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How Requirements Elicitation Process Takes User Experience(UX) Into Account

Systematic Literature Review

*Bachelor of Science Thesis in the Programme Software Engineering and
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Abstract— The aim of this study is to understand how Requirements Elicitation process takes User Experience(UX) into account. In order to answer research question a systematic literature review was performed. It focuses on user requirements, the incorporation of user experience into requirements elicitation process, as well as identifies necessary tools and techniques. The study also explores challenges and benefits of incorporating User Experience into Requirements Elicitation process.

Keywords—Requirements Engineering; Requirements Elicitation; Requirements gathering; User Experience; Emotional

RE- Requirements Engineering;

UX- User Experience

I. INTRODUCTION

Requirements engineering plays an important role in product development lifecycle. How product is performing and accepted on the market is largely dependent on well written software requirements and on products ability to engage user[1]. Eliciting user requirements from different stakeholders and addressing User Experience(UX) as a quality requirement are major Requirements Engineering(RE) challenges not only during the early phases of the product development but also throughout the product life cycle[1].

Nowadays users have higher expectations for products. Not only products are means to complete certain tasks or accomplish certain goals, the product must be also enjoyable to use and provide positive experience. Experience itself can be very different, it is subjective, based on how users feel at one specific moment. According to Hassenzahl [2,pp.12] UX is "a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service". By that, UX shifts attention from the product and materials (i.e., content, function, presentation, interaction) to humans and feelings [2]. User experience focuses on hedonic qualities such as aesthetics, positive emotions and affect that people experience while interacting with products[2].

It is important to understand users' view on what kind of user experience is expected from interacting with product and gain insight into user requirements that would affect user experience[2]. Research shows that product development teams are still unable to infuse in their traditional processes a

way to include user experience [1]. Furthermore, analysis of users' affective reaction to requirements has received little attention in the RE apart from consideration in computer games. The reason for that [1] is the gap between traditional academic theory generation and industry practices. However, majority of the studies incorporating UX into requirements elicitation process are mainly theoretical and the industry practices have not been yet fully investigated.

This study aims to investigate the current state in the field of RE in context to user experience. This study also tries to identify tools and techniques that could help elicit users emotional response, providing developers with a better understanding of users needs. To conduct this study, a systematic literature review was performed [3] which explores how UX is addressed during requirements elicitation process, as well as summarizes challenges and benefits of user experience within requirements elicitation process.

The research paper is structured as follows: section II presents the related work, section III describes the methodology, section IV presents the results of this research, the results are discussed in Section V and section VI concludes the research with recommendation on future research and work.

II. RELATED WORK

This section introduces Requirements Elicitation, User Experience and describes the related work on requirements elicitation in context of user experience.

A. Requirements Elicitation

Requirements Elicitation is defined as a process to determine needs of users and other inputs from different sources to construct user requirements with system developer[4]. The goal of RE is to identify requirements that accurately represent users' needs[5] as well as understanding users and how they operate within the context of the proposed system [6]. Getting the right requirements is considered a vital but difficult part of software development projects[7] that involves many different tools and techniques to perform the necessary activities.

Elicitation techniques can help developers to identify the exact requirements the user wants. Based on research by Kasirun [4], the major techniques are focus groups, use cases,

prototyping, observations, interviews, workshops and role-playing. For example, the focus group is the most common technique, because it is comfortable to all involved and is most efficient and effective way to elicit information.

B. User Experience(UX)

In general, user experience has many different definitions that cover all aspects of end-user interaction with specific system or product, including person's behavior and emotions about those products[8]. User experience emphasizes the affective and meaningful aspects of human-computer interaction, but also includes user's perceptions such as ease of use and efficiency of the system[9]. Furthermore, UX is generally understood as inherently dynamic, given the ever-changing internal and emotional state of a person and differences in the circumstances during and after an interaction with a product [10]. Despite the growing interest in user experience, there are still disagreement on its nature and scope [11]. The interest in UX, in academia and industry, can be attributed that, both , academia and industry, becoming aware of the limitations of traditional usability framework, which focuses primarily on user cognition and user performance in human-technology interaction , whereas UX is shifting attention to user affect, emotions and sensations of such interaction[11]. However, UX is associated with broad range of concepts, including affective, emotional, experiential, aesthetic variables[12]. The research is complicated and mostly theoretical, each focusing on many different aspects, such as pleasure, beauty, hedonic quality, enjoyment and provide various theoretical models.

However, fun and enjoyment are qualities only rarely called for in the context of software products and computers[13]. Furthermore, not everyone agrees, that user experience or users emotions should be introduced to software design on the grounds that there is a radical difference between leisure and work [13]. On the other hand, enhancing enjoyment when using a system increases the acceptance of this system by users, independent of how useful this system seemed to be[14]. Enjoyment also could be attributed to the appeal of the product, its look and feel, how users take pleasure, for example, from the aesthetic qualities of Apple products[15].

Therefore UX should not only be viewed as something that can be evaluated after interaction with product, but also before and during interaction[16].

C. Requirements elicitation and UX

Requirements elicitation techniques are focused on identifying the functional and non -functional requirements for software such as functionality and usability of a system as well as its maintainability, reliability and other aspects. Such aspects as emotions and feeling evoked by interaction with products were not considered during requirements elicitation process. However, to develop a product, that is engaging and enjoyable, what are the requirements that need to be elicited from users? Considering emotion as part of the requirements picture for personal goals enables designers to anticipate human emotional responses and mitigate their downside.

Further motivation to consider human emotion in RE arises from the rapid growth of social software. Even bigger motivator for exploring emotions during elicitation process lies in development of computer and video games.

