboard. These tooltips aim at passing on general information regarding the gamification approach. Next to the headline an information tooltip was added which displays the following text on hover: "*Welcome to the Playful Dashboard! Check out your current status regarding tasks, earned badges, your progress and your current position in the leaderboard. Hover over the headlines to get more information!*". Therefore, the headlines "*Tasks*", "*Progress Bar*", "*Badges*" and "*Leaderboard*" also contain a tooltip on hover. The following Table 11 represents the information texts within the tooltips in more detail.

Headline	Information Text
Tasks	"*This list represents the tasks that should be accomplished by you today. Can you do them all?"*
Progress Bar	"*Check out your daily, weekly and project related progress. Each task helps to increase it!"*
Badges	"*Try to earn as many badges as possible. They will be unlocked on specific amount of points. And maybe there is a surprise ...*"
Leaderboard	"*Try to increase your Ranking and outpace the others by earning as many points as possible!*"

Table 11: The added tooltips to the headlines on the Playful Dashboard

5.2 Summary

In order to implement the gamified mockup prototype PT2, Bootstrap was used. In addition, several other libraries like slick were used to realize the Playful Dashboard according to the designed wireframe. The Playful Dashboard represents one possibility of how to add a gamification layer into the Enterprise Data Management System MUM. In total, four game elements were designed and added to it: points, progress bars, badges and a leaderboard. According to Xu (2011) these four game elements have a positive affect an all four different player types: achievers, killers, socializers and explorers. For the design of the dashboard, the goal was to match the overall design of the system best. Meaning, the Playful Dashboard should integrate as good as possible into the current design, regarding color scheme, fonts and font sizes. This also affects the designed badges. In case a user increased his/her ranking or received a badge, a modal is suggested to notify the user about it. In addition to these notifications, tooltips were added to the Playful Dashboard. These aim at not only giving the user an idea what these game elements are about, but also try to motivate the employees.

Within this implemented gamified mockup prototype PT1 the user is able to fulfill six tasks and get 10 points in total. 2 badges can be reached as well as the "*second*" place within the leaderboard. This way, it is aimed at catching the user's attention regarding gamification resulting in a wish to explore the system and its game elements. The proposed long-term gamification process is, to impede earning a badge over time slowly. Receiving a badge should not take place whenever 10 points are reached but should instead become more difficult over time.

6 Evaluation of Gamification Concepts

To receive feedback about the proposed gamification process within the mockup prototype PT2, another survey was conducted. Therefore, a third questionnaire was developed again consisting of a pre- and post-questionnaire. While the pre-questionnaire focused on general questions regarding gamification, for example whether the term "*gamification*" is known or if the use of game elements has a positive motivational aspect on the participants, the post-questionnaire focused on the design and implementation of the gamified mockup prototype PT2. Respectively, the post-questionnaire comprised the following two parts:

1. **Gamification part**: to gain insight about the chosen game elements, their placement and behavior, open-ended as well as single choice questions were formulated which aim at answering these aspects
2. **System Usability Scale**: the SUS is again used in order to be able to directly compare the three software versions on the base of the SUS' result

The complete questionnaire for this experiment 2 can be found in Appendix C and Appendix D. Within the following sections, first the participants and the general procedure to conduct the usability study will be described, followed by the study's result and an overall summary.

6.1 Participants

The second experiment was again conducted with *N = 20* participants. In comparison to the previous experiment, the participants who were part of this study were solely employees from Netconomy Software & Consulting GmbH. The two employees which took part of the first usability study, were also part of the second usability study. Therefore it is possible, to compare all three evaluated systems on basis of these two participants.

6.2 Procedure

The usability study was conducted equally to the first usability study's approach described in section 4.2. Taking place at two locations of the company in Graz, Austria, this survey took each participant around 25 minutes. First, the pre-questionnaire was handed over to the participants. Once this was filled out, the gamified mockup prototype was shortly presented, in such a manner, that each participant is aware of its main purpose and functionalities. After this clarification, the participants were asked to fulfill the listed tasks (see Figure 37 and Figure 39) in the respective order so they can experience the proposed gamification process. As soon as all tasks were completed successfully, the post-questionnaire was handed over.

During this whole process, a supervisor took notes of participants' comments and the issues that were faced. After the post-questionnaire was handed back again to the supervisor, the study was closed.

6.3 Results and Discussion

The subsequent sections will give insights into the results of both, the pre- and post-questionnaire. The post-questionnaire part will focus on analyzing the user's perception of the used game elements, their positioning and behavior and the System Usability Scale.

6.3.1 Pre-questionnaire

The aim of the pre-questionnaire was to get an overall insight into whether platforms which include game elements are used by the participants and if they result in a motivational increase.

Only two out which include game elements. Figure 46 illustrates the result on question A3.3 (see Appendix C), whether game elements do have a positive of the 20 participants claimed to not know the term "gamification", but 50% of the participants said to not use any platforms motivational effect on the users.

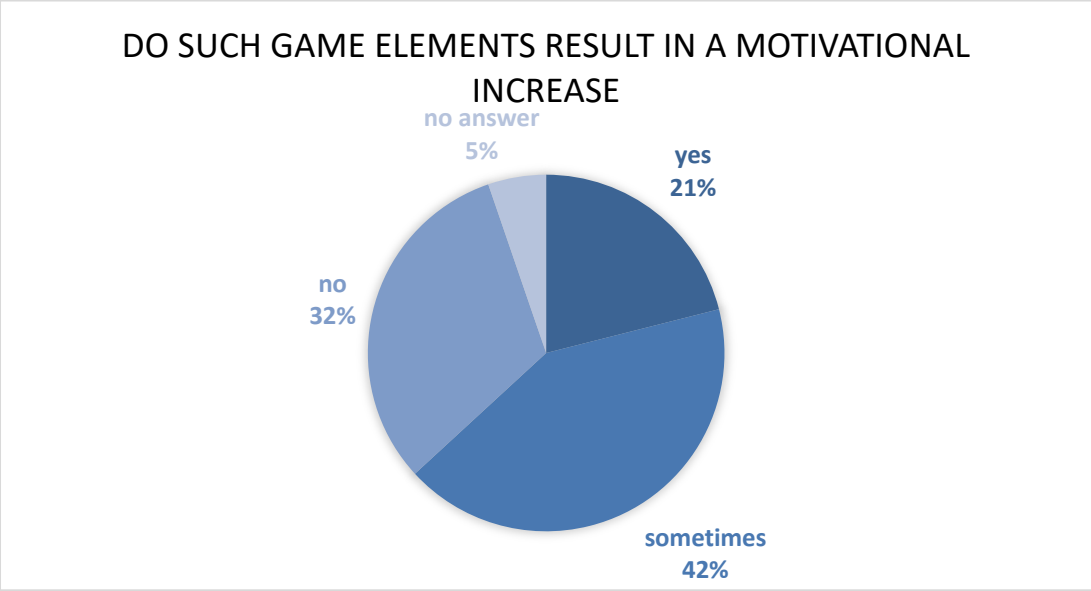

Figure 46: This figure illustrates the result regarding the question, whether game elements are the cause of an increase on the users' motivation.

Those participants who said to experience a motivational increase due to game elements said to prefer the following: points, badges, rankings, progress bars, achievements and privileges. The most often mentioned game elements are progress bars, which were mentioned four times and badges, which were as well mentioned four times. All others were said to result in a motivational increase by one respective person.

6.3.2 Post-questionnaire

As already mentioned, the post-questionnaire's aim was to get insight into the gamified mockup prototype itself, the used game elements and its usability. Therefore, the participants were asked to not only evaluate the overall gamification approach but also each implemented game element on its own. Moreover, specific questions were formulated regarding the implemented popups but also regarding changes which should be done.

6.3.2.1 Gamification

75% of all participants said to experience the chosen and implemented game elements as "very good" or "good". Only five participants assessed the used game elements as "average", see Figure 47.

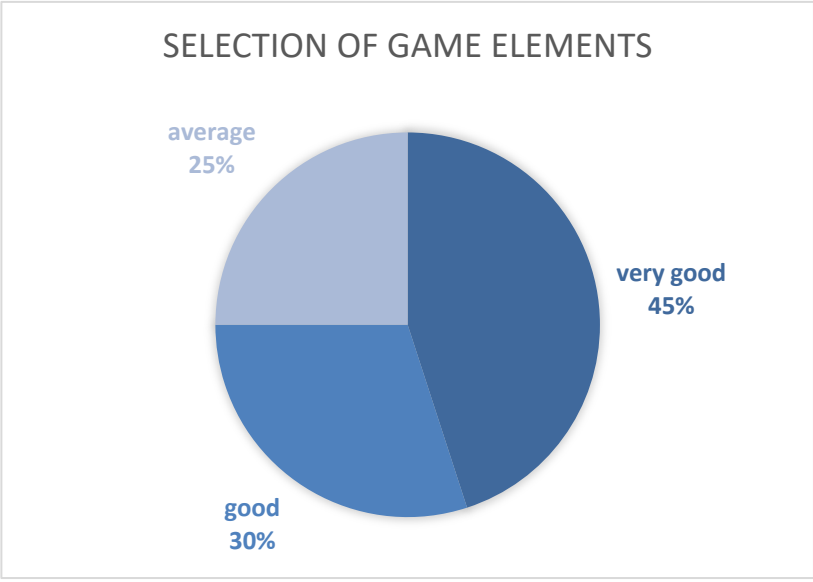

Figure 47: Overall assessment of the selected and implemented game elements.

Although no participant evaluated the overall selection of game elements as "*bad*" or "*very bad*", there were possible improvements mentioned as remarks. These varied from "*too many*" game elements are being used to "*there could me more used, like random rewards*".

The proposed approach to include the gamification layer mainly using the separated side menu "*Playful Dashboard*" was rated "*very good*" to "*average*", while more than two thirds said it to be "*very good*" or "*good*", see Figure 48.

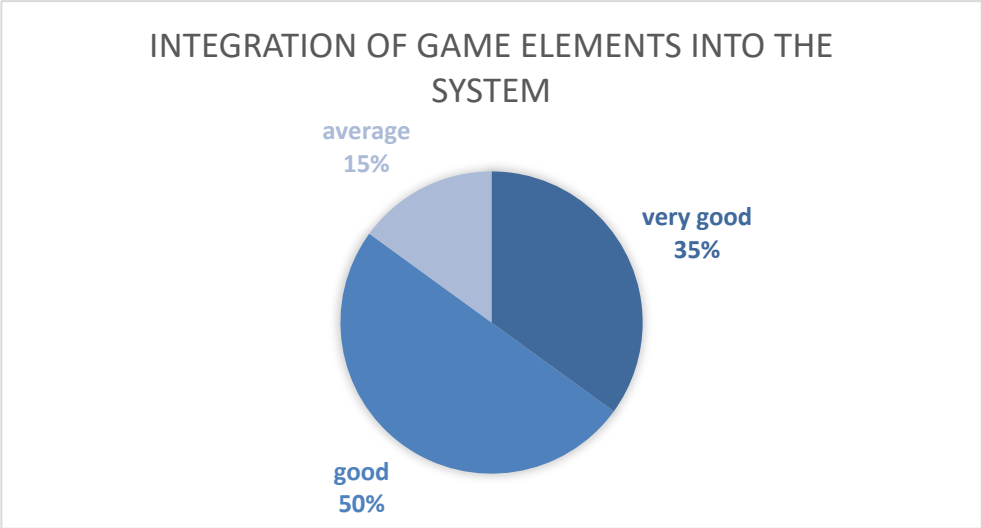

Figure 48: Evaluation of the proposed integration approach of the game elements into the system.

Progress Bars

Based on the results of the questionnaires, the game element progress bars, stood out the most positive to the participants. Only eight out of 20 participants rated the design and implementation of the progress bars as "*good*" while the remaining 12 voted for "*very good*".

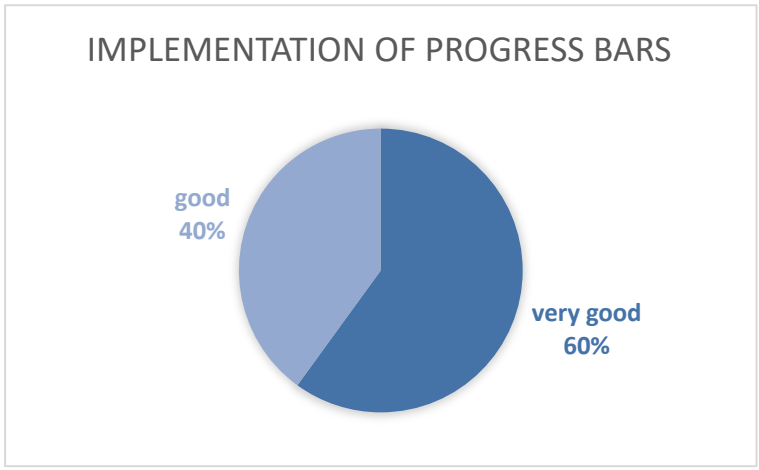

Figure 49: Evaluation of the implemented progress bars.