III. METHOD

This section describes the methodology and research process. Qualitative systematic literature review was performed based on guidelines proposed by Kitchenham [3].The aim of this study is to explore how UX is taken into account during requirements elicitation process. This study summarizes empirical evidence from literature, identifies gaps in present research, provides recommendations and guidelines for future research (to improve requirements elicitation process with help of UX).

A. Research Questions

The primary goal of this study is to investigate how UX is taken into account during requirements elicitation process. Furthermore, this study will explore the benefits and challenges of UX in consideration with requirements elicitation.

RQ1. How is user experience being handled during requirements elicitation?

RQ1.1. What are the benefits of taking UX into account during requirements elicitation process?

RQ1.2. What are the challenges of taking UX into account during requirements elicitation process?

RQ1.3 What tools and techniques are available today for user requirements elicitation?

B. Search Strategy

The following digital libraries were searched in order to determine existing evidence on how user experience is taken into consideration during requirements elicitation process , suggested in the study by Kitchenham [4]:

- Inspec
- Scopus
- IEEE
- ACM Digital Library
- SpringerLink

The search string was decided based on preliminary study of articles on requirements elicitation and user experience. In order to cover our research area carefully, specific search strings were created to identify relevant and critical articles. The search string contains explicitly selected words that are related to the research questions, the following search string was applied to above mentioned digital libraries based on title and abstract search: (“ Requirements Elicitation” OR “Requirements Gathering “)AND(“User Experience ” OR “Emotional”). Table1 describes how search was performed.

Table 1 Search String Deconstruction for Digital Libraries

Database	Search String	Description
ACM Digital Library Scopus Inspec IEE	Requirements Elicitation & User Experience; Requirements Gathering & User Experience Requirements Elicitation & Emotional; Requirements Gathering & Emotional;	The search strings were used to search articles by title and abstract.
SpringerLink	("Requirements Elicitation" OR "Requirements Gathering") AND ("User Experience" OR "Emotional").	The search was performed on entire SpringerLink database on full text articles

C. Study Selection Criteria inclusion /exclusion

When performing a Systematic Literature Review it is critical to define the inclusion /exclusion criteria. This is done so that the researchers will be free from prejudice and would not select the final papers based on their own biases. The following criteria were applied to the literature that was included in the study:

- The study should contain information on user experience and requirements elicitation within software development context;

- The studies must include empirical data;
- The articles must be in English;
- The study must be either a published article in magazine or a journal, or conference publication.

Books were excluded from study since they are peer reviewed.

D. Study Selection Procedure

Article selection procedure was run in four phases, which are shown in the Figure 1. After downloading references of all articles from digital libraries, the inclusion/exclusion criteria was applied in order to select primary studies.

This was done in three phases. Before title and abstract reading, books and non-English articles were removed, as well as duplicates. The first phase was to apply exclusion /inclusion criteria to entire set of articles based on title. The next iteration was to apply exclusion criteria on remaining articles based on abstract. In the third phase exclusion /inclusion criteria was applied to full text of remaining articles.

The removal of duplicates from Inspec, Scopus and IEEE databases was done in Endnote, while removal of duplicates

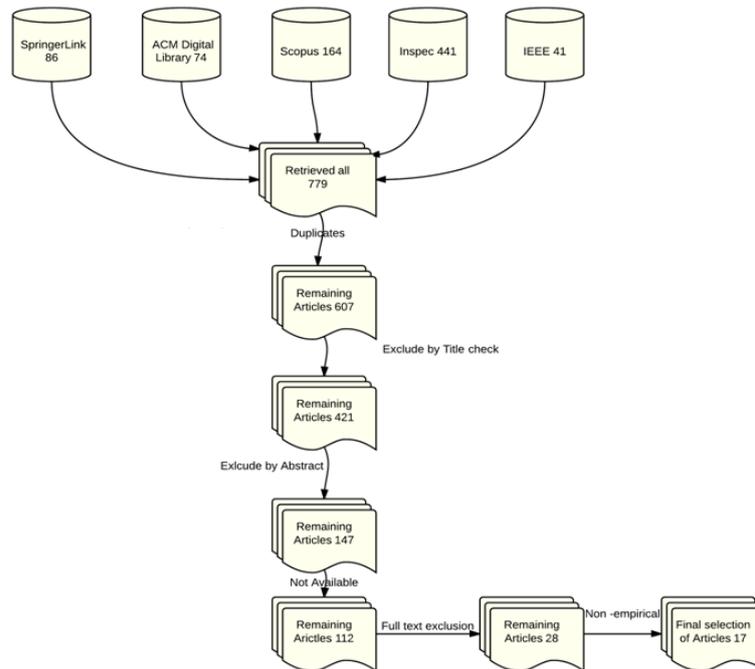


Figure 1 Selection Procedure

from SpringerLink and ACM Digital library was done manually, since the import of references to EndNote was not possible.

The initial amount of papers collected from the five digital libraries was 779. 172 duplicate papers was excluded. Hence, the amount of papers was 607 kept for further inspection,

In the first phase the inclusion/exclusion criteria was applied based on title check. In this phase the same 300 articles were reviewed separately by both researchers. The title check of reviewed articles revealed that different articles were included, even though the Kappa agreement was quite high, 0,85. The Kappa agreement was calculated using the Cohen Kappa statistics[3]. After discussing differences, the 300 articles were reviewed again, this time by both researchers

together. The remaining 307 articles were reviewed separately again and Kappa agreement was 0,86. 421 papers remained after title check.

In the second phase exclusion/inclusion criteria was applied on the remaining 421 papers based on abstract reading. After reading abstract and reviewing articles, the Kappa agreement was calculated again and was 0,85.

For the third phase 147 articles were selected for the full text analysis. However, it wasn't possible to obtain copies for 35 articles through Chalmers library, which only included abstracts, but not a full text, hence the amount of articles to be read was 112. Finally, after filtering out all the studies that were found to be irrelevant to the topic of the thesis, the remaining amount of papers was 16 that had to be analyzed.