Remarks to this game element varied from "*design well done*" to "*nicely integrated into the system*". One possible improvement was given by P5, who suggested to highlight new progress in a different color each time a task was fulfilled successfully.

Despite the positive remarks on this game element, it was noticed by the supervisor while conducting the usability study, that the three different types of progress bars daily, weekly and project, were not noticed. Not one of the 20 participants interacted with this section to check on his/her weekly or project progress.

Badges / Surprise Badges

Almost the half of all participants, nine respectively, rated the design and implementation of the badges as "*very good*". On the other hand, six participants assessed the badges as "*averagely*" well developed. Comparing this to the proposed approach of surprising badges it can be seen, that the participants of the usability study preferred the standard approach over the surprising badges. Figure 50 illustrates that two participants evaluated the surprising badges as "*bad*".

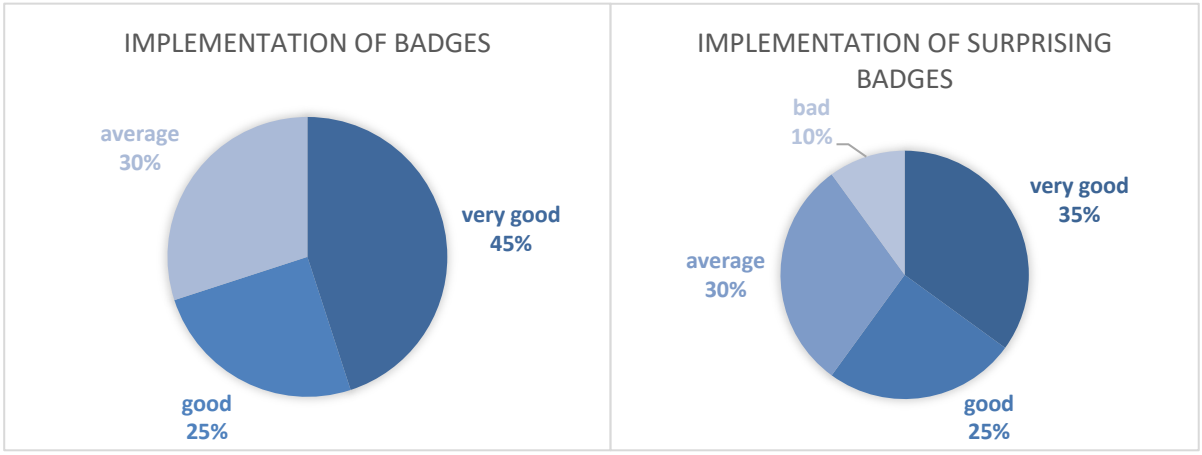

Figure 50: Evaluation of both types of implemented badges.

The most often expressed suggestion for improvement referred to the approach of using a slider component to display the badges. The participants criticized a missing overview of all badges at all time. Especially, as the approach was to always show only one badge at a time, the knowledge of how many badges there are still to reach was not clear. Regarding surprise badges it was mentioned, that they are less prepared because "*that's nothing you can actually work for*".

During the study, it was noticeable, that the badge section gained the most attention from the participants. Especially P19 expressed several times "*let's see if I finally received the badge*" and added "*ok no, not yet*" immediately after the first two tasks were completed successfully. Receiving the badge after the third task, resulted in a visible motivational increase.

Leaderboard

85% of all participants rated the design and implementation of the leaderboard as "*very good*" and "*good*", see Figure 51.

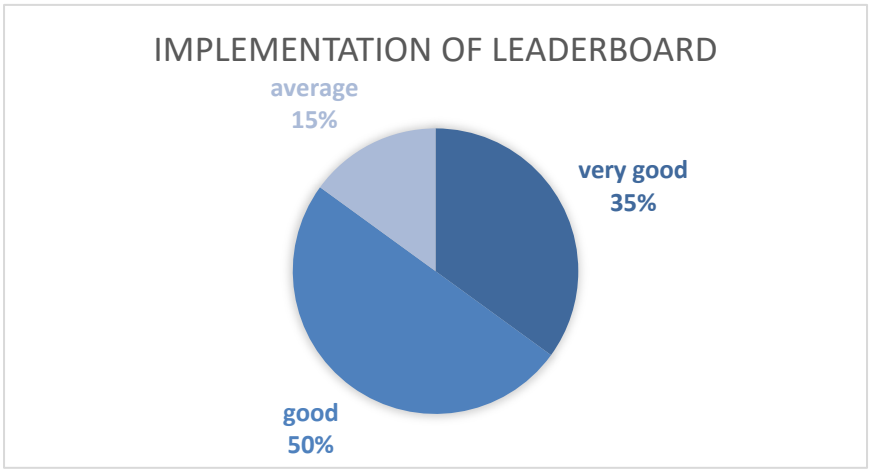

Figure 51: Evaluation of the implemented leaderboard.

The three participants who evaluated this game element as "*average*", did not suggest any possible improvement regarding design or implementation. Similar to the progress bars it was noticed, that although the participants were notified via a popup in case the ranking increased, only a few checked the ranking and his/her current amount of points afterwards. Instead the majority of participants focused on reading the next task immediately. It is therefore assumed, that the unpopular positioning of this game element in the right bottom may be one reason for this.

In addition, the leaderboard was implemented in such a way, that although the user might have an equal amount of points he/she is positioned secondly. The main goal behind this was, to analyze whether this increases the user in addition to fulfill another task successfully or it even demotivates people to continue maintaining data. Only 25% of the participants stated that this approach was noticed by them, which suits the observation of the supervisor

of hardly anyone monitoring the leaderboard. Regarding the effect that this ranking takes on the users, only three claimed to experience this as "*motivating*", 12 claimed to experience this as "rather *motivating*", while the remaining five participants experienced it as "*rather demotivating*". This approach exhibits a possible positive tendency towards motivating users, as 75% evaluated it as either "*motivating*" or "*rather motivating*".

6.3.2.2 System Usability Scale

In order to also assess whether the added Gamification layer changes the software's overall usability, the System Usability Scale was added to the post-questionnaire. The results show, that the software's usability in the end increased by adding game elements and the task list to it. The gamified mockup prototype PT2 received an average score of M = 82.375 (SD = 14.35).

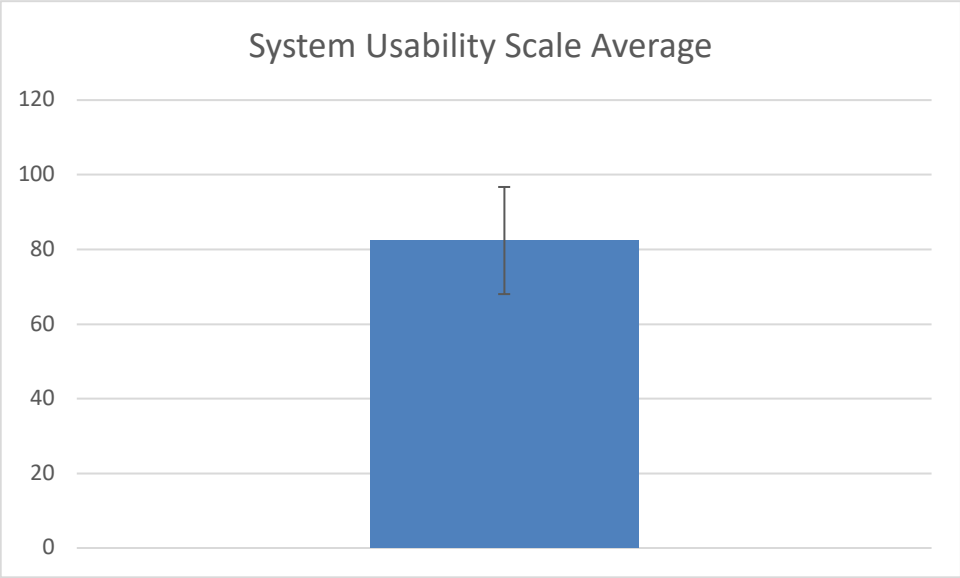

Figure 52: Average and standard deviation of the System Usability Scale for the gamified mockup prototype.

Adding this result equally to as in Figure 3, it can be seen, that the usability of this mockup prototype is positioned in the fourth quartile and close to reaching the "*excellent*" adjective rating. Moreover, the software's usability is no longer in the marginal area but instead almost in the middle of the "*acceptable*" area.

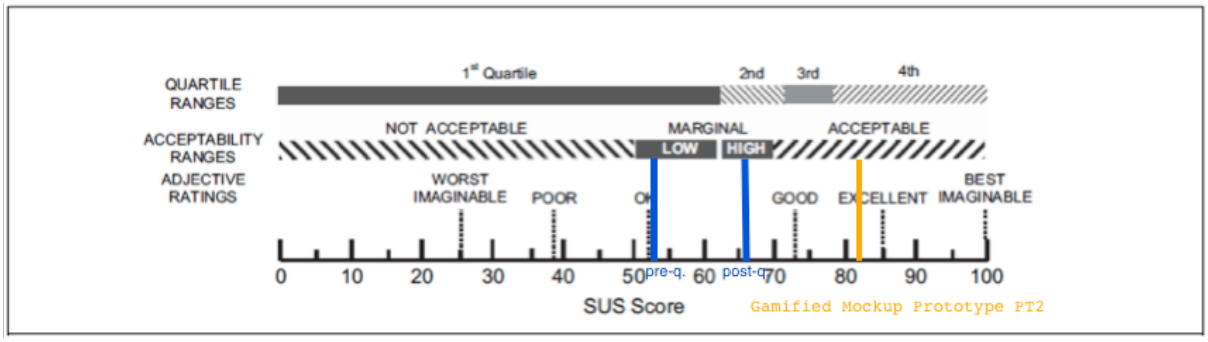

Figure 53: SUS' score enhanced with the average result of the gamified mockup prototype PT2 (orange).

The following Figure 54 illustrates the result of the System Usability Scale for each of the 20 participants in more detail. While PT14 assessed the usability of the gamified mockup prototype as "*best imaginable*" (referring to Figure 53), PT1 on the other hand evaluated the gamified mockup prototype's usability as "*not acceptable*" according the above Figure 53.