Table 2 Selection Process of Primary Studies

Database	Primary Studies	Title Selection	Abstract Selection	Final Selection
ACM Digital Library	47	29	7	3
Scopus	164	89	35	2
Inspec	441	238	73	4
IEEE	41	22	13	5
SpringerLink	86	43	19	2
Total	779	421	147	16

E. Selected Articles for study

The final selection of primary studies is shown in the Table 3.

Table 3 Final Selection of Articles

Paper #	Title	Author	Publication	Ref #
1	Requirements engineering: making the connection between the software developer and customer	H. Saiediana, R. Dale	<i>Information and Software Technology, 2000</i>	[17]
2	An empirical investigation of user requirements elicitation: comparing the effectiveness of prompting techniques	Browne, G. J. , Rogich, M. B.	<i>Journal of Management Information Systems; Spring 2001</i>	[29]
3	Putting Some Emotion into Requirements Engineering	Todd Bentley, Lorraine Johnston, Karola von Baggo	<i>In Proceedings of the 7th Australian Workshop on Requirements Engineering, 2002</i>	[20]
4	Designing mobile information services: user requirements elicitation with GSS design and application of a repeatable process	den Hengst, M.; van de Kar, E.; Appelman, J.	<i>System Sciences, 2004 Proceedings of the 37th Annual Hawaii International Conference</i>	[32]
5	A new approach for software requirements elicitation	Rajagopal, P. Lee, R. Ahlswede, T. Chiang, Chia-Chu Karolak, D.	<i>Sixth International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing and First ACIS International Workshop on Self-Assembling Wireless Network, 2005</i>	[28]
6	Requirements Engineering and the Creative Process in the Video Game Industry	David Callele Eric Neufeld Kevin Schneider	<i>Proceedings of 13th IEEE International Conference on Requirements Engineering, 2005</i>	[24]
7	Emotional Requirements in Video Games	David Callele Eric Neufeld Kevin Schneider	<i>14th IEEE International Requirements Engineering Conference, 2006</i>	[23]
8	Ubiquitous enterprise service adaptations based on contextual user behavior	Dan Hong Dickson K. W. Chiu Vincent Y. Shen S. C. Cheung Eleanna Kafeza	<i>Springer Science, 2007</i>	[19]
9	Challenges in "Mobilizing" Desktop applications: a New Methodology for Requirements Engineering	Rabeb Mizouni Adel Serhani Rachida Dssouli Abdelghani Benharref	<i>Journal, Software IEEE., 2009</i>	[18]

10	Requirements on Next Generation Social Networking—A User's Perspective	Lene Tolstrup Sørensen · Knud Erik Skouby	<i>Wireless Personal Communications, 2009</i>	[26]
11	Bridging the Gap Between Usability and Requirements Engineering	Juho Heiskari Marjo Kauppinen Mikael Runonen Tommi Mannisto	<i>17th IEEE International Requirements Engineering Conference, 2009</i>	[21]
12	An Introduction To Experience Requirements	David Callele Eric Neufeld Kevin Schneider	<i>Journal, Software IEEE, 2010</i>	[25]
13	On eliciting requirements from end-users in the ICT4D domain	Kristina Pitula Thiruvengadam Radhakrishnan	<i>Requirements Engineering, 2011</i>	[30]
14	Using the Affect Grid to Measure Emotions in Software Requirements Engineering	Ricardo Colomo-Palacios Cristina Casado-Lumbreras Pedro Soto-Acosta Ángel García-Crespo	<i>Journal of Universal Computer Science, 2011</i>	[27]
15	Integrating Requirements Engineering and User Experience Design in Product Life Cycle Management	Anitha, P. C. Prabhu, Beena	<i>IEEE International Requirements Engineering Conference, 2012</i>	[31]
16	Expected user experience of mobile augmented reality services: a user study in the context of shopping centers	Thomas Olsson Else Lagerstam Tuula Karukka Kaisa Vaananen Vainio-Mattila	<i>Personal and Ubiquitous Computing, 2013</i>	[22]

F. Data extraction and analysis

The articles were randomly assigned between two researchers, and data extraction form was created in order to answer research questions. For properties P1-P4 list of values was established, but the data for properties P5-P7, such as tools and techniques, challenges and benefits, must be extracted from the selected articles. Properties P2 and P3 describe framework of the studies on Requirements Elicitation and

Table 4 Data Extraction Form

ID	Property	Research Question
P1	Research Method	Overview of the studies
P2	Context	Overview of the studies
P3	User Experience	RQ1
P4	Requirements elicitation	RQ1
P5	Combination of UX and RE	RQ1
P6	Tools and Techniques in context to UX	RQ1.3
P7	Challenges and Benefits of UX within RE process	RQ1.2
Q1	Does the article clearly states the purpose of the study?	RQ1
Q2	Does the article describe how the results were achieved?	RQ1
Q3	Does the article mention or explain limitations of the study and validity threats?	RQ1
Q4	Do the findings answer research question?	RQ1, RQ1.1, RQ1.2, RQ1.3
Q5	Is it clear in which context the research was carried out?	RQ1
Q6	Does the paper state how to perform requirements elicitation in context to UX?	RQ1

G. Quality Assessment

The study quality assessment can be used to guide the interpretation of the synthesis [6]. According to Kitchenham [3] quality assessment is done for following purposes:

- To provide even more thorough inclusion/exclusion criteria;

User Experience. To answer the research question RQ1, the study must contain and describe how requirements elicitation takes into account User Experience. To answer research questions RQ1.1 and RQ1.2, articles have to describe user experience and the challenges and benefits of including into requirements elicitation process, which are properties P5, P7.