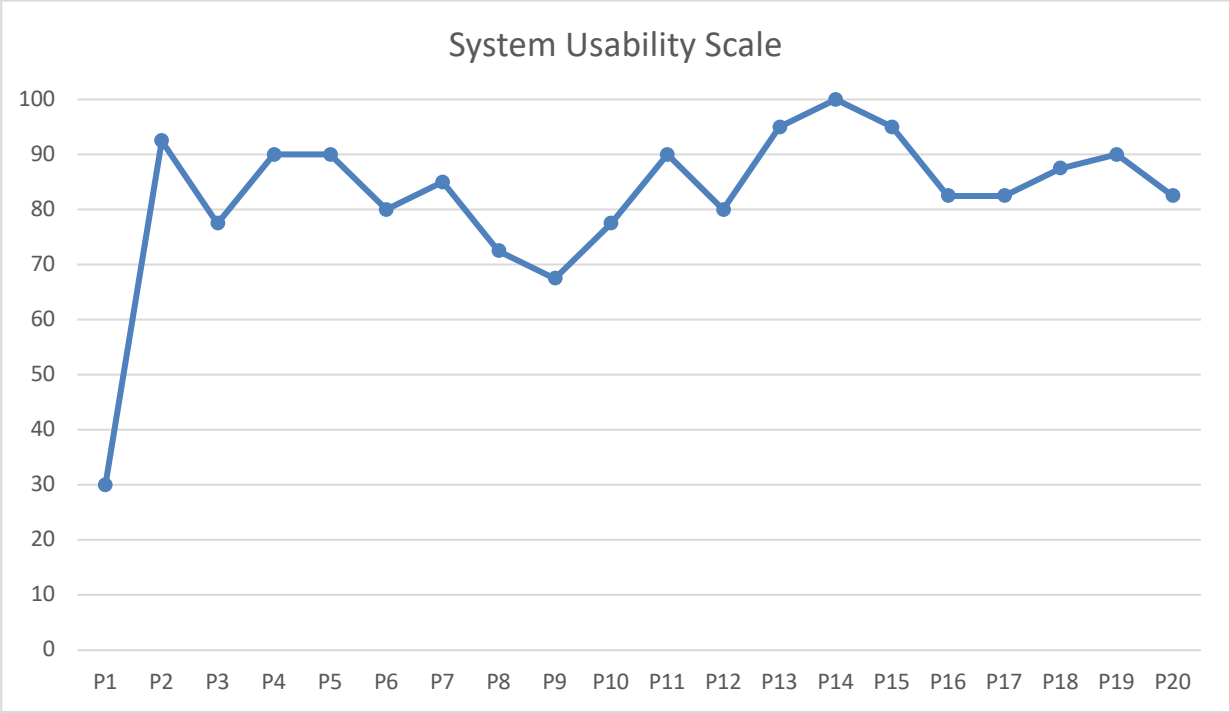

Figure 54: Detailed result of the System Usability Score for the gamified mockup prototype for each participant of the second usability study.

As already mentioned, P1 and P2 represent the two employees from Netconomy Software & Consulting GmbH, who as well took part in the first usability study and therefore also assessed the usability of both, the existing client and the implemented prototype PT1. Thus, it is possible to draw a direct comparison between all three tested systems for these two test persons.

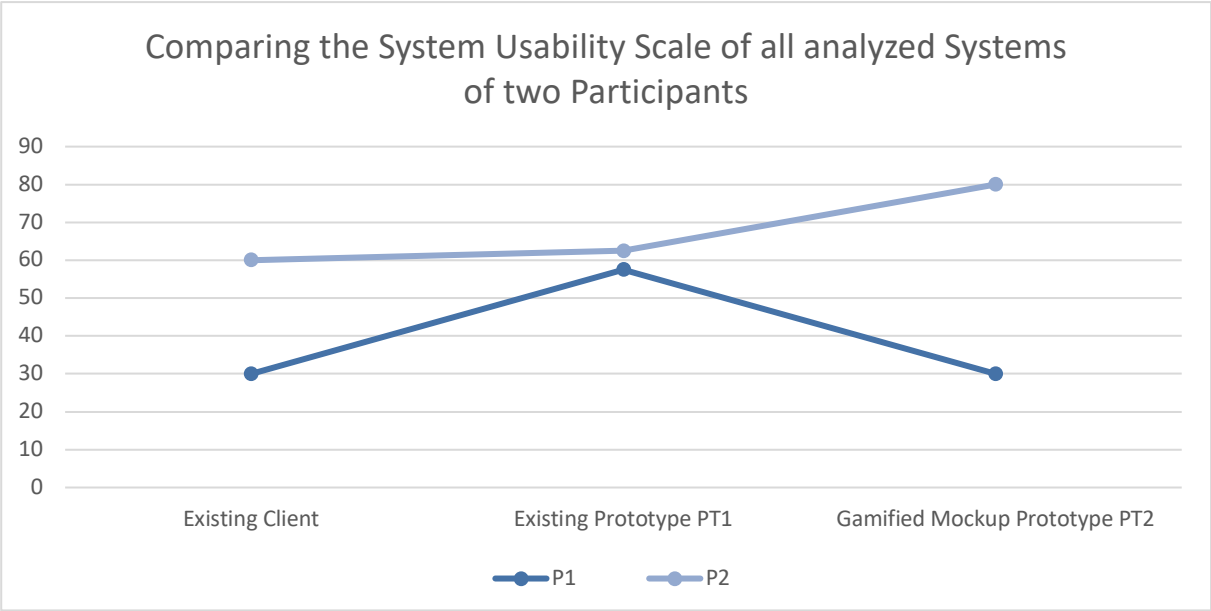

Figure 55: Comparing the score of the SUS of all three analyzed systems of two participants taking part in both usability studies.

Although the overall SUS score of the gamified mockup prototype PT2 is considerably higher compared to the existing client's and existing prototype PT1's usability, it can be seen that P1 rated the usability of the gamified mockup prototype PT2 equally low as the existing client's usability. As PT1 and PT2 are operating in the same way and also their design is, the reason for this must lie in the added Playful Dashboard and its game elements. During the usability study, this participant mentioned several reasons for this. First, the need to switch between the Playful Dashboard and the Data section in order to fulfill the tasks were experienced as "*unnecessarily complicated and annoying*". To prevent this, it was suggested to include the task itself in all different sites of the system, for instance as a modal. Second, the different game elements were experienced as "*too prominent*". This especially referred to the modals which were implemented in order to inform the user about a ranking increase or an earned badge. The participant suggested to change the current implementation of these popups in such a way, that these fade out as default on their own. Therefore, it would not be needed to click somewhere in order to discard the modal again.

Even though participant P2 assessed the usability of the gamified mockup prototype PT2 higher than PT1, one valuable suggestion was given with regard to the Task section. Instead of using checkboxes which are checked once the task is completed successfully, a colored traffic light system bullet list is proposed. Tasks which can be fulfilled easily and quickly, should be highlighted using a green bullet point and therefore represent a "quick win" for the user, whereas complicated tasks should use a red bullet point. Therefore, the user would also gain insight into the tasks complexity. Using this approach, it would be needed to enhance the Tasks section in such a way, that the user gets informed once a task is completed successfully, for example by erasing the representative task from the list or by adding some history tab.

6.4 Summary

Overall it can be said that the evaluation of the gamified mockup prototype PT1 was successful. Both, the evaluation of the game elements as well as the system's usability achieved positive results. Among the game elements, the design and implementation of the progress bars achieved the best results, followed by the leaderboard, the badges and finally the concept of surprising badges. Several possible improvements and changes were suggested on part of the test persons. Including the task itself as a modal on each site and therefore preventing the need to switch between the Playful Dashboard and the Data section was one of them. This would, according to P1, also lead to an increased usability. Possible improvements regarding the selected game elements varied from "*there could be more used*" to "*(almost) too many*" and "*too many*" to the game elements being "*too prominent*" within the system and "*there is no difference in design to the actual system*". For the badges explicitly, the lack of overview was criticized. Without using the slider, the users did not have an overview about the badges that can still be achieved. It was therefore suggested, to change the design of this section in such a way, that the user is always able to see all possible badges. Moreover, the surprising badges should as well be separated into another section and their design should be, for instance, changed to only see their silhouette and a question mark on them. Thus, the surprising badges should appear mysterious and increase the user's motivation to earn them. The proposed ranking on equal amount of points within the leaderboard seems to be promising, since 75% of the participants claimed this ranking to be either "*motivating*" or "*rather motivating*". Nevertheless, in the context of Enterprise Data Management Systems this ranking can also have a drawback in case there is no more task and therefore no more data to be maintained. If the user is positioned secondly, this may also lead to demotivating the user and is therefore crucial to evaluate this in more detail.

Regarding the proposed approach of passing on information via modals and tooltips, 79% of all participants claimed it to be either "very good" or "good". In addition, the texts have a motivating or averagely motivating affect for 95% of the participants. Only one participant claimed the texts not to have a motivating effect on him/her. Nevertheless, during the usability study it was observed, that only the modals drew the participants attention. No test person noticed or even interacted with the tooltips on the Playful Dashboard.

Using the System Usability Scale the gamified mockup prototype's usability was rated with an average of M = 82.375 (SD = 14.35). Comparing this to the scores of the existing prototype PT1 this score represents an increase of +15.875 in average. Overall it can therefore be said that the added gamification layer does not decrease the system's usability.

During the study the supervisor observed the participants mainly focusing on the task list instead of the game elements. The main goal of almost every participant was, to fulfill the task. It seemed, the test persons only expected "*something to happen*" in case all six tasks were completed successfully. This is also substantiated by the users not interacting with the

different progress bars, the badge slider or checking the earned points on the leaderboard regularly.

7 Lessons Learned

This chapter outlines several experiences which were made during the research of the theoretical part of the work, the design and implementation of the gamified mockup prototype PT2 and the two conducted usability studies.

7.1 Theory

During the literature study for the theoretical part of this work, research regarding usability and gamification was done. While there is a high variety of sources available about usability and gamification in general, sources regarding gamification in the context of Enterprise Data Management Systems are rare. Only one resource referring to this was found. Moreover, this resource did not include details, instead only the main aspects were carried out. As a result, the gamification approaches in Business and IT were analyzed and compared. Companies such as Oracle, SAP, Microsoft and Cisco use various game elements and approaches which inter alia aim to increase the employees' engagement. As games are said to "*be an important component of the workplace of the future*", the effect of gamification in the area of Enterprise Data Management Systems is crucial to explore and is still missing in the literature (Smith, 2011).

7.2 Development

In order to implement the gamified mockup prototype PT2, several frameworks and JavaScript libraries were used. By using html, css, js and Bootstrap, the design of the improved prototype PT1 was recreated. To implement the Playful Dashboard and its game elements, two additional JavaScript modules were used. The slider for the badges is based on "slick" and the circled progress bars are built on an open source jQuery plugin from webseotips.com. The main gamification process of points, the leaderboard and unlocking badges on a specific amount of points is developed from scratch. One way to overcome this need, would have been to use other JavaScript modules such as score.js[16] or gamification.js. Using score.js adding "levels, checkpoints, badges" is easily possible (Mulhoon, 2014). This means, the Playful Dashboard could have been enhanced by other game elements.

[16] https://www.npmjs.com/package/score-js

7.3 Evaluation

Within this work, two usability studies were conducted evaluating three different systems: the existing client, the improved prototype PT1 and the gamified mockup prototype PT2. In order to evaluate these systems in total 4 questionnaires were developed, two pre- and two post-questionnaires. These questionnaires contained both, standardized questionnaires, such as the System Usability Scale or the Isonorm 9241/10, as well as environment specific questions. These additional questions were necessary in order to evaluate the gamified mockup prototype, as – to the knowledge of the author – there is no standardized questionnaire regarding gamification in place. A development of such a standardized questionnaire would be crucial to be able to compare different gamified approaches among each other.

During the usability studies, several experiences were made. As the first usability study was conducted with real customers of the existing MUM client, there was the need to interview two participants simultaneously. This did not only lead to a higher stress factor for the survey conductor but can also result in the two participants influencing each other. Therefore, one should refrain from such an approach whenever possible. In addition, it was noticed that observing the participants during the study is essential to gain more insight into the participants' thoughts than to rely on the survey results solely. In this special case, observation lead to a completely diversely result, especially concerning the second usability study with regards to the gamified mockup prototype PT2. In addition, a misconception regarding gamification on part of the usability study participants was encountered, as a high majority claimed game elements are not favored but in the end led to a remarkable increase of the system's usability.

8 Suggestions for Future Work

Building on the results of the two conducted usability studies, several possible steps for the future arise. These include possible improvements regarding the software's functionalities as well as enhancements regarding the implemented gamification layer. The following sections will discuss suggestions for future work.

8.1 Functionalities and Design

As a result of the first conducted usability study, several wishes from the customer's side regarding the functionalities of the MUM Software were identified. These mainly affected possible improvements to ease the employee's daily work with the existing MUM client. Moreover, several design improvements were given related to the improved prototype PT1. Therefore, implementing these suggested additional functionalities as well as the suggested improvements concerning the design of the prototype PT1 is recommended. This can lead to an even higher customer retention as well as an increase in sales.

8.2 Gamification Layer

The gamified mockup prototype PT2 aims at giving one possible approach how gamification and game elements can be added to the Enterprise Data Management Software MUM. There are several suggestions for future work regarding this gamification layer and its game elements. Since game elements result in an "*immediate and short-term change*" according to literature, a long-term study about the gamified approach would be interesting (Nicholson, 2015). Therefore, the employees' motivation can be checked and whether their motivation decreases over time.

In addition, it is suggested to implement the results derived from the second usability study. Meaning, for instance, to change the design of the badge component from a slider in such a way, that there is a better overview about the badges which can still be reached, as well as the concept and design of surprising badges should be reconsidered. The implemented leaderboard can be changed and grouped into different categories. Xu (2011) mentions that rankings can be grouped into a global, friends and relatives part. This can be adapted to the needs of users of the MUM Software. Therefore, it is suggested to cluster the leaderboard for example into a "*department*", "*location*" and "*world-wide*" section. Employees would therefore be able to compare with different levels.