- To explore whether the differences can provide explanation in different study results;
- Use it as means to assess the importance of individual studies when results will be synthesized;
- To provide guidance for result interpretation and determine strength of inferences;

- Provide guidelines for future research[3].

Quality assessment questions were designed as follows:

Q1.Does the article clearly states the purpose of the study?

Q2.Does the article describe how the results were achieved?

Q3. Does the article mention or explain limitations of the study and validity threats?

Q4. Do the findings answer the research question?

Q5. Is it clear in which context the research was carried out?

Q6. Does the paper state how to perform requirements elicitation or requirements gathering in context to user experience ?

H.Study Quality Assessment

By applying quality criteria to the articles 16 of them was selected to extract and the synthesize the data for the study. Table5 shows the statistics of the quality criteria application and can be concluded that majority of articles specify the objectives of the study as well as provide empirical data.

Table 5 Results of Applying Quality Criteria

Criteria	Yes	No
Q1 Clear purpose of the study	100%	0%
Q2 Clear methodology	88%	12%
Q3 Clear Limitations	62%	38%
Q4 Result answer RQ	100%	0%
Q5 Clear context	100%	0%
Q6 RE in context to UX	45%	55%

H. Secondary studies

After noticing the low amount of articles, secondary research was performed by reading references of selected articles. However, after full text reading of the potentially interesting articles, none were included for data analysis.

I. Validity threats

1) Publication Bias

Publication bias refers to the problem that positive results are more likely to be published than negative results. The concept of positive or negative results sometimes depends on the viewpoint of the researcher[3]. While publication bias is a threat, it shouldn't have an effect on this study. This study aims to identify the challenges and benefits of incorporating

user experience(UX) into requirements elicitation process as well as finding the gaps in current research. Furthermore, the results of this study, negative or positive, will provide some understanding into requirements elicitation and user experience. Hence, the results of this study will be published.

2) Threats to identification of primary studies.

The search string was designed to include relevant articles for the study. There is a risk, that search string designed for this study could be incorrect, which could lead to misidentification of the articles included in the study. The search strings were applied to five different databases: Scopus, SpringerLink, ACM Digital Library, Inspec and Science Direct. There is a threat that even though we have performed the search of five major databases and secondary search as well, that some of the important articles were missed.

3) Selection bias and validity of data extraction

The total amount of articles that required reviewing was 800, which was divided between two researchers. In order to assess the selected papers, first articles were excluded by title, then by abstract, and later the remaining articles were assessed based on full text. The trial was conducted on articles from SpringerLink database. Total amount of articles reviewed was 86. After first phase of title exclusion the Kappa agreement was quite high, 0,87, but the included articles were different. The Kappa agreement was measured using the Cohen Kappa statistics[3].After noticing that we have excluded different articles based on title, we have discussed the differences and performed exclusion on the same amount of articles again. We calculated the Kappa agreement again, which was 0,86. The Kappa agreement during abstract exclusion phase was also high 0,93. During the article selection phase the strategy was to select articles that included information on requirements elicitation as well as user experience. The percentage of bias is small, since there weren't many studies, that included both search strings.

IV. RESULTS

This section presents findings of this study on how user experience is taken into account during requirements elicitation process and its benefits and challenges.

A. Addressing UX with regards to Requirements Elicitation-RQ1,RQ1.1

During the study three aspects of UX, such as usability, emotions and aesthetics have been reported to be investigated as part of requirements elicitation process as shown in Table 6:

Table 6 Aspects of UX

Aspect of UX	Reference	Description
Usability	[18],[19],[20],[21]	Usability is among quality attributes that deals directly with user needs and is incorporated into requirements elicitation process.
Emotions(fun, enjoyment, pleasure)	[20], [22], [23], [25], [27]	Emotions or their impact are not considered critical during software development process, since their highly subjective nature is very difficult to measure. However, from users perspective it might play a bigger role, since current products or systems become more interactive, rather than only provide certain functionality.
Flow and Aesthetics	[20], [22], [23], [25]	Aesthetics are often referred to as appreciations for the beauty. Aesthetics are a category or property of a designed object that have desirable if unspecified effects

		on their intended users.
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1) Usability

User and system requirements are gathered as the first step in development process and usability is considered during last stages, however this might negatively affect the future system. In order to avoid this, it would be beneficial to include usability characteristics at the requirements elicitation stage[17]. For a long time, usability was the only quality attribute that could evaluate user performance.

Usability is among one of most investigated attributes which concerns with ease of use and ease of learning of a product. Mizouni et al.[18] and Hong et al.[19] in their studies differentiate the usability attributes as objective and subjective. The objective attributes related to the product are effectiveness, efficiency, learnability and reliability. The subjective usability attributes are related to user experience such as positive attitude and product/system attractiveness.

Mizouni et al.[18] also state that one way to benefit the requirements elicitation phase of project is to perform usability studies and to translate them to requirements. In their work usability studies were performed to improve features of mobile applications that resulted in better user experience and product usability. In a study performed by Bentley et al.[20] the sub characteristics of usability, learnability leads users to computer games enjoyment

Findings in the study by Heiskari et al.[21] suggest to invite usability specialists into requirements elicitation teams early on, which helps to "grasp bigger picture that is needed to define usability requirements for specific product". Another sub characteristic of usability, aesthetics, has received an attention from researchers in context to requirements elicitation.

2) Flow and Aesthetics

How products look and feel, their design will affect the users perception of the product and how long the user will stay interested in it. The aesthetics of product and the continuous interaction with it, for instance, playing computer games for long periods of time(state of flow) would decide the products ability to stay on the market.

Study by Bentley et al. [20] identified that in the state of flow, actions flow without conscious intervention by the actor. Olsson et al. [22]also states that users experience feelings of being immersed and captivated in the interaction with the augmented environment . In the studies by Callele et al. [24] they state that video games as well stimulate a state of flow in the player, engendering concentration so intense that their perception of time and sense of self become distorted or forgotten.

Bentley et al.[20] also indicate that user pay attention to aesthetic appeal of the game, like graphics, cinematic effects, sounds. The data suggests that aesthetics can increase positive affective response of a user. The same is true in the studies by Olsson et al.[22] where users brought up the need to relate augmented reality to more pleasurable and stimulating aspects of life by adding artistic content, such as arts or virtual graffiti. Callele et al.[25] also agrees that fun, storyline, continuity, aesthetics, and flow play a bigger role during requirements elicitation process and must be taken into consideration [23]. By understanding how users react to emotional intensity, can help developers to ensure that every element contributes to how users feel, for example during high intensity video or computer games[24]. Therefore, eliciting user experience of flow and aesthetics can provide valuable information on how the product can engage users and provide aesthetically pleasing experience. The pleasing experience can elicit emotional response from users.

3) Emotion

Considering emotion as part of the requirements enables designers to incorporate design features and anticipate human emotional responses of users to the product.

Positive attitude and enjoyment, according to Bentley et al.[20], are consequences of designable elements, that can elicit positive affective responses from users. Sørensen and Skouby [26] discovered that users want to have fun interaction mechanisms for better user experience. For instance, Olsson et al.[22] study on mobile augmented reality services(MAR) suggests that users expected playful and entertaining momentary experiences. They concluded that overall, including playful aspects is a fruitful way of introducing the user to new technologies[22].

However, according to Callele et al.[24], subjective nature of emotions makes them very difficult to identify, define or represent. The designers must also be able to express the means by which the emotional state is induced as part of the emotional requirements[23]. The study by Callele et al. [23]found that to be useful an emotional requirement must capture designer's intent and means by which designer must induce the target emotional state and artistic context. The designer's intent expresses a target emotional state to be induced in user, it may also express a location in virtual reality and or temporal qualifier of some form[25]. Another way to elicit emotional requirements is through the affect grid, which is a single -item scale of pleasure and arousal as described by Colomo-Palacios et al.[27]. In their work they also consider an issue such as an emotional bias. Emotional bias is a distortion in cognition and decision making due to emotional factors. Nowadays there are more tools available to developers to elicit users emotional response.

B. Tools and Techniques of UX implementation with RE - RQ 1.3

There are many tools and techniques available for developers to use during requirements elicitation process. The Table 7 provides an overview of techniques and tools used to elicit and measure affect and user's emotional response currently in practice. There are tools and techniques that weren't included in the list, since many of them are either still in development, or relate to usability studies and it was not

clear, if they were formally validated. Considering the fact that UX is highly subjective and is heavily dependent on users perception, in all the reviewed studies, researchers relied on users description and evaluation of product and allow users to describe experiences in their own words. The tools in the Table 7 provides more complex data, while evaluating user responses.

Table 7 Tools and Techniques6

Tools and Techniques	Description	References
User Studies	User study is concerned with gathering data on users and their needs, and translates these into user requirements. The data is gathered with elicitation techniques, such as interview or observation. User studies often take place in the requirements elicitation phase.	[18] [19] [20] [21]
Repertory Grid	In this method several concepts are contrasted and user must select which they prefer This technique requires that many (often 10+) design styles are compared and contrasted. Each design style may be compared with more than one item. This technique can capture the overall user-experience that is desired by selecting appropriate terms.	[20]
Affect Grid	Affect grid, a scale designed as a quick means of assessing affect along pleasure-displeasure and arousal-sleepiness dimensions on a 1-9 scale. According to the studies , the affect grid is potentially suitable for any study that requires judgments about affect of either a descriptive or a subjective kind.	[27]
Emotional terrain	In an emotional terrain, the target emotion is linked to a spatial representation of the world, the emotion is color-coded, and the intensity of the emotion is associated with the luminance or perceived intensity of that color.	[25]
Emotional Intensity Map	Luminance is used to quantify intensity, while the identity of local emotion is indicated via graphic symbols such as emotion, Chernoff face or some derivative of Ekman's Facial Coding System. The addition of the facial icon allows the artist to quickly express the desired emotion.	[25]
Emotional tracks and Emotional Timeline	Emotional tracks can capture the designers intent for a given emotion. For example, emotion tracks for tension, frustration, fear, relief, accomplishment, etc. could be associated with progress through the game. The timeline can be sketched as a simple graph.	[25]

C. Challenges and Benefits of addressing User Experience during Requirements Elicitation , RQ1.1-1.2

The requirements elicitation is a difficult process[28][29], however introducing UX into it might create even bigger challenge. Introducing new software process to software development company, such as UX, will require to introduce the "change agent"[21]. As in earlier research with usability, and the attempt to bridge the gap between usability and RE, the challenges seem similar. Heiskari et al.[21] explored challenges of incorporating usability into RE and they discovered that, no "every day practices have been delivered" , neither the" defined methodology". Rajagopal et al.[28] address the challenges of seamless integration and collaboration of RE and UX, noting that communicating requirements that can be easily incorporated into formalized requirements documents is difficult. The complexity of modern system can also complicate the requirements elicitation process and it's documentation[17]. The resulting document which includes the information elicited from users and gathered from other sources would represent a system that is aimed at achieving certain goals, set by stakeholders[28][29][30].

Another challenge is that UX attributes are subjective, rather than objective, and it is difficult to draw any conclusion from the evaluated data. For instance, a game can be exciting

to the user today, but he might find it completely boring tomorrow. The subjective nature of UX can create difficulties to translate collected user experience and translate it into usable requirements. The emotional state of users is another challenge, since UX is dealing with psychological aspects such as feelings, types of affect and user perception, will likely create difficulties expressing and communicating them, however subjective they are. Furthermore, Callele et al. [23] emphasize on the tractability of changing emotional state of users. Study by Anitha and Prabu [31]addresses traceability documentation as well, citing that both RE and UX during the product development.