Another possible future work would be to change or enhance the selected and implemented game elements. By implementing other game elements, such as levels, quests, challenges or community collaboration it can be evaluated, whether these do have a different effect on the employees. Due to an iteration over the selected game elements and evaluating different combinations, the best grouping of game elements in the context of motivational increase can be identified. In addition, another approach and/or design regarding the passed-on information about the game elements can be proposed and evaluated.

Finally, tests regarding gamification metrics are suggested, similar to the in section 2.2.2 Measuring Gamification described approach. Thus, it would be possible to evaluate which effects the added gamification layer has on a long-term.

9 Summary and Outlook

The Enterprise Data Management Software MUM, developed at Netconomy Software & Consulting GmbH, provides a solution to handle complex and extensive companies' data. Data from different departments are combined at a central location and logically related, which can in addition also be prepared and enriched. The MUM Software covers several different organizational information such as employee data, customer data, CRM and ERP data, organizational structure data and many more. Due to this high amount of available data MUM provides a solution for Master Data Management, Organization Management and Human Resource Management, to name only a few. Nevertheless, the design of the existing MUM Software client suffered from this high amount of functionalities and areas of application. To overcome this issue, a new prototype PT1 with a completely new design was developed from Netconomy Software & Consulting GmbH. Using these two software versions, a first usability study was conducted with 10 participants. These test persons represented real customers of the existing client and where introduced to the proposed new design using this study. Within this study, the System Usability Scale was added to the questionnaires and addressed both software versions in order to be able to compare the result of this standardized questionnaire, as the main goal of this newly designed prototype PT1 is to increase the software's usability. The results showed, that 100% of the participants preferred the new design and rated the usability of it in average 13.05 higher compared to the existing client's usability.

The fact that data maintenance is said to be a rather monotonous working task caused another issue which is needed to be overcome: a lack of motivation on part of the customers. Keeping companies' data up to date and correct is crucial for a companies' success. This lack of motivational engagement to maintain data is addressed by adding a gamification layer into the newly designed prototype PT1. Therefore, a gamified mockup prototype PT2 was developed using HTML, CSS, JavaScript and Bootstrap, which aims at giving a suggestion in how to include a gamification process into Data Management Software. This includes in total four game elements: points, progress bars, badges (including surprising badges) and a leaderboard. According to literature, these game elements address all four player types socializers, killers, achievers and explorers. As related work still seems to be missing in the literature, the selection of the game elements was mainly retrieved from the results of the first questionnaire, meaning, these reflect the customers' preferred elements. Based on the implemented gamified mockup prototype PT2, another usability study was conducted with 20 employees from Netconomy Software & Consulting GmbH. The developed questionnaires again contained the SUS and environment specific questions to evaluate not only the overall proposed gamification approach but also each added game element separately. The results revealed, that the progress bars achieved the best results, followed by the leaderboard, the badges and finally the concept of surprising badges.

Comparing the score of the System Usability Scale of all three evaluated systems, revealed, that the gamified mockup prototype PT2 obtained the highest result, although its functionalities of maintaining data were equally to the newly designed prototype PT1's approaches. Nevertheless, it is questionable, if this is only the result of the added game elements or also due to the implemented tasks list which shows the user an overview about all data which needs to be maintained.

However, the area of gamification within Enterprise Data Management Systems still seems to be mainly unexplored. This is based on the fact, that only one related work was identified during the literature survey. Therefore, this work represents an important step and highlights a possible approach on adding gamification within the area of Enterprise Data Management Systems, in particular the Enterprise Data Management Software MUM. Using an iterative approach of adding other game elements to the Playful Dashboard or changing their current behavior, and evaluating these combinations/changes again, the best possible combination of game elements can be identified. Once identified, the best possible combination of game elements can be evaluated on a long-term approach and the users' motivation to use the software including the Playful Dashboard be rechecked. In addition, also the general approach of adding the gamification layer to the system can be revised. Instead of the Playful Dashboard, the game elements can be added by enhancing the system using a "My Profile" section. In general, this work can be seen as basis for other attempts of adding a gamification layer into similar systems.

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List of Abbreviations

GWT	Google Web Toolkit
LQG	Language Quality Game
ROI	Return on Investment
SCN	SAP Community Network
SUS	System Usability Scale

Appendix

Appendix A: Pre-questionnaire – Usability Study 1

Position:

Wie viele Stunden pro Woche benutzen Sie die Software durchschnittlich?

Verwenden Sie die Software täglich?

o Ja o Nein

Welche Funktionalitäten werden am öftesten verwendet?

1.
2.
3.
4.
5.

Welche Funktionen verwenden Sie ungern?

Was gefällt Ihnen an der derzeitigen Software?

Was würden Sie an der momentanen Software gerne ändern?

Welche zusätzlichen Features wünschen Sie sich?

Was würden Sie am derzeitigen Design ändern?

Verwenden Sie Plattformen wie StackOverflow, LinkedIn, Foursquare, Runtastic oder Nike?

o Ja o Nein

Wussten Sie, dass diese Plattformen Gamification Elemente verwenden?

o Ja o Nein

Können Sie sich vorstellen, dass Elemente wie Rankings, Badges etc. Sie motivieren könnten die Software öfter/lieber zu benutzen?

o Ja o Nein o Eventuell

Falls ja/eventuell, welche Elemente würden Sie am meisten motivieren?

1: stimmt gar nicht **5: stimmt völlig**

1. Ich denke, dass ich das System gerne häufig benutzen würde.

   o 1 o 2 o 3 o 4 o 5

2. Ich fand das System unnötig komplex.

   o 1 o 2 o 3 o 4 o 5

3. Ich fand das System einfach zu benutzen.

   o 1 o 2 o 3 o 4 o 5

4. Ich glaube, ich würde die Hilfe einer technisch versierten Person benötigen, um das System benutzen zu können.

   o 1 o 2 o 3 o 4 o 5

5. Ich fand, die verschiedenen Funktionen in diesem System waren gut integriert.

   o 1 o 2 o 3 o 4 o 5

6. Ich denke, das System enthielt zu viele Inkonsistenzen.

   o 1 o 2 o 3 o 4 o 5

7. Ich kann mir vorstellen, dass die meisten Menschen den Umgang mit diesem System sehr schnell lernen.

   o 1 o 2 o 3 o 4 o 5

8. Ich fand das System sehr umständlich zu nutzen.

   o 1 o 2 o 3 o 4 o 5

9. Ich fühlte mich bei der Benutzung des Systems sehr sicher.

   o 1 o 2 o 3 o 4 o 5

10. Ich musste eine Menge lernen, bevor ich anfangen konnte das System zu verwenden.

    o 1 o 2 o 3 o 4 o 5

Appendix B: Post-questionnaire – Usability Study 1

NETCONOMY
WE KNOW HOW

Was hat Ihnen am neuen Design der Software gefallen?

Was ist Ihrer Meinung nach noch verbesserungswürdig?

Gefällt Ihnen das neue Design besser als das alte?

o Ja o Nein

Die Software	**---**	**--**	**-**	**-/+**	**+**	**++**	**+++**	
bietet nicht alle Funktionen, um die anfallenden Aufgaben effizient zu bewältigen.								bietet alle Funktionen, die anfallenden Aufgaben effizient zu bewältigen.
bietet einen schlechten Überblick über ihr Funktionsangebot.								bietet einen guten Überblick über ihr Funktionsangebot.
ermöglicht keinen leichten Wechsel zwischen einzelnen Menüs oder Masken.								ermöglicht einen leichten Wechsel zwischen einzelnen Menüs oder Masken.
erschwert die Orientierung, durch eine uneinheitliche Gestaltung.								erleichtert die Orientierung, durch eine einheitliche Gestaltung.
ist so gestaltet, dass der Benutzer die Bildschirmdarstellung schlecht an seine								ist so gestaltet, dass der Benutzer die Bildschirmdarstellung gut an seine

individuellen Bedürfnisse anpassen kann.								individuellen Bedürfnisse anpassen kann.
ist so gestaltet, dass sich einmal Gelerntes schlecht einprägt.								ist so gestaltet, dass sich einmal Gelerntes gut einprägt.

1: stimmt gar nicht **5: stimmt völlig**

1. Ich denke, dass ich das System gerne häufig benutzen würde.

   o 1 o 2 o 3 o 4 o 5

2. Ich fand das System unnötig komplex.

   o 1 o 2 o 3 o 4 o 5

3. Ich fand das System einfach zu benutzen.

   o 1 o 2 o 3 o 4 o 5

4. Ich glaube, ich würde die Hilfe einer technisch versierten Person benötigen, um das System benutzen zu können.

   o 1 o 2 o 3 o 4 o 5

5. Ich fand, die verschiedenen Funktionen in diesem System waren gut integriert.

   o 1 o 2 o 3 o 4 o 5

6. Ich denke, das System enthielt zu viele Inkonsistenzen.

   o 1 o 2 o 3 o 4 o 5

7. Ich kann mir vorstellen, dass die meisten Menschen den Umgang mit diesem System sehr schnell lernen.

   o 1 o 2 o 3 o 4 o 5

8. Ich fand das System sehr umständlich zu nutzen.

   o 1 o 2 o 3 o 4 o 5

9. Ich fühlte mich bei der Benutzung des Systems sehr sicher.

   o 1 o 2 o 3 o 4 o 5

10. Ich musste eine Menge lernen, bevor ich anfangen konnte das System zu verwenden.

    o 1 o 2 o 3 o 4 o 5

Appendix C: Pre-questionnaire – Usability Study 2

A3.1) Kennen Sie den Begriff „Gamification“?

o Ja o Nein

A3.2) Verwenden Sie Plattformen die Gamification Elemente verwenden?

o Ja o Nein

A3.3) Wenn ja, welche Plattformen / Elemente?

A3.4) Welche von diesen Elementen bevorzugen Sie?

A3.5) Motivieren Sie derartige Gamification Elemente?

o Ja o Teilweise o Nein

Appendix D: Post-Questionnaire Usability Study 2

B3.1) Wie gefällt Ihnen die Auswahl der verwendeten Gamification Elemente?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.2) Wie gefällt Ihnen die Umsetzung der **Progress Bars**?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.3) Wie gefällt Ihnen die Umsetzung der **Badges**?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.4) Wie gefällt Ihnen die Idee der **überraschenden Badges**?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.5) Wie gefällt Ihnen die Umsetzung des **Leaderboards**?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.6) Ist Ihnen aufgefallen, dass Sie bei Punktegleichstand nachreihend aufgelistet sind?

o Ja o Nein

B3.6a) Wie wirkt diese Reihung auf Sie?

o Motivierend o Eher Motivierend o Eher Demotivierend o Demotivierend

B3.7) Wie gefällt Ihnen die Art und Weise wie die Game Elemente in das System integriert wurden?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.8) Wie gefällt Ihnen die Art und Weise, wie Informationen zum Thema Gamification im System vermittelt werden (Modals, Tooltips)?

o Sehr Gut o Gut o Mittelmäßig o Schlecht o Sehr Schlecht

Anmerkungen:

B3.9) Empfinden Sie die Informationstexte innerhalb der Modals und Tooltips motivierend?

o Ja o Mittelmäßig o Nein

B3.10) Was würden Sie ändern?

1: stimmt gar nicht **5: stimmt völlig**

11. Ich denke, dass ich das System gerne häufig benutzen würde.

o 1 o 2 o 3 o 4 o 5

12. Ich fand das System unnötig komplex.

o 1 o 2 o 3 o 4 o 5

13. Ich fand das System einfach zu benutzen.

o 1 o 2 o 3 o 4 o 5

14. Ich glaube, ich würde die Hilfe einer technisch versierten Person benötigen, um das System benutzen zu können.

o 1 o 2 o 3 o 4 o 5

15. Ich fand, die verschiedenen Funktionen in diesem System waren gut integriert.

o 1 o 2 o 3 o 4 o 5

16. Ich denke, das System enthielt zu viele Inkonsistenzen.

o 1 o 2 o 3 o 4 o 5

17. Ich kann mir vorstellen, dass die meisten Menschen den Umgang mit diesem System sehr schnell lernen.

o 1 o 2 o 3 o 4 o 5

18. Ich fand das System sehr umständlich zu nutzen.

o 1 o 2 o 3 o 4 o 5

19. Ich fühlte mich bei der Benutzung des Systems sehr sicher.

o 1 o 2 o 3 o 4 o 5

20. Ich musste eine Menge lernen, bevor ich anfangen konnte das System zu verwenden.

o 1 o 2 o 3 o 4 o 5