The emotional state of the user is important when users have to conceptualize and visualize the future system. To collect the required information from users, developers mainly rely on interviews with users and their perception of the current and future system[29]. However, this often leads to lack of user input, or unrealistic user input due to poor understanding of resources and time constraints[28]. In order to elicit emotional requirements from users many new tools and techniques become available in recent years.

As shown in Table 7, methods to elicit and measure users affective responses are already available, there are many new methods, that are not fully developed yet, which could

mitigate the challenges of addressing UX during requirements elicitation. Olsson et al.[22] and den Hengst et al. [32] state that requirements elicitation process is more beneficial based on user's expectations and needs. If the success of a system is dependent on the user experiences, its development should be done with those experiences in mind.

V. DISCUSSION

This study shows that there is an evidence that UX is being investigated to be taken into consideration during requirements elicitation process. This study also identifies challenges and benefits of UX being taken into account during elicitation process. It also introduces tools and techniques that help elicit emotional requirements.

A. Addressing UX during Requirements Elicitation Process, RQ 1

This study identified that aspects of UX such as usability, emotions and aesthetics can be gathered during the requirements elicitation process. It is well known that usability can determine the success of a software product and usability attributes are the outcome of a usable product or system.

Usability studies can help identify user behavior as well as establish how well users can interact with the system and meet their goals[18]. In current practices usability studies are introduced during the design phase. The requirement elicitation process would benefit more, if usability studies were done earlier in requirements elicitation phase, however, Heiskari et al.[21] argue that usability is very difficult to integrate with requirements and that usability is not perceived an integrated part of the RE process. According to Hassenzähl et al.[2] usability matters only as a part of the entire complex of functions, features, appearance, pleasure, image, and, of course, cost. Conducting usability studies and incorporating user experience into RE could prove to be very expensive, which could explain why organizations are not widely adopting it into practice. However, [31] think that emphasis should be put on conducting usability studies in the early phases of a development lifecycle with the use of low fidelity prototypes, thereby enabling feedback to be incorporated before it becomes too late or costly to make changes.

On the other hand the earlier study by Bentley et al.[20] suggest to extend the usability to include affect, and re-label it as user-experience. The relationship between usability and UX is very strong. Many recent publications on UX, for instance [9], are basing their research on usability methods and metrics. The efforts are made to explain how usability can affect requirements elicitation process[13]. The need to understand how users feel not only based on task performance, but in terms of emotional responses, how product or a system affects, users before, during and after interaction[10]. Formalizing these experiences in terms of requirements will ensure that these issues are addressed at the beginning of the design process. It is not always possible to add affective qualities later [20] but still it can be concluded that even though it is difficult to deal with user experience theories during the requirements elicitation process, if approached with

creativity it's possible to perform usability studies during the entire elicitation process as well as product development cycle.

This study shows that even though UX is still very immature, its subjective nature is well known and developers pay attention to the fact, that many products developed nowadays aim at providing pleasurable experience. This study also explores the need to understand the "particularities"[9] of pleasurable experience and ways, to elicit, provoke those experiences, such as joy, spontaneity and fun. More studies are needed to understand the relationship between product and experience.

1) Emotions and Aesthetics

According to Callele et al.[25], emotions or their impact are not considered critical during software development process, since their highly subjective nature is very difficult to measure. However, from users perspective it might play a bigger role, because current products or systems become more interactive, rather than only provide certain functionality.

Callele et al.[23]. in their study have researched the possibility of eliciting emotional requirements during pre-production and production of video games development, documenting the process. They note that requirements like fun and absorbing are not well understood by requirements engineering, which lead to misunderstanding not only between users but also between game designers and software developers[14]. Furthermore, fun, storyline, continuity, aesthetics, and flow must dominate the requirements specification, but there is no established method to capture and specify such requirements[23].

While it is still difficult to capture emotions as part of requirements elicitation process, Colomo-Palacios et al.[27] propose to measure emotional state of user with help of affect grid psychological tool to characterize requirements in software development processes. This means that different stakeholders may express the emotion based on how they feel about given requirements[31]. This emotional assessment supposed to be discreet and because emotions change over time, the collected data can help to establish patterns about given requirements[12]. This method implies that the practice has to be repeated and the new assessment provides traceability to stakeholders' emotional states.

Olsson et al.[22] explored user experience for mobile augmented reality that was expected to offer stimulating and pleasant experiences, such as playfulness, inspiration, liveliness, collectivity and surprise. Furthermore, such emotions have a multitude of functions in the context of interaction, ranging from shaping the interaction itself to the evaluation and communication about product use[9]. Consequently, this creates both possibilities and challenges for the design of pleasurable user experience.

While Olsson et al.[22] provide various methods how to elicit requirements based on user experience, Pitula and Radhakrishnan [30] discuss how to elicit requirements that address user needs as well as shortcomings of conventional techniques. They [30] also note, that when developers and

stakeholders come from different backgrounds, they will bring different perspective to requirements elicitation process. Hong et al.[19] also agree that typical elicitation methods are not enough, when it comes to eliciting user needs. Hassenzahl argues that need fulfillment and affect are direct enquiries into experience[9], the more needs are embedded in product, the wider the possible range of resulting emotions. Callele et al. [23] explores possibilities to elicit emotions in video games, adding that not only fun and enjoyment are part of user experience. Users also notice high quality graphics and game space design, sound and music may as well be attractive to users. Same is true for Bentley et al.[20] when they mention aesthetic appeal. Neil Maiden[15] argues that aesthetics aren't only about being beautiful for the sake of being beautiful, but that they have an important effect on users as they interact with a product. As mentioned by Hassenzahl in many of his publication [2],[9],[10], [13] eliciting emotional, affective, hedonic and aesthetical variables is possible, however the mechanisms that translate those variables into requirements are not as widely available, which makes it challenging to incorporate UX into RE.

2) *Challenges and Benefits, RQ 1.1-1.2*

Majority of the authors of the primary studies have mentioned that products would greatly benefit if UX is addressed early in development phase and be an integral part of requirements elicitation process which will result in enjoyable and engaging product. This is supported by Callele et al.[23] that incorporating UX early in development phase of the product can lead to increased customer satisfaction, potentially improving the quality of the user experience.

According to den Hengst et al.[32] the first phase of designing the system is getting to know what the potential user wants. The users express their feelings, emotions and experiences through communication, either verbal or written[5][17]. Unsurprisingly, effective communication has been notoriously difficult to achieve and is a recurring problem in the elicitation of requirements[6][8]. On the other hand, Olsson et al.[22] addresses user's internal expectations, concerns, attitudes and moods, the users experience prior to actual use by focusing on potential users' experience. Sometimes user experience could be just about certain aspect of the product, or users' are reluctant to talk about all their experiences in interviews. However, there are many tools and techniques available to elicit user requirements as shown in Table7.

3) *Tools and Techniques, RQ1.3*

As shown in Table 7, there are tools and techniques available today to elicit emotional requirements. To gather requirements, there are common methods, such as interviews[8], storyboarding and questionnaires. However, with the need to gather affective requirements as well, there must be tools to evaluate UX and find a way to translate it into requirements. Tools presented in Table 7 are the ones, that have been evaluated and used in the field, or a lab. For instance, affective grid, which is borrowed from psychology, is suggested to be incorporated into requirements elicitation process to measure and elicit affect. The requirements elicitation process could greatly benefit, if UX evaluation tools could address different experiences, for example, the

emotional state of the user before product is used, or during and after interaction with product. Callele et al. [23] also agree that finding a way to track experience over time and translate it into requirements. Furthermore, many tools and techniques are developed by academia, rather than industry, and to gather necessary data could require a lot of time, which most companies cannot afford. They would benefit from having "quick-to-use, validated measures for the different constructs of UX"[16].

This study shows that UX evaluation methods are available, so are the tools and techniques to elicit emotional requirements. However, these methods and tools need to be widely accessible and used in practice. More work is required to classify and identify many tools that industry and academia deploy for UX evaluation [16], but there is a need to explore further, to define the tools that are more useful, since developers most of the time are constrained by time. This study also shows that currently, research efforts have been invested in collecting, consolidating and categorizing UX evaluation methods to find common ground for both RE and UX.

VI. CONCLUSION AND FUTURE WORK

With growing interest in User Experience the need for consensual definition of UX and systematic research on how to measure and evaluate UX is becoming very important.

The contribution of this paper is a synthesis of an existing research where aspects of UX, such as emotions and aesthetics, as well as usability are being incorporated into requirements elicitation process. However, incorporating UX into RE is not a widely accepted practice and more work and evidence is needed for it to become adopted by industry. There are many authors, like Hassenzahl, who advocate for wider incorporation of UX in software development industry, but until research of UX becomes more mature, it's difficult to envision industry to adopt it into mainstream processes, like requirements elicitation. Introducing new methods will require a significant change in requirements elicitation process. While requirements elicitation uses some of the similar techniques, for example interviews, the difficulty is in evaluating UX and collected data, and translate it into requirements. This study shows that efforts are made to incorporate UX into RE, however, the complexity of UX is making it very difficult and potentially could be very expensive. As mentioned above, the elements of UX are taken into account during RE, such as usability, emotions and aesthetics, however, there is very little evidence that all of these components together are evaluated and elicited during RE at the same time.

This study has also identified tools and techniques used to elicit emotional requirements as presented in Table7. The availability of such tools indicate that UX can be addressed during RE and help with user requirements elicitation as well as trace users' emotional state. The research has been conducted to collect and consolidate UX evaluation methods, tools and techniques. There is an ongoing research on modeling user experience which can help understand UX processes in context of software development. Understanding

human needs, affect and emotions can arm developers with necessary knowledge to create and develop products that provide not just core functionality, but be aesthetically pleasing and fun to interact with. Many researchers and practitioner agree that in order to create successful and engaging products, UX should be taken into account in the early phases of product development cycle.

For future research it would be interesting to do an action research, which would focus on deployment of tools and techniques as well as taking UX into account early on into requirements elicitation process and provide software industry with much needed best practices.

References

- [1.] A.Nazir, A. Raana, and N. Majeed, "Highlighting the role of Requirement Engineering and User Experience Design in Product Development Life Cycle", *International Journal of Modern Education and Computer Science*, vol. 6, no. 1, pp. 34-40, 2014.
- [2.] M. Hassenzahl and D. Ullrich, "To do or not to do: Differences in user experience and retrospective judgments depending on the presence or absence of instrumental goals," *Interacting with Computers*, vol. 19, pp. 429-437, 2007.
- [3.] B. Kitchenham, "Guidelines for performing systematic literature reviews in software engineering," Technical report, EBSE Technical Report, July 2007.
- [4.] Z. M. Kasirun, "A Survey on Requirements Elicitation Practices Among Courseware Developers," *Malaysian Journal of Computer Science*, vol. 18, 1970.
- [5.] M. Asim, & Sahar, F., "Advance Topics in Software Engineering Topic: Requirement Elicitation Techniques Case Study: Online Vehicle Trading", Bleking Institut of Technology, 2009.
- [6.] J. Coughlan and R. D. Macredie, "Effective Communication in Requirements Elicitation: A Comparison of Methodologies," *Requirements Engineering*, vol. 7, pp. 47-60, 2002.
- [7.] D. Zowghi and C. Coulin, "Requirements Elicitation: A Survey of Techniques, Approaches, and Tools," in *Engineering and Managing Software Requirements*, A. Aurum and C. Wohlin, Eds., ed: Springer Berlin Heidelberg, pp. 19-46, 2005.
- [8.] T. Tullis and B. Albert, ScienceDirect, *Measuring the user experience: collecting, analyzing, and presenting usability metrics*. Amsterdam: Morgan Kaufmann, 2013.
- [9.] M. Hassenzahl, S. Diefenbach, and A. Göritz, "Needs, affect, and interactive products – Facets of user experience," *Interacting with Computers*, vol. 22, pp. 353-362, 2010.
- [10.] M. Hassenzahl, "User experience (UX): towards an experiential perspective on product quality," *ACM*, pp. 11-15, 2008.
- [11.] E. Law, V. Roto, M. Hassenzahl, A. Vermeeren, and J. Kort, "Understanding, scoping and defining user experience: a survey approach," *ACM*, pp. 719-728, 2009
- [12.] N. Tractinsky and M. Hassenzahl, "User experience - a research agenda," *Behaviour & Information Technology*, vol. 25, pp. 91-97, 2006.
- [13.] Monk, M. Hassenzahl, M. Blythe, and D. Reed, "Funology: designing enjoyment," *ACM SIGCHI Bulletin - a supplement to*, vol. 2002, pp. 11-11, 2002.
- [14.] C. Nass, S. Adam, J. Doerr, and M. Trapp, "Balancing User and Business Goals in Software Development to Generate Positive User Experience," in *Springer Berlin, Heidelberg*, pp. 29-53, 2012
- [15.] N. Maiden, "Requirements and Aesthetics," *IEEE Software*, vol. 8, pp. 20-21, 2011.
- [16.] A.Vermeeren, E. Law, V. Roto, M. Obrist, J. Hoonhout, and K. Väänänen-Vainio-Mattila, "User experience evaluation methods: current state and development needs," *ACM*, pp. 521-530, 2010.
- [17.] H. Saiedian and R. Dale, "Requirements engineering: making the connection between the software developer and customer," *Information and Software Technology*, vol. 42, pp. 419-428, 2000.
- [18.] R. Mizouni, A. Serhani, R. Dssouli, and A. Benharref, "Challenges in "mobilizing" desktop applications: A new methodology for requirements engineering," pp. 225-229, 2009.
- [19.] D. K. Hong, W. Chiu, V. Y. Shen, S. C. Cheung, and E. Kafeza, "Ubiquitous enterprise service adaptations based on contextual user behavior," *Information Systems Frontiers*, vol. 9, pp. 343-358, 2007.
- [20.] T. J. Bentley, L. Johnston and K.L von Baggo, "Putting Some Emotion into Requirements Engineering," in *proceedings of 7th Australian Workshop on Requirements Engineering*, 2002.
- [21.] J. Heiskari, M. Kauppinen, M. Runonen, and T. Mannisto, "Bridging the Gap Between Usability and Requirements Engineering," In *proceedings, of 17th IEEE International Requirements Engineering Conference*, pp. 303-308, 2009.
- [22.] T. Olsson, E. Lagerstam, T. Kärkkäinen, and K. Väänänen-Vainio-Mattila, "Expected user experience of mobile augmented reality services: a user study in the context of shopping centres," *Personal and Ubiquitous Computing*, vol. 17, pp. 287-304, 2013.
- [23.] D. Callele, E. Neufeld, and K. Schneider, "Emotional Requirements in Video Games," *IEEE*, pp. 299-302, 2006
- [24.] D. Callele, E. Neufeld, and K. Schneider, "Requirements engineering and the creative process in the video game industry," *proceedings of 13th IEEE International Conference on Requirements Engineering*, pp. 240-250, 2005
- [25.] D. Callele, E. Neufeld, and K. Schneider, "An Introduction to Experience Requirements," pp. 395-396, *proceedings of 18th IEEE International Conference on Requirements Engineering*, 2010.

- [26.] L. Sørensen and K. Skouby, "Requirements on Next Generation Social Networking—A User's Perspective," *Wireless Personal Communications*, vol. 51, pp. 811-823, 2009.
- [27.] R. Colomo-Palacios, Casado-Lumbreras, C., Soto-Acosta, P., & García-Crespo, Á. , "Using the affect grid to measure emotions in software requirements engineering," *Journal of Universal Computer Science*, vol. 17, pp. 1281-1298, 2011.
- [28.] P. Rajagopa, R. Lee, T. Ahlswede, C. Chiang and D. Karolak, "A new approach for software requirements elicitation" *Sixth International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing and First ACIS International Workshop on Self-Assembling Wireless Network.* , pp. 32-42. 30, 2005.
- [29.] G.J.Browne and M.B. Rogich, "An Empirical Investigation of User Requirements Elicitation: Comparing the Effectiveness of Prompting Techniques", *Journal of Management Information Systems*, vol. 17, no. 4, pp. 223-249, 2001
- [30.] K. Pitula and T. Radhakrishnan, "On eliciting requirements from end-users in the ICT4D domain," *Requirements Engineering*, vol. 16, pp. 323-351, 2011.
- [31.] P. C. Anitha and B. Prabhu, "Integrating requirements engineering and user experience design in Product life cycle Management," *IEEE*, pp. 12-17, 2012
- [32.] M. den Hengst, E. van de Kar, and J. Appelman, "Designing mobile information services: user requirements elicitation with GSS design and application of a repeatable process," in *proceeding of 37th Annual Hawaii International Conference on System Sciences*, pp. 10, 2004